FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED BALLINAGREE WIND FARM

VOLUME 2 – MAIN EIAR

CHAPTER 10 – HYDROLOGY AND WATER QUALITY

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10. HYDROLOGY AND WATER QUALITY

10.1 Introduction

This chapter has been prepared to describe the existing hydrology and water quality of the local environment in the study area and to examine the aspects of the hydrology and water quality of the local environment that could be affected by the activities associated with the proposed development.

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

- The wind farm site (also referred to in this EIAR as 'the Site');
- The grid connection;
- The turbine delivery route (also referred to in this EIAR as 'the TDR');
- Biodiversity enhancement and management plan lands (also referred to in this EIAR as 'the BEMP lands').

A detailed description of the project is contained in Chapter 3.

Section 10.3 of this chapter provides details on the existing hydrology and water quality in the receiving environment including receiving waterbodies and catchments. It includes information on any historical flooding within the site, internal site drainage and grid connection watercourse crossings.

Following an analysis of the receiving environment potential impacts during construction, operation and decommissioning phases are identified for each of the above elements of the project and discussed in Sections 10.4. Flood risk assessment is set out in Section 10.5.

Section 10.6 describes the proposed drainage layout and Section 10.7 identifies the proposed mitigation measures for impacts identified in Section 10.4 and 10.5.

Impacts on Natura 2000 sites are fully assessed in Chapter 8B Aquatic Impact Assessment and impacts on same are referred to below.

10.1.1 Study Area

The Study area regarding hydrology and water quality comprises of catchments, sub-catchments, sub-basins and associated hydrological features therein relevant to the proposed project.

For each element of the project, catchment characteristics and associated hydrological features are addressed within this Section.

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

10.1.2 Objectives

The objectives of the assessment are as follows:

- Produce a baseline study of the existing water environment in the area of the project.
- Identify the potential impact of the project on flood risk.
- Identify likely positive and negative impacts of the proposed development on surface water during construction, operational and decommissioning stage of the development.
- Consideration of potential cumulative impacts arising from other developments within the same regional hydrological catchment.
- Identify mitigation measures to avoid, remediate or reduce significant negative impacts and assess residual impact.

10.2 Methodology

The following sources of information were considered in this assessment:

- The design layout of the wind farm site, grid connection and TDR.
- Legislation and guidance, as described in Section 10.2.1 below.
- A desk-based assessment of the surface water hydrology and water quality in the catchments relevant to the proposed project, including an assessment of the watercourses which will be intercepted by the layout of the wind farm site, grid connection and TDR, and those which will receive surface water runoff from same.
- A field assessment of the existing hydrological environment, to both verify desk-based assessment and record all significant hydrological features.
- Cork County Development Plan 2014.
- Draft Cork County Development Plan 2021.

10.2.1 Legislation and Guidance

10.2.1.1 Relevant EU Directives and Legislation

Water Framework Directive (WFD)

The WFD established a new system for the protection and improvement of water quality and water dependent ecosystems. It has influenced the management of water resources and has affected conservation, fisheries, flood defence, planning and development. It has endeavoured to ensure that all impacts on water resources – physical modification, diffuse and point source pollution, abstraction or otherwise – are controlled.

The overriding purpose of the WFD is to achieve at least 'good status' in all European waters and to ensure that no further deterioration occurs in these waters. European waters are classified as ground waters, rivers, lakes, transitional and coastal waters.

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 has been prepared by Department of Housing, Planning and Local Government.

The plan 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.

The WFD has been transposed into Irish law following:

- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003)[1]
- European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014)
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009)[2]
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)[3]
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (S.I. No. 610 of 2010)[4]
- 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)[5] (the Surface Water Regulations), give effect to 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:

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

Q-Value	Water Quality	WFD Status
Q5	Pristine	High
Q4-5	Very good	
Q4	Good	Good

[1] Amended in 2005 (S.I. No 413/2005), 2008 (S.I. No. 219/2008) and 2010 (S.I. No. 93/2010)

[2] Amended in 2012 (S.I. No. 327/2012) and 2015 (S.I. No. 386/2015)

[3] Amended in 2011 (S.I. No 389/2011), 2012 (S.I. No 149/2012) and 2016 (S.I. No 366/2016)

[4] Amended in 2014 (S.I. 31/2014)

[5] Amended in 2012 (S.I. No. 327 of 2012) and 2015 (S.I. No. 386 of 2015)

Q-Value	Water Quality	WFD Status
Q3-4	Slightly Polluted	Moderate
Q3	Moderately Polluted	Poor
Q2-3	Moderate to Poor	
Q2	Poor	Bad
Q1-2	Poor to bad	
Q1	Bad	

In accordance with the Surface Water Regulations, water classified as 'High' or 'Good' 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.

Relevant Guidance

The following guidelines were considered 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 - Draft, Environmental Protection Agency (EPA), August 2017;
- Advice Notes for Preparing Environmental Impact Statements, EPA, Draft September 2015;
- Wind Energy Development Planning Guidelines - Department of the Environment, Heritage and Local Government, 2006;
- Best Practice Guidelines for the Irish Wind Energy Industry - Irish Wind Energy Association, 2012;
- Good Practice Note on Strategic Environmental Assessment for the Energy Sector, Environmental Protection Agency (EPA), March 2021.

In addition to considering the documents above, the methodology for the baseline 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
- 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)
- 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)
- Good Practice During Wind Farm Construction (Scottish Natural Heritage 2010)
- The SuDS Manual (C753) - Construction Industry Research and Information Association (CIRIA), 2015
- Control of water pollution from linear construction projects (C648) – Construction Industry Research and Information Association (CIRIA), December 2001;
- Control of water pollution from construction sites. Guidance for Consultants and Contractors (C532) - Construction Industry Research and Information Association (CIRIA), December 2001
- PUB C571 Sustainable construction procurement - a guide to delivering environmentally responsible projects - Construction Industry Research and Information Association (CIRIA), January 2001
- UK Guidance for Pollution Prevention (GPP):
    - 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, January 2018)
    - 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)
- Coillte (2009): Forest Operations & Water Protection Guidelines.

10.2.2 Desk Study

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

- Current and historic Ordnance Survey Ireland mapping, and ortho-photography.
- 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).

10.2.3 Field Assessment

Site walkover surveys and TDR inspection were carried out in January and February 2021 to establish the pattern of existing drainage and to record existing hydrology features of the wind farm site. During the site visits, the GPS coordinates, descriptions, and photographs of hydrological features were recorded. The site walkover involved an initial review of available information gathered in the desk study followed by a site visit.

A site visit was carried out in November 2020 to inspect crossing structures relevant to the grid connection. Findings from this assessment were used to propose the most suitable methodology for grid connection crossings with respect to watercourses. A further site visit to inspect TDR temporary accommodation works areas was carried out in May 2021.

No significant constraints were noted in terms of hydrology and water quality during the site visits.

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.

Thresholds for assessing the sensitivity of the environment and magnitude of impacts are outlined in Figure 10-1.

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'.

Sensitivity of Receptors

The sensitivity of a hydrological receptor or attribute is based on its ability to absorb development without perceptible change. The hydrological environment of the site is considered to be of high sensitivity for receptors draining to the Nadanuller Beg Stream which ultimately drains into the Nad Stream which is part of the Blackwater River (Cork/Waterford) SAC. The receptors which are part of Special Areas of Conservation (SAC) are rated as 'high' sensitivity.[6]

The southern part of the wind farm site and grid connection drain into the River Laney which joins the River Sullane approximately 10km south of the wind farm. The River Sullane discharges into the River Lee via the Carrigadrohid Reservoir. The River Lee in turn flows into the Lee Valley NHA, and ultimately to the Cork Harbour SPA and Great Island Channel SAC. Due to the hydrological distance between the wind farm and designated areas, it is concluded that the vast majority of the site drains into the non-designated receptors which have medium sensitivity. Notwithstanding, surface waters will be treated the same in terms of the level of protection and mitigation measures employed. Strict mitigation measures in relation to maintaining a high quality of surface water runoff from the development have been proposed.

[6] A handbook on environmental impact assessment Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment Process in Scotland, Scottish Natural Heritage.

Refer to Chapter 8B Aquatic Ecological Assessment and the Natura Impact Statement for more details on protected designated sites.

Assessment of Magnitude and 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 as set out in Table 10-2:

Table 10-2: Assessment of Magnitude of Hydrological Impact[7]

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 diagram below, Figure 10-1, shows how comparison of the character 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 will be applied to assess potential impacts on downstream environmental receptors resulting from the development.

- Description of Potential Impact Source: The activity that brings about the potential impact or the potential source of pollution is described.
- Pathway / Mechanism: The route by which a potential source of impact can transfer or migrate to.
- Receptor: A receptor is a part of the natural environment that could potentially be impacted.
- Pre-mitigation Impact: Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.

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

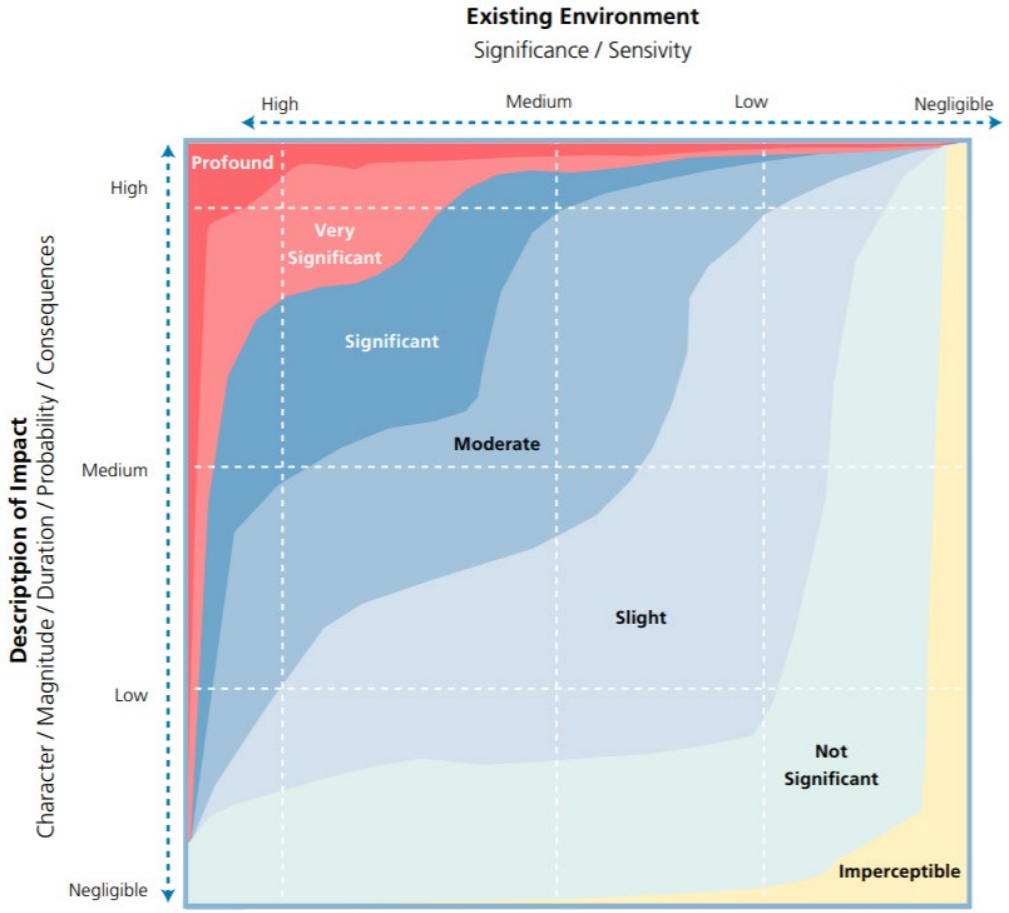

Figure 10-1: Classifications of the Significance of Impacts[8]

10.2.5 Consultation

This chapter considers the consultation responses as referred to in Chapter 5, with particular regard to concerns relating to hydrology and water quality. The scope of this appraisal has thus been informed by the consultation with the Inland Fisheries Ireland (IFI), Irish Water and Geological Survey of Ireland. Full details of the responses received are set out in Appendix 5.1

A response from Inland Fisheries Ireland (IFI) was received on 16th July 2020. The key notes in their response are listed below:

- prevent pollutants and hydrocarbons entering the watercourses,
- no drainage or other physical interference with the bed or bank without prior consultation with IFI

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

The proposed development will utilize new water crossing points. The IFI requests the following:

- the free passage of fish must not be obstructed.
- the original slope of the river bed should be maintained with no sudden drops on the downstream side. Design details on any proposed crossing should be incorporated at planning stage.
- Bridges are preferable to culverts.
- All instream works should be carried out only in the May-September period.

A response from Irish Water (IW) was received on 3rd July 2020. The key notes in their response are listed below:

- Any potential impacts on the assimilative capacity of receiving waters in relation to IW discharge outfalls including changes in dispersion/ circulation characterises (sic).
- 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 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.

On-site meeting with IFI was carried out in April 2021 during which watercourse crossing methods at key locations was discussed, and the proposed approach to the drainage design, water crossings and in-stream works was agreed in principle.

A response from Geological Survey Ireland (GSI) was received on 15th July 2020. The key note in their response is listed below:

- With regard to Flood Risk Management, there is a need to identify areas for integrated constructed wetlands. We recommend using the GSI's National Aquifer and Recharge maps on our Map viewer to this end. The Groundwater Vulnerability map indicates the area covered is variable. We would therefore recommend use of the Groundwater Viewer to identify areas of High to Extreme Vulnerability and 'Rock at or near surface' in your EIAR.

10.2.6 Drainage Methodology

As standard and best practice approach, surface water runoff attenuation and drainage management are key elements in terms of mitigation against impacts on surface water bodies.

Two distinct methods will be employed in the management of construction surface water runoff. The first method involves keeping clean water clean by avoiding disturbance to natural drainage features, minimising any works in or around drainage features, and diverting clean surface water flow around excavations and construction areas. The second method involves collecting any drainage water from works areas within the site that might carry silt or sediment, and to route them towards settlement ponds prior to controlled diffuse release over vegetated natural surfaces. There will be no direct discharge to surface water.

The proposed drainage is shown on Planning Drawings Series- 0100.

'Clean' water is separated from 'dirty' water utilizing interceptor drains as illustrated on diagram below. The interceptor drains will be installed on the upslope side of the construction area.

This will reduce the amount of water from the construction area that will need to be treated before it can be safely discharged into the environment. Collected clean water will be carried under wind farm infrastructures by cross drains at regular intervals to ensure the original hillside flow is not impeded.

The maximum distance between the cross drains will be 250m. The cross drains will be connected to a diffuse outfall to allow collected water to disperse overland.

The proposed access tracks will be constructed from a permeable material to allow the runoff to infiltrate underground. The excess water will drain into the swales which will be connected, during the construction stage, to the settlement ponds. The settlement ponds will have a diffuse outfall which will disperse the flow across the site. On completion of the works the settlement ponds will be filled in and the swales will be connected to a diffuse outfall.

The proposed access roads and associated drainage infrastructure will follow contours as much as possible to reduce the gradient of the road and road drains (swales). This will reduce velocities within the swales, and consequently erosion.

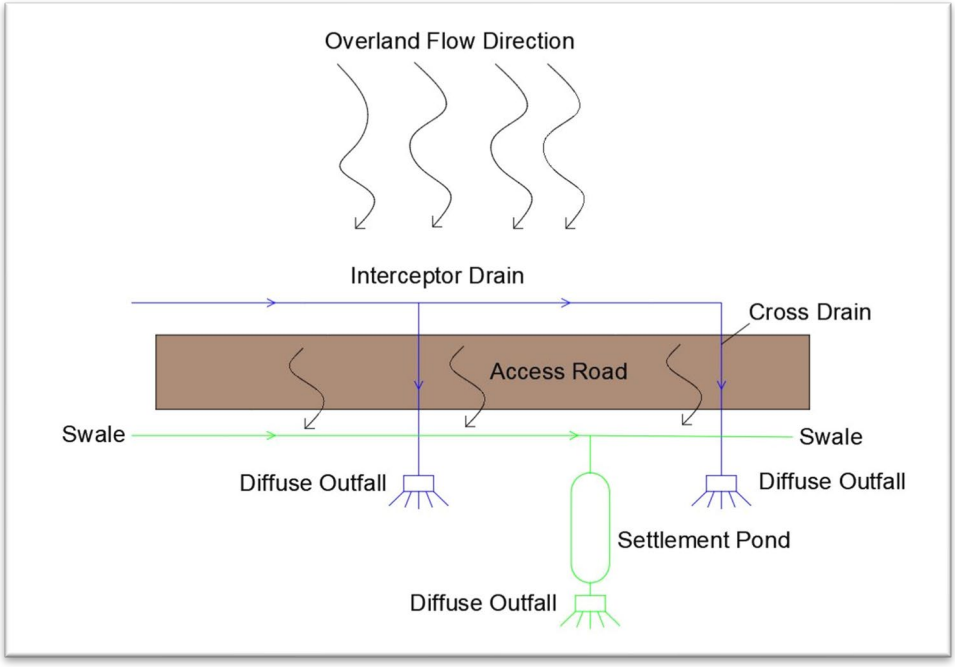

Plate 1: Drainage Diagram

The settlement ponds will be designed in the accordance with CIRIA C648. The volume of a settlement pond is determined by the area draining into it. Any upslope runoff from site will be diverted from ponds. This is achieved by interceptor drains as discussed above. Drainage pond details including sizing is included in the Surface Water Management Plan.

Suspended solids will settle out only when the water is still. It is necessary to retain the water in the settlement pond for several hours to allow the suspended solids to settle out. Retention time depends on the particle size, disturbance of the water, depth of water, temperature and particle density. Retention time of 2h has been applied in for designing the ponds as suggested in CIRIA C648. This will allow silts to settle out.

CIRIA C648 recommends designing the outfall from the ponds to accommodate a 1 in 10 years storm event, for this project the outfalls have been designed to accommodate flows associated with a 1 in 100 year event.

The settlement ponds will be 1.0m deep. The proposed size of the settlement ponds is provided in the Surface water management plan (SWMP) contained in Appendix 10.2.

The existing access roads, where required, will be upgraded. The existing drainage infrastructure does not prevent mixing of clean and dirty water. It is proposed to improve drainage at these locations by implementing drainage methodology proposed for new access roads.

The existing drainage is described in Section 10.3.6. The proposed drainage is described in Section 10.6 and in the SWMP contained in Appendix 10.2.

10.3 Existing Environment

10.3.1 Description of Catchments

This section addresses catchment characteristics of the wind farm site and grid connection. Receiving environment of the TDR and Biodiversity Enhancement And Management Plan lands (BEMP) is addressed in Section 10.3.8 and 10.3.9.

The wind farm site is located within two hydrometric areas (catchment) of the Irish River Network System. These are Lee, Cork Harbour and Youghal Bay (ID 19) and Blackwater (Munster) (ID 18).

The wind farm site is situated within three sub-catchments as defined by the WFD and shown on Figure 10-2. These waterbodies are known as:

- Sullane_SC_020 (19_7)
- Blackwater (Munster)_SC_050 (18_4)
- Blackwater (Munster)_SC_070 (18_7).

The wind farm site is situated within eight sub-basins as shown on Figure 10-2. These waterbodies are known as:

- Awboy_010 – IE_SW_19A030200
- Laney_030 – IE_SW_19L010400
- Laney_020 – IE_SW_19L010200
- Owenbaun (Rathcool)_010 – IE_SW_18O050500
- Laney_010 – IE_SW_19L010100

- Rathcool_010 – IE_SW_18R010400
- Nad_010 – IE_SW_18N010400
- Glen (Banteer)_010 – IE_SW_18G040600

There are no construction activities and surface runoff from the wind farm site in the Awboy_010 and Owenbaun (Rathcool)_010 sub-basins.

Turbines T1, T2, T3, T6, T7, T8, T9, T10, T11, T12, T13, T16 and T17 are within Laney_010 sub-basin. Turbines T4 and T5 are within Laney_020. Turbines T14, T15 and T18 are within Nad_010 and Turbines T19 and T20 are within Glen (Banteer)_010 sub-basin.

Several watercourses draining to the north of the site share downstream hydrological connectivity with the Blackwater River SAC (002170) via the Nadanuller Beg Stream and Glen River. The project also overlaps with the Lee-Laney and Munster Blackwater *Margaritifera* (Freshwater Pearl Mussel) sensitive areas. To elucidate potential impacts resulting from the proposed wind farm project, detailed surveys of physical and riparian habitats, and assessments of fish stocks, fisheries habitat, white-clawed crayfish, freshwater pearl mussel (FWPM), otter, biological water quality (Q-sampling) and physiochemical water quality were undertaken in June-July 2020 and June 2021.

Details on this can be found in Chapter 8B- Aquatic Ecological Assessment.

The grid connection between the proposed on-site substation and existing substation at Clashavoon is within four waterbodies (river sub-basins) catchments as defined by the WFD. These are:

- Laney_010_IE_SW_19L010100,
- Laney_030_IE_SW_19L010400,
- Awboy_010_SW_19A030200,
- Laney_040_SW_19L010500

The elevation range of the overall wind farm site varies between approximately 640 mOD and 210m OD, and it has a mountainous topography. Turbines will be installed in the range between approximately 460m OD and 255 mOD. T16 will be at the highest point and T9 at the lowest point.

The main hydrology feature within the wind farm site is the Laney River and Nadanuller Beg Stream as shown on Figure 10.5. All surface runoff within the Laney_010 sub-basin drains to the River Laney or its tributaries. The River Laney runs in northwest-southeast direction. The following tributaries of the River Laney are receiving receptors of the wind farm site:

- West Ballynagree Stream
- Knocknagappul 19 Stream
- Carrigagulla
- Unnamed Stream and its tributary located approximately 700m southwest of turbine T13
- Ballynagree East Stream
- Unnamed Streams east of the proposed borrow pits located at the western side of Laney_010

- Unnamed Stream located approximately 400m west of turbine T17
- Unnamed Stream located approximately 350m southwest of turbine T18

The northeastern part of the windfarm site drains ultimately into the Nadanuller Beg Stream which forms part of Blackwater River (Cork/Waterford) SAC approximately 3.6km northeast of the site. The following tributaries of the Nadanuller Beg Stream will be receiving the runoff from the wind farm site:

- Unnamed Stream located approximately 350m north of turbine T14
- Unnamed Stream located approximately 600m west of turbine T18
- Unnamed Stream located approximately 330m north of turbine T18
- Unnamed Stream located approximately 640m northeast of turbine T18

The surface runoff from turbine T19 and T20 drains into the Glen (Banteer) Stream which forms part of Blackwater River (Cork/Waterford) SAC approximately 4.7km northeast of the wind farm site.

The average annual rainfall in period 1981-2010 in the area of the wind farm site is 1,720 mm.

M5-60[9] at development location is 17.6 mm according to the Met Éireann rainfall data. This is the predicted rainfall depth in a sixty minute storm that will occur with a frequency of once every five years.

All wind farm turbines have been located at least 75m from any open waterbody. The OPW have a watercourse database showing indicative flow direction. On Figure 10-2 it can been seen that the proposed turbine T2 appears to be situated within 75m of the Knocknagappul Stream. However, during site inspection it was noted that this stream does not form as shown on OPW mapping but is situated 160m northeast of T2.

There are no lakes or reservoirs within the wind farm site study area.

[9] This is for a 5-year return period, with a 60-minute duration rainfall.

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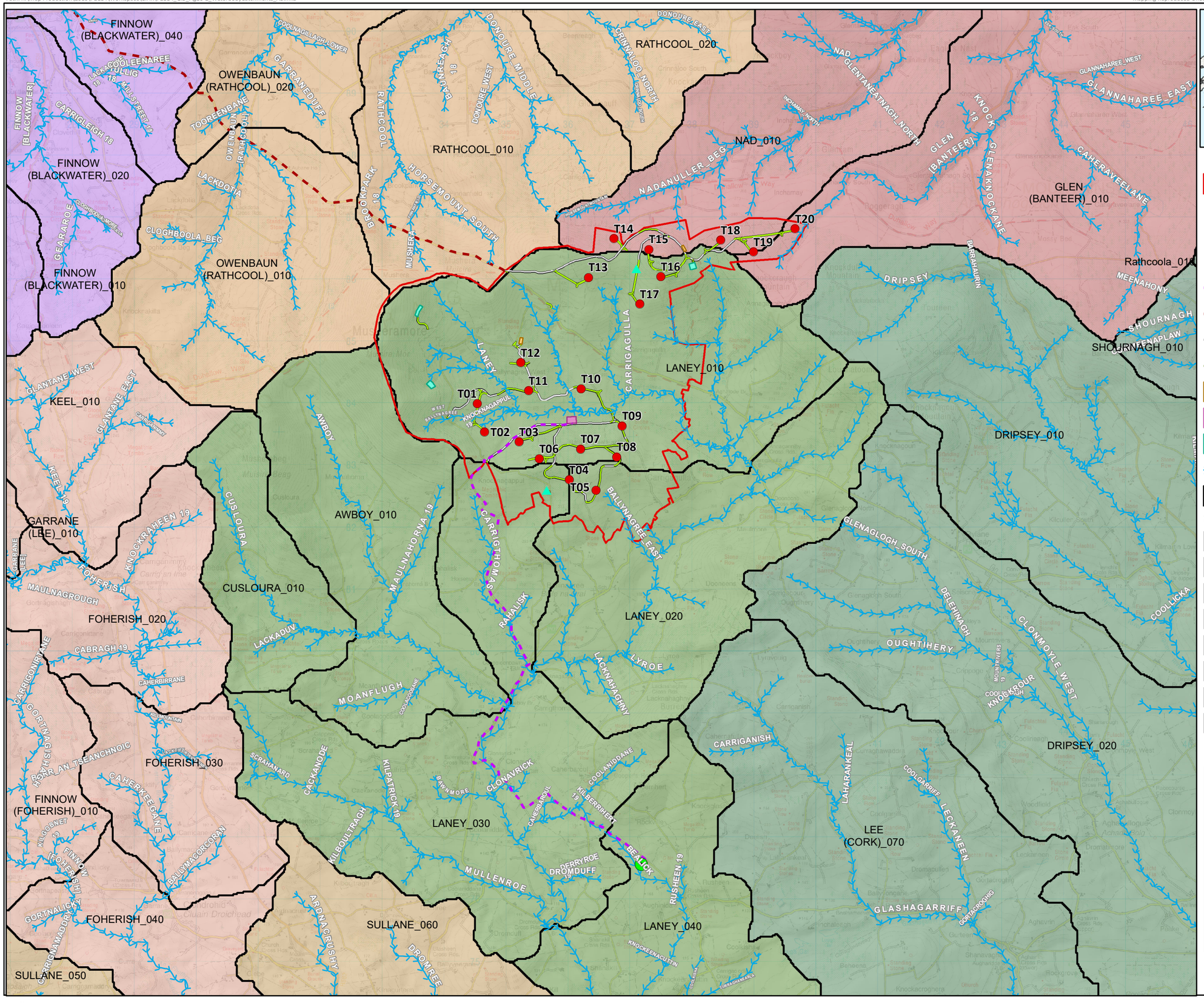

Legend

- Proposed Wind Farm Site
- Proposed Turbine Layout
- Met Mast
- Substations (110-220kV)
- Grid Connection
- Turbine Delivery Route
- Existing Track Upgrade
- New Access Track
- Temporary Construction Compound
- Substation Compound
- Proposed Borrow Pits
- Rivers
- WFD River Sub Basins

WFD Sub Catchments

- Blackwater[Munster]_SC_040
- Blackwater[Munster]_SC_050
- Blackwater[Munster]_SC_070
- Foherish_SC_010
- Lee[Cork]_SC_040
- Lee[Cork]_SC_060
- Sullane_SC_010
- Sullane_SC_020

TITLE:	Waterbody Catchments		
PROJECT:	Ballinagree Wind Farm		
FIGURE NO:	10.2		
CLIENT:	Coillte & Brookfield		
SCALE:	1:60000	**REVISION:**	0
DATE:	05/10/2021	**PAGE SIZE:**	A3

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10.3.2 Historical Flooding

The national flood hazard mapping (www.floodmaps.ie), does not indicate any record of historical flooding within the wind farm site boundary. However, there is a recurring flood incident recorded under the name "Annagannihy North to Musheera Co. Cork Recurring" located at the unnamed stream approximately 650m northeast of turbine T10.

There are no recorded flood incidents within 2km buffer zone of the wind farm site identified in the OPW database. It is unlikely that the recorded flood incidents outside of the buffer zone had any effect on the site, this is due to the mountainous topography of the wind farm site.

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

There are no historical flood incidents along the grid connection or within 2km buffer zone. The grid connection is detailed in Section 10.3.7.

Historical flood incidents and recurring flooding along the TDR are listed below. The TDR is detailed in Section 10.3.8.

- Foynes 8th Jan 2005 (ID 2597)
- Foynes near Castle Recurring (ID 2673)
- Horan's Cross Limerick Recurring (ID 2709)
- Massey's Bridge Limerick Recurring (ID 2553)
- Ballynaclogh Ballinacurra Recurring (ID 2701)
- Ballynaclogh Rosbrien August 1986 (ID 2688)
- Ballynaclogh Rosbrien (ID 2544)
- Maigue Creggane Bridge Limerick November 1982 (ID 2608)
- Maigue Creggane Bridge August 1986 (ID 2635)
- Maigue River Creggane Kilmallock Recurring (ID 2614)
- Awbeg N20 Road, Kilbronbey, Velvestown Recurring (ID 2336)
- Blackwater at Killetra near racecourse recurring (ID 5109)
- Flooding at Firville West, N72, Co. Cork November 2009 (ID 10828)
- N72 Firville West near Mallow recurring (ID 5107)
- Gearanaskagh N72 junction recurring (ID 5108)
- Blackwater N72 Dromcummber Bog Nov 1980 (ID 5140)
- Blackwater R579 Ballymaquirk Bridge Banteer November 1980 (ID 5141)
- Blackwater R583 at Keale Bridge recurring (ID 5130)

There is one recurring flood incident recorded under the name "Delehinagh River Coakley's Bridge Recurring" located 1.65km downstream of Joseph Barrett's BEMP lands. There are no recorded historical flood incidents within 2km buffer zone of the BEMP lands.

Flood risk assessment is detailed in Section 10.5.

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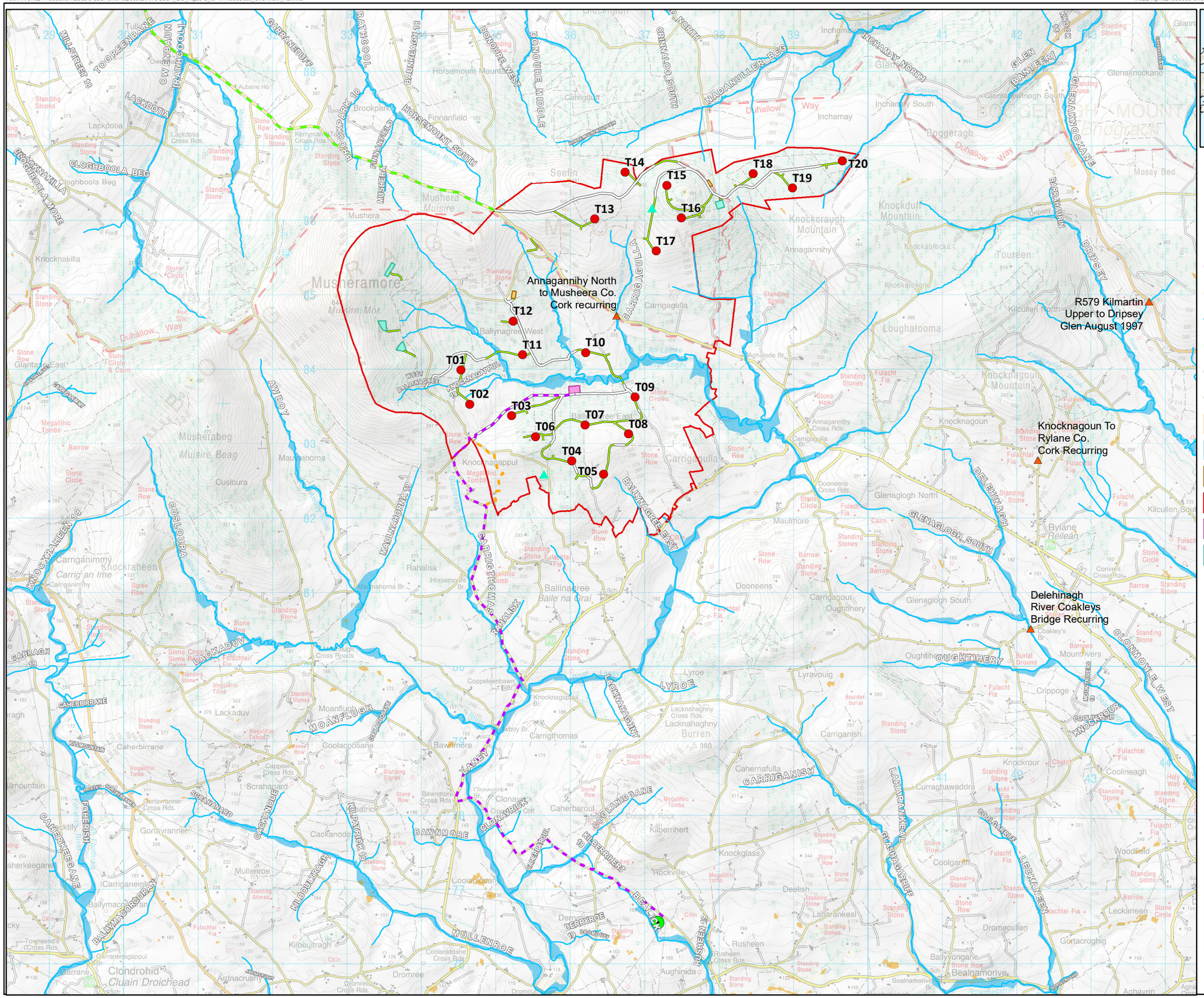

- OPW Historic Flood Points
- Substations (110-220kV)
- Met Mast
- Proposed Turbine Layout
- Grid Connection
- Grid Connection Route Variant
- Rivers
- Turbine Delivery Route
- Existing Track Upgrade
- New Access Track
- PFRA 1% AEP Pluvial Flood Extent
- PFRA 1% AEP Fluvial Flood Extent
- Temporary Construction Compound
- Proposed Wind Farm Site
- Substation Compound
- Proposed Borrow Pits

TITLE:	OPW Flood Data		
PROJECT:	Ballinagree Wind Farm		
FIGURE NO:	10.3		
CLIENT:	Coillte & Brookfield		
SCALE:	1:50000	**REVISION:**	0
DATE:	11/05/2021	**PAGE SIZE:**	A3

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10.3.3 Surface Water Quality

WFD water quality status and river waterbody risk associated with the wind farm site and grid connections are provided in Table 10-3. It can be observed that the river status and waterbody risk of the receiving waters of the wind farm site are classified as 'High' and 'Not At Risk'. For waterbodies associated with grid connection river status is 'Good' and 'High'.

Table 10-3: WFD River Status and River Waterbody Risk[10]

Watercourses (as shown on Figure 10-2)	Waterbody	River Status	Waterbody Risk
Wind Farm			
Laney River	Laney_010	High	Not at Risk
West Ballynagree	Laney_010	High	Not at Risk
Knocknagappul 19	Laney_010	High	Not at Risk
Carrigagulla	Laney_010	High	Not at Risk
Nadanuller Beg	Nad_010	High	Not at Risk
Glen (Banteer)	Glen (Banteer)_010	High	Not at Risk
Unnamed tributaries of Laney River	Laney_010	High	Not at Risk
Unnamed tributaries of Nadanuller Beg	Laney_010	High	Not at Risk
Grid Connection			
Bealick	Laney_040	Good	At Risk
Kilberrihert 19	Laney_030	High	Not at Risk
Coolaniddane	Laney_030	High	Not at Risk
Caherbaroul	Laney_030	High	Not at Risk
Clonavrick	Laney_030	High	Not at Risk
Laney	Laney_030	High	Not at Risk
Awboy	Awboy_010	Good	At Risk
Carrigthomas	Laney_030	High	Not at Risk

Regardless of their 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.

[10] https://gis.epa.ie/EPAMaps/.

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 of varying sensitivity to pollution. Biological Water Quality data was examined as part of this assessment.[10]

The location of the EPA's biological Q-value stations for the receiving waters are shown on Figure 10-4.

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.[11]

The most recent Biological Water Quality Ratings at stations downstream of the wind farm site and grid connection are outlined in Table 10-4. Q ratings range between Q4 to Q4-5. There is no recorded quality status data for 'Laney Bridge-downstream of Bawnmore' since year 1990.

Table 10-4: EPA Biological Water Quality Ratings

Station ID	Station Name	1990	2017	2018	2019
RS18G040100	Glencam Bridge	-	-	4-5	-
RS19L010100	Garrigagulla Bridge	-	-	4-5	-
RS19L010200	Coppeleenbawn Bridge	-	4-5	-	-
Rs19A030200	Awboy Bridge	-	-	-	5
RS19L010300	Laney Bridge – downstream of Bawnmore	5	-	-	-

[11] http://www.epa.ie/QValue/webusers/

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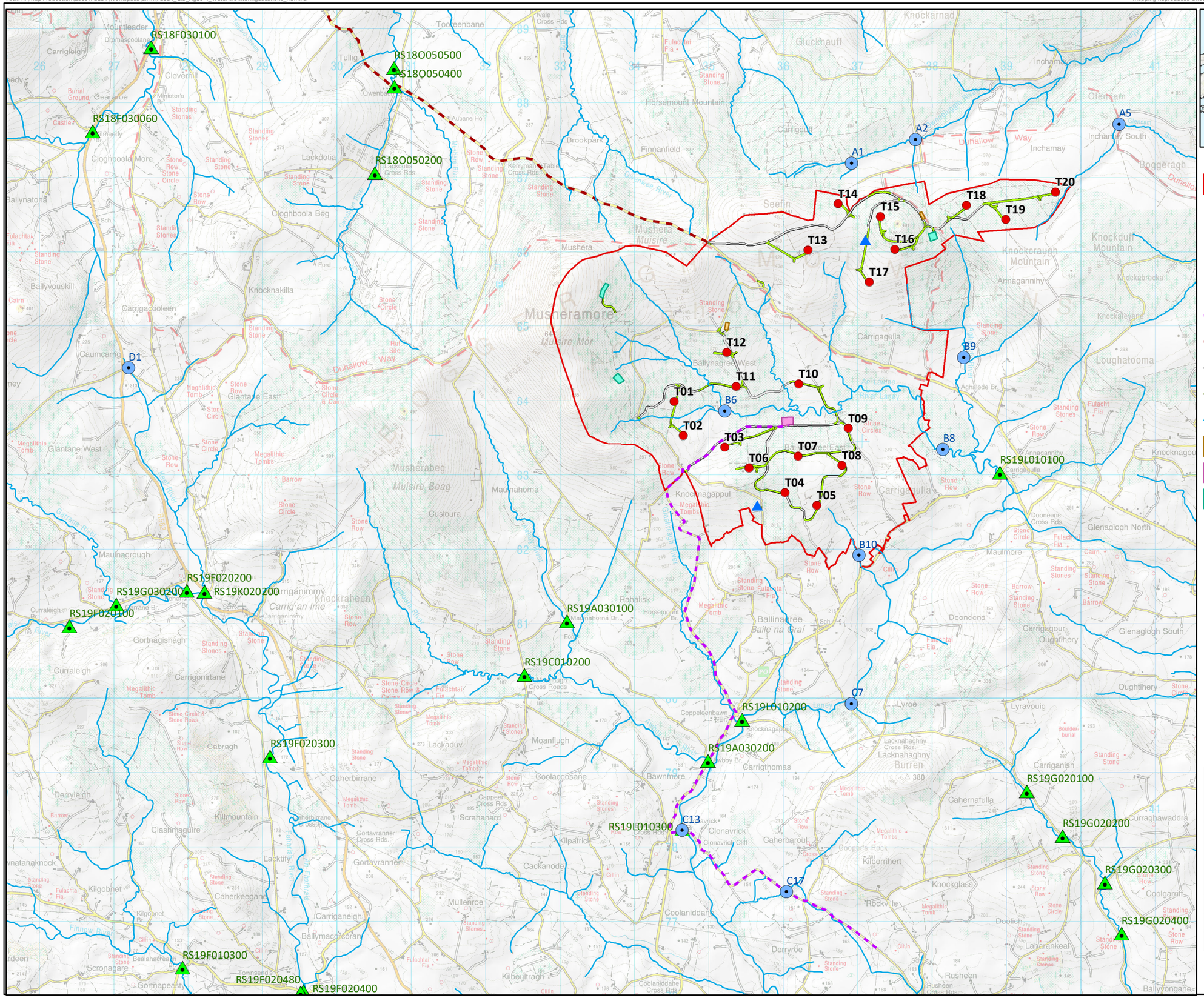

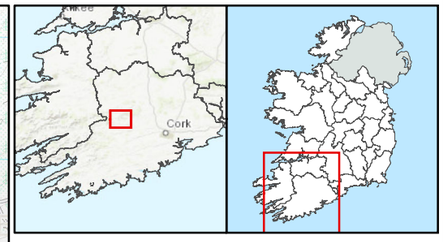

Legend

- Proposed Wind Farm Site
- Proposed Turbine Layout
- Met Mast
- Pre-Construction Sampling Locations
- Biological Q Stations
- Grid Connection
- Turbine Delivery Route
- Existing Track Upgrade
- New Access Track
- Rivers
- Temporary Construction Compound
- Substation Compound
- Proposed Borrow Pits

TITLE:	Water Quality Locations		
PROJECT:	Ballinagree Wind Farm		
FIGURE NO:	10.4		
CLIENT:	Coillte & Brookfield		
SCALE:	1:50000	**REVISION:**	0
DATE:	05/10/2021	**PAGE SIZE:**	A3

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10.3.4 Surface Water Physiochemistry

Surface water sampling has been carried out to establish a baseline for water quality for the receiving waters of the proposed wind farm and grid connection. Water sampling has been carried out as part of Aquatic ecological assessment at locations shown on Figure 10-4. Results of the laboratory analysis are shown alongside relevant water quality regulation in Table 10-5.

In addition, European Communities Environmental Objectives (Surface Water) Regulations S.I. 272 of 2009, (EOSWR 272/09) thresholds are shown in Table 10-6.

The following parameters were measured in order to provide a comprehensive baseline of the 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)

The monitoring points A1, A2 and A3 were located in Blackwater (Munster)_SC_070, monitoring points B6, B8, B9, B10, C7, C13 and C19 were located in Sullane_SC_020 sub-catchment.

The pH levels across the riverine sites was typically circumneutral with levels recorded between 6.58 and 7.54 (however, site N1 was 6.22). The majority of the sample sites were of low alkalinity (i.e. ≤20mg/l $CaCO_3$ at sites A1, A2, B6, B7, B8, B9, C7, C13, N1, N2, N3 and N4). Sites A5 (Glen River), B10 (Ballynagree East Stream), C17 (Coolaniddane River) and D1 (Keel Stream) were of moderate alkalinity (i.e. 20-100mg/l $CaCO_3$ due to greater calcareous influences).

With the exception of site A1 (0.094mg N/l) and D1 (0.059mg N/l), the sampling sites had low levels of total ammonia which were equivalent to high status water quality (i.e. Total Ammonia levels ≤0.040 mg N/l) according to S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019. Site A1 failed to meet the good status standard (i.e. ≤0.065 mg N/l) whilst site D1 achieved good but not high status.

With regards nutrients, molybdate reactive phosphate (MRP) levels were typically very low across the sampling and thus met high status as required in the Surface Water Regulations (i.e. levels ≤ 0.025 mg P/l). However, MRP concentrations were elevated at sites A1 (0.043mg P/l) and D1 (0.116mg P/l), with both sites failing to meet the good status threshold (≤0.035mg P/l) as set out under S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019.

Levels of total oxidised nitrogen (TON) ranged from 0.011 to 2.489mg N/l across the sampling sites. Particularly high levels were recorded at sites B10 (2.299mg N/l) and C17 (2.489mg N/l). Total oxidised nitrogen is taken to be equivalent to nitrate given the concentration of nitrite is usually negligible (O'Boyle et al., 2019).

Whilst there are no environmental quality standards for nitrate, average nitrate concentration values ≤4 mg/l NO_3 (≤0.9mg N/l) and ≤8mg/l NO_3 (≤1.8mg N/l) are considered by the EPA to be indicative of high and good quality water, respectively. Thus, only sites B10 (Ballynagree East Stream) and C17 (Coolaniddane River) fell outside acceptable parameters for nitrate.

The observed dissolved organic carbon (DOC) levels were low across most survey sites, being <5mg C/l. These levels indicated low levels of leaching of DOC and escapement of solids into surface waters from the afforested and improved agriculture-dominated landscape in the catchment of the wind farm. However, several sites to the north of the site boundary (sites A1, A2 and A5) featured considerably higher DOC levels (i.e. 18.7, 10.4 and 5.61mg C/l, respectively). All three of these sites drained upstream coniferous plantations.

BOD levels were low across all sites with all sampling locations achieving equivalent high-status water quality under S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (i.e. ≤1.3 mg O_2/l).

Whilst there are no clearly defined standards for COD concentrations in surface waters, levels were especially high at sites A1 and A2 on the Nadanuller Beg Stream (i.e. an order of magnitude higher than other sampling sites at 66.9mg and 35mg O_2/l, respectively).

Table 10-5: Results of Surface Water Samples

Parameter	Sample Location									
	A1	A2	A5	B6	B8	B9	B10	C7	C13	C17
pH	6.69	7.16	7.21	7.04	7.33	7.32	7.54	7.40	7.40	7.46
Alkalinity (mg CaCO3/l)	9.6	18.3	21.1	12.8	16.5	18.4	26.3	16.9	18.3	38.0
Total Ammonia (mg N/l)	0.094	0.023	0.006	0.003	0.005	0.008	0.008	0.019	0.017	0.025
MRP (mg P/l)	0.043	0.016	0.004	0.001	0.002	0.005	0.009	0.010	0.006	0.116
TON (mg N/l)	0.155	0.126	0.011	0.267	0.443	0.265	2.299	0.730	0.701	2.489
DOC (mg C/l)	18.7	10.4	5.61	1.95	2.41	2.95	1.38	3.27	3.75	3.40
BOD (mg O2/l)	1.3	0.9	0.5	0.3	0.5	0.4	0.6	0.6	1.1	1.0
COD (mg O2/l)	66.9	35.2	16.4	8.2	9.1	13.2	8.6	12.7	13.7	9.5
Suspended Solids (mg/l)	3.8	2.4	0.4	0.2	1	1.6	14.6	1.0	2.0	2.2

Table 10-6: Chemical Conditions

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)

10.3.5 Protected Ecological Environment

A small portion of the wind farm site (0.36 km^2 or 0.02% of wind farm development boundary) is situated within Boggeragh Mountains NHA. The existing access road runs through this area. This road will be used for construction traffic. No road widening or drainage installation is required in this area. The existing 'over the edge' drainage is suitable, and no alteration is required. The wind farm collector circuit cable will be buried within this road before it exits the site onto the public road. The entirety of the associated works will be contained within the footprint of the existing road. The trench will be backfilled with suitable imported material and reinstated to match the existing road surface. When the trench is backfilled, the existing road surface will be improved by way of a layer of compacted stone which will match the existing surface aggregate.

A small portion of the northern part of the site (1.5 km^2 or 7.7% of wind farm development boundary) ultimately drains into the Blackwater River (Cork/Waterford) SAC. The proposed turbines T14, T15, T18, T19 and T20 drain towards the waterbodies which ultimately discharge into the Blackwater River (Cork/Waterford) SAC.

The Blackwater River (Cork/Waterford) SAC is approximately 4.5km downstream of the wind farm site.

The wind fam site does not traverse any Special Protection Area (SPA).

Designated protected areas are detailed in Chapter 8.

10.3.6 Existing Drainage

A site walkover survey took place in January and February 2021 to examine the existing drainage and hydrological features at the site. The visit involved a walkover of the site by FT staff, recording existing drainage features and noting their locations. The locations of the hydrological features observed during the site visit are shown in Figure 10-5.

Photographs of existing hydrological features are included in Appendix 10.1.

Drains and Existing Road Drainage

Turbines are situated within 4 sub-basins. Greenfield runoff from the southern extent of the wind farm site ultimately drains to the Laney River and its tributaries. The northern part of the site drains into the Nadanuller Beg Stream and its tributaries.

Two ford crossings were identified over the Laney River and Unnamed tributary of the Laney River. Fords are used to cross a watercourse when water depth is shallow enough. These crossing points are recorded under the name WF-HF9 and WF-HF16 and are shown on Figure 10-5.

Photos of the fords are presented in Appendix 10.1.

There is an existing road at the northern part of site. It is drained by a road drain with cross drains installed at the lowest points along the road. Details on crossing are presented in Table 10-5.

Existing tracks are present throughout the site. Some of these tracks are access tracks for the forestry inspection and tree felling which are approximately 5m in width. The majority of the access tracks are made up of sandstone/siltstone hardcore. The existing track drainage consists of 'over the edge' drainage to roadside drains.

It is proposed to utilise the existing tracks in so far as possible to access the new turbines. The existing tracks will require strengthening and widening to achieve a track width of 5 m except for the section of road in the NHA which this has been examined on site in detail and found to be suitable for the proposed development traffic.

During the site visits 13 crossing points, over the streams, drains and watercourses were identified. The location and general description of these crossings are provided in Table 10-7:

Table 10-7: Existing Hydrology Features

Feature ID	ITM_X	ITM_Y	General description
WF-HF1	535872.40	583688.56	Cross drain, 450mm dia. pipe
WF-HF2	536174.22	583720.06	Forestry pipe drain, 450mm dia.
WF-HF3	536671.36	583903.55	Cross drain, 450mm dia. pipe
WF-HF7	535351.81	585631.49	Pipe culvert, 1000mm dia. pipe
WF-HF8	535968.55	584260.95	Bridge

Feature ID	ITM_X	ITM_Y	General description
WF-HF9	535672.57	586172.37	Ford
WF-HF10	436277.94	586388.27	Cross drain, 450mm dia. pipe
WF-HF11	436860.02	586589.36	Cross drain, 450mm dia. pipe
WF-HF12	538070.76	586369.22	Cross drain, 450mm dia. pipe
WF-HF13	537922.59	586405.21	Cross drain, 450mm dia. pipe
WF-HF14	537459.04	586737.52	Cross drain, 450mm dia. pipe
WF-HF15	535872.40	583688.56	Cross drain, 450mm dia. pipe
WF-HF16	536615.97	583889.21	Ford

Hydrology features WF-HF1 and WF-HF3 are existing road cross drains located at the southern part of the wind farm site. Hydrology feature WF-HF2 is a forestry pipe drain.

Hydrology features WF-HF7 and WF-HF8 are located along local road. WF-HF7 is a 1000mm concrete pipe culvert. WF-HF8 is a 2-span bridge, pier is constructed from rock slabs. It is proposed to replace this crossing structure. This is further detailed in this report.

Hydrology features WF-HF9 and WF-HF16 are existing fords over the Laney River. A ford at the location WF-HF16 is approximately 10m wide. It is proposed to construct a bridge approximately 55m east of that location. This is further detailed in Section 10.5.

Hydrology features WF-HF10, WF-HF11, WF-HF12, WF-HF13, WF-HF14 and WF-HF15 are existing road cross drains located at the northern part of the wind farm site.

The locations of stream crossing are shown on Figure 10-5.

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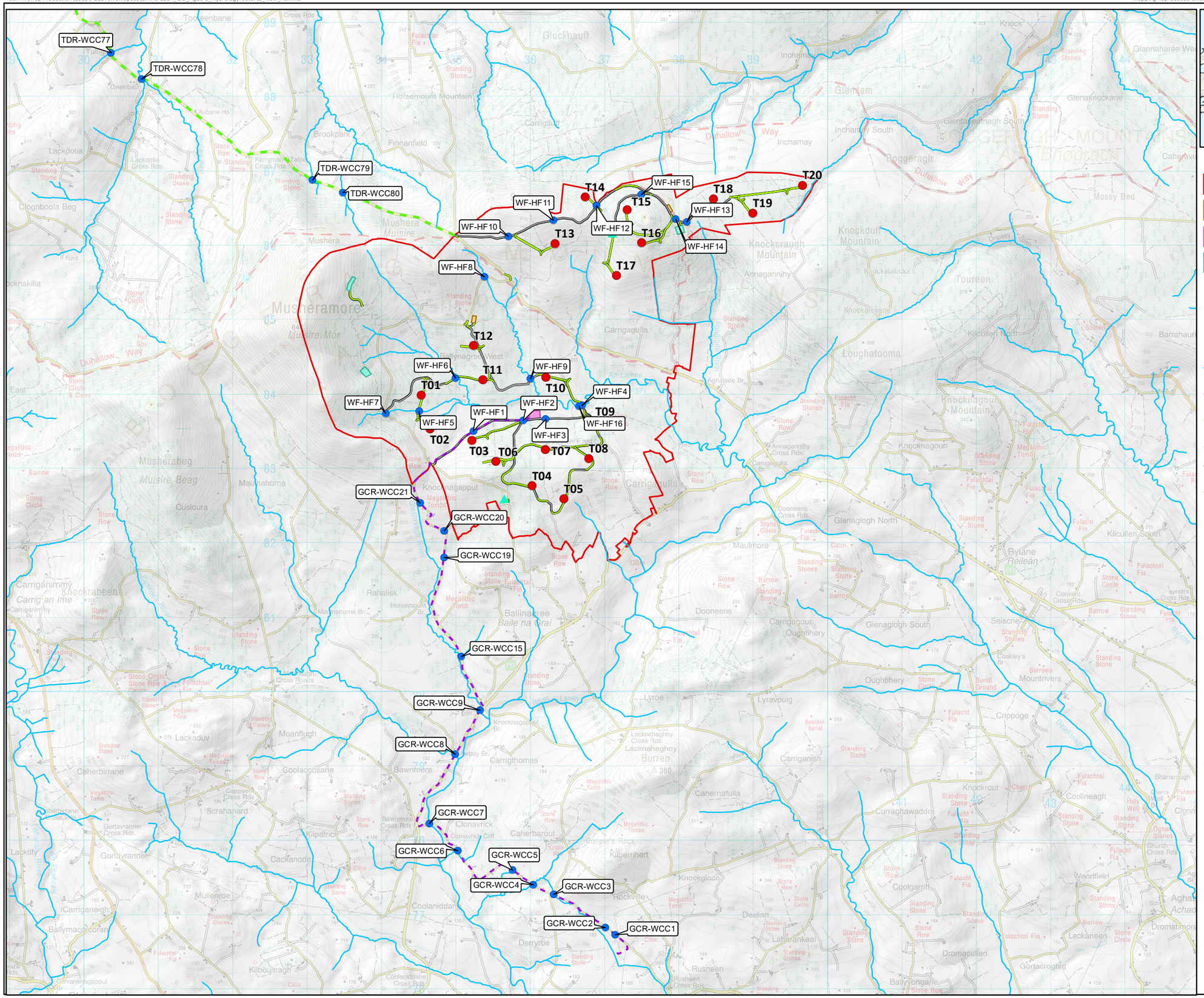

Legend

- Proposed Wind Farm Site
- Temporary Construction Compound
- Substation Compound
- Proposed Borrow Pits
- Proposed Turbine Layout
- Met Mast
- Hydrological Features New
- Rivers
- Grid Connection
- Turbine Delivery Route

Access Tracks:

- Existing Track Upgrade
- New Access Track

TITLE:	Hydrology Features		
PROJECT:	Ballinagree Wind Farm		
FIGURE NO:	10.5		
CLIENT:	Coillte and Ørsted		
SCALE:	1:50000	**REVISION:**	0
DATE:	13/12/2021	**PAGE SIZE:**	A3

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10.3.7 Grid Connection Route

The grid connection route from the proposed 110kV substation at Clashavoon to the proposed on-site substation crosses watercourses at 13 locations as shown on Figure 10-5. All crossing locations associated with the grid connection are listed in Table 10-8. The method of crossing over the watercourses is proposed for each crossing location. Suitable method of crossing is based on the type of the crossing structure and cover level. For crossing structures with insufficient cover level, ducts will be installed under the structure.

The proposed grid connection trench will be 930 mm wide and 1200 mm deep. Where the proposed grid connection encounters minor culverts, the ducts will be installed above or below the culvert depending on its depth in accordance with construction methodologies outlined in the CEMP (Appendix 3.1).

The cable ducting will be installed so as not to impact the existing culvert. Installation of grid cable will not have an effect on flow conveyance area of the crossing structures.

Table 10-8: Grid Connection Crossing Methods

Feature ID	ITM_X	ITM_Y	Crossing Method	Crossing Structure
GCR - WCC1	537107.75	576788.20	Ducts installed under existing service by standard trenching methods.	Pipe culvert, cover level 300mm
GCR - WCC2	536977.57	576884.77	Ducts installed under existing service by standard trenching methods.	Pipe culvert, cover level 200mm
GCR - WCC3	536281.19	577329.27	Ducts installed under existing service by standard trenching methods.	Pipe culvert, cover level 500mm
GCR - WCC4	536008.14	577458.39	Ducts installed under existing service by standard trenching methods.	Pipe culvert, cover level 300mm
GCR - WCC5	535728.74	577653.12	Ducts installed above existing service by standard trenching methods.	Pipe culvert, cover level 1300mm
GCR - WCC6	534992.49	577917.84	Ducts installed under existing service by standard trenching methods.	Pipe culvert, cover level 300mm
GCR - WCC7	534610.85	578281.04	Ducts installed beside the arch bridge by horizontal directional drill methods.	Arch Bridge, cover level 300mm
GCR - WCC8	534957.21	579214.70	Ducts installed beside the arch bridge by horizontal directional drill methods.	Arch Bridge, cover level 300mm

Feature ID	ITM_X	ITM_Y	Crossing Method	Crossing Structure
GCR - WCC9	535292.70	579807.10	Ducts installed beside the arch bridge by horizontal directional drill methods.	Arch Bridge, cover level 200mm
GCR - WCC15	535039.28	580524.91	Ducts installed above existing service by standard trenching methods.	Pipe culvert, cover level 900mm
GCR - WCC19	534809.36	581860.59	Ducts installed above existing service by standard trenching methods.	Box culvert, cover level 500mm
GCR - WCC20	534810.11	582216.59	Ducts installed under existing service by standard trenching methods.	Pipe culvert, cover level 200mm
GCR - WCC21	534488.56	582592.96	Ducts installed under existing service by standard trenching methods.	Pipe culvert, cover level 200mm

The grid connection between the proposed on-site substation and the existing substation is within four sub-basins as defined by the WFD. These are:

- Laney_010_IE_SW_19L010100,
- Laney_030_IE_SW_19L010400,
- Awboy_010_SW_19A030200,
- Laney_040_SW_19L010500

Crossings for the cables in the internal access roads serving the proposed development, have been assessed as part of the proposed drainage for the wind farm development. These crossing locations are discussed in Section 10.6.

10.3.8 Turbine Delivery Route

Turbine components will be delivered along the route as described in Chapter 3 of this report. In total 80 waterbodies will be crossed by turbine delivery traffic, and these are listed in Table 10-9. TDR route is situated within 2 catchments, Shannon Estuary South and Blackwater (Munster).

Table 10-9: TDR Waterbodies

Feature ID	Waterbody	Feature ID	Waterbody
TDR-WCC1	Foynes	TDR-WCC41	Knockaunavoddig
TDR-WCC2	Ardandeen	TDR-WCC42	Maigue

Feature ID	Waterbody	Feature ID	Waterbody
TDR-WCC3	Sroolane_north	TDR-WCC43	Creggane 24
TDR-WCC4	Robertstown 24	TDR-WCC44	Broghill_north
TDR-WCC5	Shanagolden	TDR-WCC45	Charleville (stream)
TDR-WCC6	Ahacronane	TDR-WCC46	Ballyhubbo
TDR-WCC7	Glenbane west stream	TDR-WCC47	Ballysallagh 24
TDR-WCC8	Lismakeery (stream)	TDR-WCC48	Awbeg (Buttevant East)
TDR-WCC9	Deegerty	TDR-WCC49	Newtown 18
TDR-WCC10	Deegerty	TDR-WCC50	South Castlewrixon
TDR-WCC11	Askeaton	TDR-WCC51	Lisballyhay
TDR-WCC12	Cragmore	TDR-WCC52	Awbeg (Buttevant)
TDR-WCC13	Upper Ballyengland	TDR-WCC53	East Boherascrub
TDR-WCC14	Deegerty	TDR-WCC54	Ballyclogh (stream)
TDR-WCC15	Dromlohan 24	TDR-WCC55	Ballyclogh (stream)
TDR-WCC16	Tonlegee 24	TDR-WCC56	East Baltydaniel
TDR-WCC17	Faha 24	TDR-WCC57	South Cloghlucas
TDR-WCC18	Elmpark_demense	TDR-WCC58	Ashgrove 18
TDR-WCC19	Elmpark demense	TDR-WCC59	Ashgrove 18
TDR-WCC20	Barnakyle	TDR-WCC60	East baltydaniel
TDR-WCC21	Rossbrien	TDR-WCC61	Annabella
TDR-WCC22	Rossbrien	TDR-WCC62	Scarteen 18
TDR-WCC23	Ballynaclogh 24	TDR-WCC63	Ballyclogh (stream)
TDR-WCC24	Derryknockane	TDR-WCC64	Ruanes 18
TDR-WCC25	Rootiagh	TDR-WCC65	Woodpark Lombardstown
TDR-WCC26	Rootiagh	TDR-WCC66	Awbeg (Kanturk)
TDR-WCC27	Rootiagh	TDR-WCC67	North Kilcaskan
TDR-WCC28	Barnakyle	TDR-WCC68	Allow
TDR-WCC29	Patrickswell 24	TDR-WCC69	Knockanroe 18
TDR-WCC30	Islandduane	TDR-WCC70	Dromagh
TDR-WCC31	Mondellihy	TDR-WCC71	Maulyclickeen
TDR-WCC32	Garranroe 24	TDR-WCC72	Keale stream
TDR-WCC33	Garranroe 24	TDR-WCC73	Blackwater (Munster)
TDR-WCC34	Laskiltagh	TDR-WCC74	Drishane_More
TDR-WCC35	Maigue	TDR-WCC75	Coomlogane

Feature ID	Waterbody	Feature ID	Waterbody
TDR-WCC36	Croom	TDR-WCC76	Drominahilla
TDR-WCC37	Anhid_East	TDR-WCC77	Tooreenbane
TDR-WCC38	West Liskennett	TDR-WCC78	Owenbaun (Rathcool)
TDR-WCC39	Glenma	TDR-WCC79	Brookpark 18
TDR-WCC40	Cappanafaraha	TDR-WCC80	Finnanfield

Minor works (furniture removal, vegetation trimming, tree removing, placement of temporary load bearing surface) will be required along the TDR to accommodate the delivery. These accommodation works are unlikely to have any significant impact on hydrology and water quality due to the nature of the required activities and distance to watercourses. The most significant temporary accommodation will be required at POI-36 and POI-44 (Point of Interest) where the change of surfaces is proposed. At POI-36 a temporary aggregate hardstanding and access tracks will be constructed and at POI-44 ground reprofiling will be undertaken 30m from the River Owenbaun (Rathcool) which forms Blackwater River (Cork/Waterford) SAC. Points of Interest are shown on Figure 3.5.

The potential impacts on hydrology and water quality of the TDR are discussed in Section 10.4.2.2.

10.3.9 Biodiversity Enhancement and Management Plan Lands

The Biodiversity Enhancement and Management Plan Lands (BEMP) comprises of seven lands located within three sub-catchments: Blackwater (Munster)_SC_070, Sullane_SC_020 and Lee (Cork)_SC_040. The lands include three wildlife corridors that will be created and maintained on Coillte lands and four private landholdings.

The BEMP lands are shown on Figure 8B.5.2, and details are provided in Appendix 3.4.

The wildlife corridors are existing mature conifer plantation that will be felled to improve the connectivity between patches of upland peatland habitat. The landowners agreed to adopt a series of land management prescriptions on their own landholdings in the vicinity of the proposed wind farm development.

The uppermost reaches of the Nadanuller Beg River and the Horsemount Mountain Stream are located along the northern boundary of the c.10ha wildlife corridor to the north of the proposed wind farm.

The upper reaches of the Glen River are located approximately 330m north-west of the c.6.6ha wildlife corridor to the north-east of the proposed wind farm.

There are no watercourses located in the vicinity of the c.0.1ha wildlife corridor located to the west of Kelleher's lands, with the nearest watercourse (Maulnahorna Stream) located c.0.5km south according to EPA mapping.

The northern part of the Anthony Kellar's lands drain into the West Ballynagree and Knocknagappul Stream which are tributaries of the Laney River. The southern lands drain towards the Carrighthomas and Maulnahorna Stream which ultimately join the Laney River south of the lands. Noel Nuna's lands are located approximately 3.3km south of the Kellar's Land. These lands drain towards the Clonavrick, Caherbaroul and Coolaniddane Stream which ultimately join the Laney River as well.

James Scannell and Joseph Barrett's land are located within Lee (Cork)_SC_040 sub-catchment. Scannell's lands ultimately drains into the Glashagarriff River, and its tributaries Carriganish Stream and an Unnamed Stream. Barrett's lands are located approximately 460m northeast of Scannell's lands. The main hydrological features are the Oughitehery Stream and an Unnamed Stream which join the Delehinagh River east of the lands.

Any extant land drains with Anthony Kellar's lands will be blocked. Livestock will be prevented from accessing natural watercourses by stock proof fencing. The BEMP includes tree felling of an area of 18ha.

The potential impacts on hydrology and water quality associated with the BEMP activities are discussed in Section 10.4.2.7 and the proposed mitigation measures are provided in Section 10.7.1.7.

10.4 Potential Impacts

The potential impacts on the hydrological regime are assessed in the following sections for the activities associated with each phase (construction, operation, maintenance, and decommissioning) of the proposed project. The conventional source-pathway-target model was applied to assess potential impacts on downstream environment receptors as a result of the proposed project. Where potential impacts are identified, the classification of the impact is evaluated as per criteria outlined in Section 10.2.4.

The potential significance of the impacts in relation to an increase in surface runoff, specific impacts during the various phases of the project and potential flood risk from the project are outlined below.

During the construction period, the project has the potential to lead to impacts on hydrology and water quality unless appropriate mitigations are applied. Inappropriate construction practices could also have the potential to impact the water quality and WFD status of existing waterbodies listed in Table 10-3 which includes the Blackwater River (Cork/Waterford) SAC.

10.4.1 Do Nothing Impact

If the proposed project does not proceed, the wind farm site will remain as predominantly forestry 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 is occurring currently with no impact on either surface or groundwater. Agricultural and afforestation pressures would continue to pose a threat to water quality within the wider catchment in the absence of the proposed wind farm project.

10.4.2 Potential Impacts During Construction

Unmitigated Increase in Surface Runoff

New access tracks and upgrade of existing tracks, turbine hardstanding areas, the on-site substation, temporary compounds and amenity trail have the potential to contribute to the increase in runoff due to changes in the finished surfaces, as indicated in Table 10-10. The increase in runoff due to grid connection is not anticipated because the finished surfaces are not changed. The impact of the TDR is discussed in Section 10.5.1.

The estimated peak runoff from the wind farm site was calculated using Rational Equation (RE) for pre and post-construction scenario for 1 in 100 year storm event. The difference between these two values is equal to an increase in the peak runoff resulted from changes in the surface at hardstanding area around turbines, access roads and substation.

The peak runoff for RE equation occurs for a storm event with duration equal to the time of concentration. Time of concentration at the location of the main wind farm site is estimated to be 60min. Therefore, the estimated increase in runoff was calculated for a 1-in-100 year storm event with a duration of 60 minutes. This equates to rainfall with an intensity of 31 mm/h. The rainfall intensity is increased by 20% for Mid-range future climate change scenario (MRFS) according to the OPW guideline. The increased intensity will also increase the peak runoff.

The estimated increase in peak runoff due to project is provided in Table 10-10.

The overall estimated increase in the unmitigated peak runoff due to the wind farm is 0.483 m^3/s (or 0.16 %) for a 1 in 100 years storm event.

Pathway / Mechanism: Site drainage network.

Receptor: Waterbodies down gradient from the wind farm site. 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 is "**Not Significant**" on receiving waters because estimated increases in the peak runoff is low compared to the flows of receiving waters. This will have no impact on Blackwater River SAC (002179) as assessed in Chapter 8B Aquatic Ecology.

This is without taking account of mitigation measures that will be put in place to slow runoff down within the proposed wind farm drainage system.

Table 10-10: Unmitigated Increase in Surface Water Runoff

			Sub-basin Area	Construction Area	Overland	New tracks (5m wide)	Widening of existing tracks	Hardstanding, Compound and Substation Area	Turbine Foundation	Total Runoff (Area x runoff coeff.)	Rainfall Intensity	Run-off	Increase in Runoff	Increase in Runoff
	Catchment	**Scenario**	ha	ha	ha	ha	ha	ha	ha	ha	mm/hr	m^3/s	m^3/s	%
Croaghaun Wind Farm	Awboy_010	Existing	1457	0.00	0.00					**0.00**	37.2	0.00		
		Post Development			0.00	0.000	0.000	0.000	0.000	**0.00**	37.2	0.00		
		Increase in Run-off											**0.000**	**0.00**
	Laney_030	Existing	2366	1.02	1.02					**0.31**	37.2	0.03		
		Post Development			0.00	0.341	0.015	0.667	0.001	**0.46**	37.2	0.05		
		Increase in Run-off											**0.016**	**0.03**
	Laney_020	Existing	1649	1.66	1.66					**0.50**	37.2	0.05		
		Post Development			0.00	0.566	0.222	0.852	0.015	**0.75**	37.2	0.08		
		Increase in Run-off											**0.027**	**0.07**
	Owenbaun(Rathcool)_010	Existing	1433	0.00	0.00					**0.00**	37.2	0.00		
		Post Development			0.00	0.000	0.000	0.000	0.000	**0.00**	37.2	0.00		
		Increase in Run-off											**0.000**	**0.00**
	Laney_010	Existing	2104	21.79	21.79					**6.54**	37.2	0.68		
		Post Development			0.00	5.099	4.378	12.209	0.102	**9.86**	37.2	1.02		
		Increase in Run-off											**0.344**	**0.68**
	Rathcool_010	Existing	1647	0.04	0.04					**0.01**	37.2	0.00		
		Post Development			0.00	0.000	0.039	0.000	0.000	**0.02**	37.2	0.00		
		Increase in Run-off											**0.001**	**0.00**
	Nad_010	Existing	1667	4.99	4.99					**1.50**	37.2	0.15		
		Post Development			0.00	0.687	1.276	3.004	0.023	**2.26**	37.2	0.23		
		Increase in Run-off											**0.079**	**0.19**
	Glen(Banteer)_010	Existing	3098	1.09	1.09					**0.33**	37.2	0.03		
		Post Development			0.00	0.187	0.000	0.888	0.016	**0.50**	37.2	0.05		
		Increase in Run-off											**0.018**	**0.03**
												TOTAL INCREASE:	**0.483**	**0.16**

Notes: *Impervious factor for overland flow is 0.3. For tracks and hardstanding areas impervious factor of 0.45 is applied; for turbine foundation the runoff coefficient of 1.00 is applied.*

Rainfall Intensity for 1-in-100 year return period storm of 60 minutes duration supplied by Met Eireann.

Factor of 1.2 is applied to rainfall intensity for MRFS.

Q100 flow derived using the Modified Rational method Q=2.78 x (Rainfall Intensity) x (Contributing Impervious Area(factored).)

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.
- A blockage in the proposed roadside drains could allow a break out of silt laden runoff to reach adjacent watercourses or streams.
- Runoff from the borrow pit area could be silt laden, with the risk of draining into receiving watercourses, given the exposed nature of the borrow pit areas due to the excavation and haulage of stone from the area.
- 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 and borrow pits. Surface water inflows can occur following a rainfall event. Pumped water from the pits will most likely contain suspended solids.
- To accommodate the access to the locations of the proposed turbines, a total of 4 new crossings over the watercourses will be constructed as shown on Figure 10-5 and referenced as WF-HF4, WF-HF5, WF-HF6 and WF-HF9. During the construction there is a potential to release suspended solids into the watercourse. Works leading to erosion of the river banks/bed could result in the release of suspended solids.
- Two new crossings will be constructed adjacent to the existing fords as shown on Figure 10-5 and referenced as WF-HF9, WF-HF16. This will reduce the potential release of suspended solids from the tyres of the vehicles.
- Tree felling could lead to an increase in sediment in the surface water runoff, if the brash is left in place in the riparian buffer zones.

Pathway / Mechanism: Drainage and surface water discharge routes.

Receptor: Waterbodies down gradient from the wind farm site.

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, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Freshwater Pearl Mussel (FWPM) are known to be particularly sensitive to the presence of fine sediments.

The nearest downstream record for freshwater pearl mussel in the River Blackwater is approximately 14.7km from a proposed turbine base excavation, along the Glen River pathway. The impact on FWPM is discussed in Chapter 8B- Aquatic Ecological Assessment.

Inappropriate management of suspended solids will have the potential to deteriorate the water quality status of existing waterbodies listed in Table 10 3 which includes the Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8b Aquatic Ecology.

The significance of the effect of the release of suspended solids into the receiving waters is "**Significant**".

Release of Hydrocarbons

- Refueling activities could result in fuel spillages which could pollute underground 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 be drained to watercourses and pollute them.
- Two new 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 process require trafficking of heavy machinery which 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.

Hydrocarbon has a high toxicity to humans and all flora and fauna, 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 "**Slight**" due to the low likelihood and low quantities involved.

Contamination from Wastewater

- Sanitary waste could lead to contamination of receiving waters.

Pathway / Mechanism: Leakage from a storage tank or tanker, site drainage network and groundwater flow paths.

Receptor: Surface water and groundwater.

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

Release of effluent from domestic wastewater has the potential to impact surface water. Due to low permeability of the subsoils at the site, surface waters are more vulnerable to impact than groundwater.

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 10-5. The waste will be removed from site by a licensed waste disposal contractor on a regular basis.

Release of Cement-Based Products

Cement based product will be used in turbine foundations and will also be used for construction of bridge abutments at WF-HF4 Precast concrete structures (box culverts) will be used for new watercourse crossings WF-HF5, WF-HF6 and WF-HF9.

- Cement-based products could lead to contamination of receiving waters and groundwaters.

Pathway / Mechanism: Site drainage network.

Receptor: Surface water and groundwater

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

Cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) 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 it is unlikely that a huge amount of cement based products could be released into the environment. This will have a negative impact on water quality of the receiving watercourses which includes the Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8B Aquatic Ecology.

Impacts from Tree Felling

It is estimated that 70 ha in total of existing forestry will be felled to allow for development of the proposed wind farm infrastructure. The main potential impacts during tree felling process are release of sediments and nutrients in watercourses due to exposure of soil and subsoil following vehicle tracking, skidding and extraction methods. The release of nutrients in watercourses can come from the brash if not managed correctly during felling process. Brash is the term that's used generally in forestry – this refers to off cuttings including the wood and needles, but it is mainly the needles that have the most nutrients. Tree felling for this proposed development will be in small compartments or coupes within the forest areas.

Any fertiliser that was used in the past would have been either absorbed by the trees or washed off into watercourses years ago. The main risk of nutrient release would be from brash – this is a particularly big risk for sites with deep peat, but usually it is quite manageable through appropriate brash management. According to the EPA database, forestry is not a pressure within sub-catchments where tree felling is proposed.

Felling has the potential to impact adversely upon the environment if done in an uncontrolled manner; however, by the adoption of sound planning procedures, operating techniques and control measures as outlined in Section 10.7.1.6, this will considerably reduce any potential adverse environmental effects.

- Potential impacts related to suspended solids is addressed in Section 10.4.2.2
- Excessive haulage distances to roads, leading to site soil damage
- Rutting and compaction through the overuse of tracks
- Tree felling could lead to an increase in sediment and nutrients in the surface water runoff, if the brash is left in place in the riparian buffer zones. It's common sense that there's more likelihood of nutrient release into watercourses if the brash is adjacent to watercourses, but it all depends on the slopes and the underlying soil type (higher risk for peat).
- During clear felling there is a higher potential for nutrient loss as there are no living tree roots left to take up the nutrients. Any organic matter (particularly recently dead material such as brash or roots) that is left on site to rot will release phosphorus and nitrogen. Decaying brash resulting from the clearfell can generate nutrients which could potentially lead to nutrient enrichment of any small first order streams. The breakdown of brash, roots and other organic matter takes a number of years.

The significance of the nutrients is appraised below:

Pathway / Mechanism: Site drainage network and surface water discharge routes.

Receptor: Surface water.

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 have a negative impact on water quality of the receiving watercourses which includes the Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8b Aquatic Ecology.

Impacts from Biodiversity Enhancement and Management Plan Lands

The potential impacts associated with the BEMP comes from tree felling activities. It proposed to fell additional 18ha. Note, 70ha will be felled to accommodate wind farm construction. In total 88ha will be felled.

The main potential impacts during tree felling process are release of sediments and nutrients in watercourses due to exposure of soil and subsoil following vehicle tracking, skidding and extraction methods. The potential impacts are the same as discussed in Section 10.4.2.2, Section 10.4.2.3 and 10.4.2.6.

The significance of the nutrients is appraised below:

Pathway / Mechanism: Site drainage network and surface water discharge routes.

Receptor: Surface water.

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 have a negative impact on water quality of the receiving watercourses which includes the Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8b Aquatic Ecology.

The BEMP proposes to block any extant land drains in accordance with the advice of the project ecologist.

Pathway / Mechanism: Site drainage network.

Receptor: Surface water and groundwater.

Pre-mitigation Impact: Direct, Neutral, Long-Term, Likely.

The significance of the effect of blocking any extant land drains will have "**Imperceptible"** impact on hydrology and water quality, because the catchment area of these drains is small compared to the catchment area of the sub-catchments. No mitigation measures are proposed.

Livestock will be prevented from accessing natural watercourses by stock proof fencing. Livestock entering the watercourses can cause siltation, bank erosion and water pollution at watercourse drinking points.

Pathway / Mechanism: Site drainage network.

Receptor: Surface water and groundwater.

Pre-mitigation Impact: Indirect, Positive, Long-Term, Likely.

The significance of the effect of preventing livestock entering the watercourse will have '**Slight'** positive impact on water quality of the local watercourses because local siltation and bank erosion will be prevented. No mitigation measures are proposed.

10.4.3 Potential Impacts Associated with Construction of Grid Connection

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 associated with HDD works could pollute watercourse.
- Sediment laden runoff during the launch pit and reception pit excavation works.

The potential impacts can be broken down into two groups and are detailed below.

Suspended Solids

Pathway / Mechanism: Surface water discharge routes.

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

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

These 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 and fish stocks of downstream water bodies.

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 very small (50m).Therefore, the quantities that can get into the receiving water are small as well.

Hydrocarbons

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.

Hydrocarbon has a high toxicity to humans and all flora and fauna, 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 "**Slight**" due to the low likelihood and low quantities involved. There is no hydrological connectivity between the grid connection and Blackwater River (Cork/Waterford) SAC..

10.4.4 Potential Impacts Associated with Turbine Delivery Route Works

Modifications along the TDR involves the temporary removal of street furniture and removal of some vegetation in addition to the temporary local widening at bends using hardcore material. Each of the locations have been assessed considering location and nature of the works, proximity to existing watercourses and potential impacts on hydrology and water quality. Following the assessment, no significant impacts have been identified for temporary accommodation works described in Chapter 3.

The most significant works associated with TDR in terms potential hydrological impacts will take place at POI-36 and POI-44.

TDR temporary accommodation areas are identified in Figure 3.5.

Potential Impacts – POI-36

A temporary hardstanding area is proposed at location POI-36. The area of hardstanding is 200m by 50m. At this location, turbine blades travelling from the port of entry will be transferred using cranes from flat, extendible carrier trailers, onto blade lifting trailers for the remainder of the route. The purpose of this is to minimise the amount of temporary accommodation works required between Millstreet and the site.

The area of hardstanding is 1.0ha. The estimated increase in runoff due to installation of temporary hardstanding areas is 0.017 m3/s for 1 in 100 years storm event. This storm event is rare, and it has a momentary effect, therefore the estimated increase in runoff is not significant on hydrology and water quality.

The estimate increase in the runoff is calculated using Rational Equation. The following parameters are applied:

- Pre-development runoff coefficient: 0.3 (grassland surface)
- Post development runoff coefficient: 0.5 (stone surface)
- Rainfall intensity: 30mm/h

The estimated increase in runoff due to installation of temporary hardstanding areas is negligible. The temporary hardstanding area will be constructed from permeable material. This will allow surface water to permeate to the soil below.

There is also potential oil leakage from the machinery used in transferring the blades. No significant earthworks are required to accommodate for the hardstanding area. The potential suspended solids running from the hardstanding area will be dispersed over the field located downslope of the hardstanding area. During the site inspection no open drains were identified that could act as a conduit for suspended solids. The closest waterbody is the Drishane More Stream located approximately 320m north of the hardstanding area. Due to the distance to the stream, no local drains directly discharging into it and no significant earthworks required, the risk of releasing the suspends solids in the watercourse is negligible.

Pathway / Mechanism: Surface water flow paths and road drainage.

Receptor: Waterbodies downgradient from POI-36.

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

The quantities of oil leakage would be low, and the closest waterbody is approximately 400m from POI-36. There are no open drains adjacent to the hardstanding area which could act as a pathway to the waterbody. The potential oil leakage would infiltrate underground through the hardstanding area. Therefore, the significance of the effect of the release of the hydrocarbons into the receiving waters is "**Not Significant**".

Potential Impacts – POI-44

Ground reprofiling and placement of load bearing surface (stone) will be required at POI-44 (details in Chapter 3 and 13). Inappropriate storage and management of excavated material could result in releasing of the suspended solids into the River Owenbaun (Rathcool) which forms Blackwater River (Cork/Waterford) SAC.

This can result in increased turbidity which in turn could affect the water quality. The River Owenbaun (Rathcool) is located 30m east of the POI-44.

Pathway / Mechanism: Surface water flow paths and road drainage.

Receptor: River Owenbaun (Rathcool), located 30m from POI-44.

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

The local road L1123 has a gentle slope towards the bridge over the River Owenbaun (Rathcool). No drainage network was identified during the site inspection with field runoff appearing to percolate towards the public road along its northern boundary which is raised above the existing road level and is bounded by a hedgerow. The surface runoff from the local road travels in sheet-flows across the carriageway surface in a north-easterly direction towards the River Owenbaun (Rathcool), discharging to vegetated verges on the north boundary of the public road.

Due to the proposed earthwork activities at POI44, small quantities of suspended solids could be transported into the River Owenbaun (Rathcool) during high rainfall conditions if no mitigation measures are applied.

The significance of the effect of the release of the suspended solids into the receiving waters is "**Slight**".

There is a potential oil leakage from the machinery used in earth works.

Pathway / Mechanism: Surface water flow paths and road drainage.

Receptor: River Owenbaun (Rathcool), located approximately 30m from POI-44.

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

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

10.4.5 Potential Impacts During Operation and Maintenance

Due to the grassing over of the drainage swales and revegetation of other exposed surfaces, and the non-intrusive nature of operations, there is a negligible risk of sediment release to the watercourses during the operational stage. The proposed drainage used during the construction stage will be used during the operation stage as well, besides the settlement ponds which will be filled in upon the completion of the construction stage.

During the operation stage, small quantities of oil will be used in cooling the transformers associated with the facility. There is therefore a potential for small oil spills.

Spills of any oil or fuels (hydrocarbons) from site vehicles onto access tracks may leach to adjacent watercourses. However, this is unlikely to be a significant impact considering the low volumes of vehicular traffic involved in typical wind farm operations.

It is not envisaged that the operation period will involve significant impacts on the water quality of the receiving watercourses which includes Blackwater River (Cork/Waterford) SAC. as assessed in Chapter 8b Aquatic Ecology.

10.4.6 Potential Impact During Decommissioning

In the event of decommissioning, activities will take place in a similar fashion to the construction phase. Potential impacts will be similar to the construction phase but to a lesser degree.

Any such potential impacts would be likely to be less than during the construction stage as the drainage swales would be fully mature and would provide additional filtration of runoff.

The decommissioning phase is described in Chapter 3 of this EIAR.

For access tracks and turbine foundations it is proposed that they are left in place. Access tracks will continue to be used for recreation, forestry and agriculture. Turbine hardstandings will be covered over with topsoil previously stripped and used for landscaping purposes during the construction stage and left to revegetate naturally.

Removal of turbine foundations infrastructure would result in considerable disruption to the local environment in terms of an increased possibility of sedimentation. It is considered that leaving the turbine foundations hardstanding areas in-situ will cause less environmental damage than removing them.

The recreational trails and associated signage shall be left in situ.

The temporary accommodation works along the TDR will not be required for the decommissioning phase as turbine components can be dismantled on site and removed using standard HGVs.

Grid connection infrastructure including the on-site substation and ancillary electrical equipment shall form part of the national grid and will be left in situ

No decommissioning activities are envisaged for the Biodiversity Enhancement and Management Plan lands.

10.5 Flood Risk Assessment

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

- Wind farm site
- Grid connection
- Turbine delivery route
- Biodiversity Enhancement and Management Plan Lands

10.5.1 Methodology

Wind Farm Site

As discussed in Section 10.4.2 the unmitigated increase in peak runoff due to construction of the wind farm site is 0.483 m^3/s for 1% AEP event. The increase in runoff will increase the risk of flooding if additional volumes are not retained. The flood risk can also increase if the time of concentration is reduced. The proposed drainage system will provide a greater time of concentration. Time of concentration (Tc) is time required for an entire catchment to contribute to runoff at the point of interest. This time is calculated as the time for runoff to flow from the most hydraulically remote point of the drainage area to the point under investigation.

Section 10.5.3 below compares the predicted increase in runoff with the increase in surface water storage provided by the proposed swales.

The proposed wind farm will have a drainage system in place to mitigate the potential risk of flooding at the wind farm and downstream of it. The key findings are presented herein.

Grid connection

There are no recorded flood incidents or recurring flooding along the grid connection or in 2km buffer zone. According to the PFRA flood mapping, the grid connection crosses Flood Zone A at the location GCR – WCC5, GCR – WCC7, GCR-WCC8 and GCR – WCC9. No increase is expected in runoff due to grid connection installation. This is because the finished surfaces are not changed. The increase in the flood risk is not expected because the finished surfaces are not changed. The installation of grid cables will not reduce the flood plain capacity.

Therefore, there is no increase in the flood risk due to grid connection.

Turbine Delivery Route

The general locations of accommodation work along TDR are shown in Figure 3.5 Minor works such as vegetation trimming, tree removal, placement of temporary load bearing surface are not expected to increase the risk of flooding.

The most significant accommodation works from a hydrological point of view will be required at POI-36 and POI-44. Location of POIs is shown on Figure 3.3. At POI-36 a 1 ha temporary hardstanding area will be constructed from permeable material. This will allow surface water to permeate to the soil below. At POI-44 a ground reprofiling will be required. There will be no changes to the finished surfaces. The surface runoff will be able to percolate as prior to the proposed works.

Therefore, there is no increase in the flood risk due to TDR.

Biodiversity Enhancement and Management Plan Lands

Tree felling (Wildlife corridors)

It is proposed to clear 18ha of Coillte lands to provide enhanced ecological connectivity between large areas of open upland habitats. The felling area is dispersed over four sub-basins.

The area of proposed felling is small relative to the overall area of sub-basin and peat dams will be installed to increase time of concentration, which will consequently reduce the peak runoff. Thus, no significant increase in the rate of runoff is anticipated as a result of tree felling.

Anthony Kellar's Lands

Erection of bird and bat nest boxes, and bat roost will have no impact on the flood risk. It is proposed to maintain the existing grasslands. This includes hedgerow and tree planting. This will increase the time of concentration of the surface runoff which will reduce the peak runoff. The blocking of a local drain will not have a not significant positive impact on the flood risk within or downstream of Kellar's Lands.

Noel Nunan's Lands

Erection of bird and bat nest boxes, and bat roost will have no impact on the flood risk. It is proposed to maintain the existing grasslands. This includes hedgerow and tree planting. This will increase the time of concentration of the surface runoff which will reduce the peak runoff. This will have a not significant positive impact on the flood risk within or downstream of Nunan's Lands.

James Scannell's Lands

Erection of bird and bat nest boxes, and bat roost will have no impact on the flood risk. It is proposed to maintain the existing grasslands. This includes hedgerow planting. This will have a negligible increase in the time of concentration. Thus, there is no increase on the flood risk within, or downstream of the lands.

Joseph Barrett's Lands

The same is applied as for Scannell's lands. Thus, there is no increase on the flood risk within, or downstream of the lands.

10.5.2 Flood Risk Identification

The OPW has produced indicative flood mapping to assist in a preliminary flood risk assessment (PFRA).[12] The PFRA mapping was prepared as part of the high-level screening exercise to identify areas for further assessment under the Catchment Flood Risk Assessment and Management (CFRAM) Programme.

According to PFRA flood mapping all the proposed turbines, hardstanding areas and on site substation are within 'Flood Zone C', -Low risk of flooding (less than 0.1%).

Essential Infrastructure is defined in Table 3.1 of The Planning System and Flood Risk Management Guidelines for Planning Authorities, OPW, November 2009, as 'Primary transport and utilities distribution, including electricity generating power stations and substations, water and sewage treatment, and potential significant sources of pollution (SEVESO site, IPPC sites, etc.) in the event of flooding'.

[12] http://www.floodinfo.ie/map/floodmaps/

The proposed substation in this project therefore comes under the category of 'Essential Infrastructure'.

The proposed substation is located in Flood Zone C as shown on Figure 10-3.

The proposed access road between turbines T1 and T11, T9 and T10, T10 and T11, will cross an area indicated as being in Flood Zone A as shown on Figure 103. The crossing structures is designed to cater for flows associated with 1 in 100 year storm event (1%AEP, Annual Exceedance Probability) with 20% climate change allowance. The soffit level will be at least 300mm above the flood level associated with 1% AEP storm event as required by the OPW.

Details on the proposed crossing structures are provided in Section 10.5.4.

No significant pluvial flood zones are mapped within the wind farm site, as would be expected in mountainous terrain with sloping topography.

10.5.3 Flood Risk Assessment

The key mitigation of the wind farm site is to ensure all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to discharge. As such, the mechanism by which potential downstream flooding is prevented and controlled is through avoidance by design. The proposed drainage attenuation measures are outlined in Section 10.6.

In Section 10.4.2 it was estimated that the increase in peak runoff for 1 in 100 years storm event is 0.483 m^3/s (0.16%) due to construction of all new hardstanding areas, on-site substation, new roads and the widening of the existing road. For 1% AEP storm event with 6h storm duration, approximately additional 5221 m^3 will runoff from the main wind farm site.

$$V_{additional\ discharge}=\text{Increase in Flow x Duration} =0.5 \times 0.483 m^3/s \times 6 \times 3600s = 5221\ m^3$$

Approximately 13.7 km new road will be constructed, and 11.8 km of existing roads will be upgraded. This gives in total 25.5 km of swales. The swales will be 0.3 m deep with a bottom width of 0.5 m and side slope of 1 in 3. For this exercise it was assumed that the swales will be at 75% capacity for 1%AEP storm event. This is to simplify calculations due to swales being constructed at different slopes across the site. Check dams will be used to provide a storage capacity at swales located at slopes greater than 2% as guided by CIRIA The SuDS Manual.

Total potential storage volume of swales is 6740 m^3.

$$V_{swale} = \text{Length x Area} = 25.5\ km \times 0.26\ m^2 = 6740\ m^3$$

For the analysed 1-in-100 year storm event approximately additional 5221 m^3 will be discharged due to the presence of the wind farm. Swale storage capacity is 6740 m^3. It is concluded that swales have sufficient capacity to retain the additional volume of surface water flow generated due to the wind farm site and that the wind farm site does not increase the flood risk on the wind farm site and downstream of it.

10.5.4 Design of Watercourse Crossings relating to Flood Risk Assessment

A design of 5 new crossing structures is provided below. The Flood Index is estimated using Flood Studies Update for small catchment equation which is based on the catchment descriptors. The catchment descriptors are provided from the FSU Web Portal. A growth curve of 1.96 for 1%AEP is applied. The estimated flow is increased for 20% to allow for the climate change expectation (MRFS – mid range future scenario).

Prior to the commencement of the construction stage, a Section 50 application for consent from the Commissioners of Public Works will be made to the OPW for the replacement of this existing bridge and new crossing structures listed in Table 10-11.

This exercise has been carried out to provide a sizing of the proposed crossing structures. At hydrology features WF-HF4 and WF-HF8 a single span bridge and at WF-HF5, WF-HF6 and WF-HF9 a pre-cast box culvert is proposed and agreed with the IFI representative during the site meeting.

Details of crossing structures are provided in Table 10-11.

In this exercise water depth in the watercourse was determined in software Pipe Flow Advisor using Manning's equation. Channel dimensions were taken during the site visit. To determine the exact water depth an on-site survey and hydraulic modelling is required. This will be required for a Section 50 consent.

The width of the River Laney is approximately 4.5m at the hydrology feature WF-HF4, and the height is approximately 1.5m. Water depth in the river for 1%AEP event is approximately 1330mm. There is no overtopping at this location. A single span bridge is suitable at this location.

At locations WF-HF5 and WF-HF6 a pre-cast box culvert is proposed. The width of the West Ballynagree Stream is approximately 1.6m at the hydrology feature WF-HF5, and the height is approximately 0.6m The width of the River Laney is approximately 2.1m wide at the hydrology feature WF-HF6, and the height is approximately 0.7m.The proposed culverts will be embedded 500mm into the riverbed as instructed by the OPW presentative during the site meeting The crossings are designed to convey 1%AEP event with a minimum 300mm freeboard elevation. Water depth for 1%AEP at location WF-HF5 and WF-HF6 is approximately 286mm and 680mm respectively.

At location WF-HF8 it is proposed to replace an existing stone bridge with a single span bridge. The peak flow at this location was estimated to be 0.64 m^3/s for 1%AEP MRFS. The unnamed stream at this location is 2.5m wide and the road is approximately 2.2m above the riverbed. Water depth for 1% MRFS event is calculated to be 0.22m. Based on that it is concluded that the proposed crossing structure is significantly above the flood level and that detailed hydraulic analysis is not required.

The width of the Unnamed Stream is approximately 2.0m at the hydrology feature WF-HF9, and the height is approximately 1.5m. Water depth in the river for 1%AEP event is approximately 977mm. There is no overtopping at this location. A pre-cast box culvert is proposed at this location. The proposed culvert will be embedded 500mm.

Table 10-11: Sizing of Crossing Structures

ID	Catchment Area (km^2)	1%AEP (m^3/s)	1%AEP MRFS (m^3/s)	Proposed Structure
WF-HF4	9.79	10.80	12.96	Single span bridge
WF-HF5	0.54	0.99	1.19	Pre-cast box culvert – 2000mm x 1100mm
WF-HF6	3.20	4.61	5.53	Pre-cast box culvert – 2500mm x 1700mm
WF-HF8	0.43	0.19	0.64	Single span bridge
WF-HF9	2.31	2.88	3.46	Pre-cast box culvert – 2000 x 1700mm

10.5.5 Summary of Flood Risk Assessment

The impact of the flood risk is based on comparing volumes generated due to changes in surface and potential storage volume in swales constructed as part of a drainage system.

It was estimated that for 1%AEP storm event with storm duration of 6h, the approximately additional 5221 m^3 would be generated due to changes in the surfaces. Approximately 13.7 km new road will be constructed, and 11.8 km of existing roads will be upgraded. This is in total of 25.5 km of swales, which gives a potential volume storage of 6740 m3.

Swales have enough capacity to retain additional volumes generated due to the construction of the main wind farm site. A flood risk assessment concludes that the wind farm site will not have a negative impact on flooding risk in the surrounding area.

There is no increase to the flood risk due to grid connection and TDR.

10.6 Proposed Drainage

The proposed drainage for the site has been designed based on the potential impacts, discussed in Section 10.4 and it has also been addressed by the flood risk assessment undertaken in Section 10.5. In addition to draining the development, the drainage design has the capacity to introduce hydrological links from the proposed development to the receiving environment.

An appropriate drainage design is the primary mitigation measure for the protection of waterbodies, incorporating silt protection infrastructure and control measures to reduce the rate of surface water runoff from the wind farm site.

The mitigation measures that follow in Section 10.7 refer to the drainage design and also include other best practice measures to mitigate any potential impacts from the development.

The proposed layout of the drainage for the development is shown in the Planning Drawings Series- 0100. Where possible, existing access roads and tracks have been utilised in the layout design for the proposed development to minimise the disturbance to soils.

The following types of surfaces are considered on this site in addressing the drainage for the proposed development:

1) existing hardcore tracks and surfaced access roads.
2) proposed new site access tracks and hard standings.
3) proposed on-site substation compound.
4) temporary site compounds.
5) borrow pits.

10.6.1 Interceptor Drains

It is not expected that overland flows will be obstructed to any great extent by the drainage layout, because where required, interceptor drains will collect overland flows on the upslope side of the access tracks and hardstanding areas. Collected water will be carried under wind farm infrastructures by cross drains at regular intervals to ensure the original hillside flow is not impeded. The maximum distance between the cross drains is 250m. The overland flow will then discharge diffusely on the downslope side over vegetated areas within the site boundary.

This SuDS design approach will ensure that existing drainage patterns will be maintained throughout the site.

10.6.2 Existing Hardcore Tracks and Surfaced Access Roads

The drainage system for the existing tracks and roads will largely be retained. During the site walkover it was observed that most of the existing tracks were between 3-5 m wide. It is proposed to widen approximately 11.8 km of existing roads by 1 m to achieve 5m width with some additional widening at bends as shown on the accompanying planning application drawings. All track widening will be undertaken using clean uncrushable stone of suitable size with a minimum of fines. This will involve slight relocation of existing roadside drains (swales) to allow widening. Swales will be connected to settlement ponds at the end of the swale.

Settlement ponds will discharge treated water overland via a diffuse outfall which will minimise any risk of soil erosion and allow further filtration of any remaining sediment particles. This treated water will ultimately percolate underground or travel overground and be assimilated into the existing drainage network. There will be no direct discharges from the wind farm to any existing natural watercourse.

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 allowing the water to outfall to the receiving environment. The settlement ponds will remain in place during construction phase. They will be filled in and the swales that were connected to them will be re-connected to the outfall once construction is completed.

The existing forestry track between proposed turbines T18 and T20 is a floating road. It is proposed to install swales and interceptor drains on either side. Details on swales are provided in Section 10.6.3 and Appendix 10.2.

The access road at the northern part of the site which runs through Boggeragh Mountains NHA does not require road widening. The existing road is drained via a drainage ditch which is appropriate and does not require any upgrade. The wind farm collector circuit cable will be buried within this road before it exits the site onto the public road. The entirety of the associated works will be contained within the footprint of the existing road. The trench will be backfilled with suitable imported material and reinstated to match the existing road surface. When the trench is backfilled, the existing road surface will be improved by way of a layer of compacted stone which will match the existing surface aggregate.

Silt traps comprising a geotextile filter fabric will be placed in the new roadside swales. The geotextile will be weighed down on the upstream side with clean filter stone to provide further filtration and stability to the silt trap.

10.6.3 New Site Access Tracks and Hard Surfaces

It is proposed to construct approximately 13.7 km of completely new access track. Proposed new tracks and turbine hard standing areas will be drained via roadside swales and interceptor drains. Roadside swales will be connected to settlement ponds at the end of the swale. Settlement ponds will discharge treated water overland via a diffuse outfall.

These grassed swales will serve to detain flow and reduce the velocities of surface water flows. The swales will be 0.3 m deep with a bottom width of 0.5 m and side slope of 1 in 3. The swales will be constructed in accordance with CIRIA C698 Site Handbook for the Construction of SuDS.

Where roadside drains are laid at slopes greater than 2% check dams will be required in the swales to slow down the velocities of flows and prevent erosion occurring, as shown in Appendix 10.2 they will also help to retain water in the swale. This will reduce effective slope and runoff velocities and any consequent potential for erosion.

Site drainage, including silt traps and settlement ponds, will be put in place in parallel with construction, such that excavation for new infrastructure will have functional drainage system in place. The settlement ponds will remain in place during construction phase. The settlement ponds will drain diffusely overland, over existing vegetated areas, within the site boundary. The settlement ponds will be backfilled and the swales that were connected to them will be re-connected to the pond outfall once construction is completed.

The proposed locations of the settlement ponds are] shown on Planning Drawings Series- 0100.

Silt fencing will be provided at strategic locations to further protect watercourses during the construction phase. This is detailed in the SWMP contained in Appendix 10.2.

10.6.4 Proposed and Existing Watercourse Crossings

The proposed wind farm site layout will have 4 new crossings over the streams and rivers. The existing and new crossings are listed in Table 10-12 and shown on Figure 10-5.

There will be four new crossings, two over the River Laney, one over the West Ballynagree Stream and one over the Unnamed Stream (tributary of the Laney River). Two new crossing structures will be constructed to avoid usage of existing fords which are currently being used by vehicles associated with forestry and agricultural activities within the site. Following construction of the project, these fords will no longer need to be used by vehicles associated with agricultural and forestry activities.

The size of the stream crossings is outlined as part of the flood risk assessment. A summary of the culvert sizing is provided in Section 10.5.4. New crossings are designed to convey 1%AEP MRFS storm event with minimum 300mm freeboard level.

A Section 50 application will be required to obtain the consent of the OPW for the construction of the crossings. The IFI were consulted at the planning stage and were consulted in the design of the proposed crossing structures.

The method of crossing ducts over the watercourses is also proposed for each crossing location as listed in Table 10-12. Suitable method of crossing is based on the type of the crossing structure and cover level. For crossing structures with insufficient cover level, ducts will be installed under the structure.

Table 10-12: Existing and Proposed Hydrology Features

Feature ID	Existing / Proposed	Feature /activity	Proposed Method of Crossing
WF-HF1	Existing	Cross drain under existing road, 450mm dia. pipe	Existing access track to be upgraded above pipe drain.
WF-HF2	Existing	Forestry pipe drain, 450mm dia pipe	Existing access track to be upgraded above pipe drain. Cable ducts installed below existing pipe drain by standard trenching methods.
WF-HF3	Existing	Cross drain under existing road, 450mm dia. pipe	Existing access track to be upgraded above pipe drain. Cable ducts installed below existing pipe drain by standard trenching methods.
WF-HF4	Proposed	Single span bridge over the Laney River	New access track. Cable ducts to be incorporated into proposed pre-cast concrete structure.
WF-HF5	Proposed	Pre-cast box culvert over the West Ballinagree Stream	New access track. Cable ducts installed above proposed pre-cast concrete box culvert.
WF-HF6	Proposed	Pre-cast box culvert over the Laney River	New access track. Cable ducts installed above proposed pre-cast concrete box culvert.
WF-HF7	Existing	Pipe culvert, 1000mm dia. over the West Ballinagree Stream	Existing access track. Cable ducts not required at this crossing

Feature ID	Existing / Proposed	Feature /activity	Proposed Method of Crossing
WF-HF8	Existing	Existing bridge to be replaced by single span bridge.	Local road. Cable ducts to be incorporated into proposed pre-cast concrete structure.
WF-HF9	Proposed	Pre-cast box culvert over the Unnamed Stream	New access track. Cable ducts installed above proposed pre-cast concrete box culvert.
WF-HF10	Existing	Cross drain under existing road, 450mm dia. pipe	Existing access track. No upgrades required. Cable ducts installed below existing pipe drain by standard trenching methods.
WF-HF11	Existing	Cross drain under existing road, 450mm dia. pipe	Existing access track. No upgrades required. Cable ducts installed below existing pipe drain by standard trenching methods.
WF-HF12	Existing	Cross drain under existing road, 450mm dia. pipe	Existing access track to be upgraded above pipe drain. Cable ducts installed below existing pipe drain by standard trenching methods.
WF-HF13	Existing	Cross drain under existing road, 450mm dia. pipe	Existing access track to be upgraded above pipe drain. Cable ducts installed below existing pipe drain by standard trenching methods.
WF-HF14	Existing	Cross drain under existing road, 450mm dia. pipe	Existing access track to be upgraded above pipe drain. Cable ducts installed below existing pipe drain by standard trenching methods.
WF-HF15	Existing	Cross drain under existing road, 450mm dia. pipe	Existing access track to be upgraded above pipe drain. Cable ducts installed below existing pipe drain by standard trenching methods.

No works are proposed to existing watercourse crossings with the exception of WF-HF8 which will comprise the replacement of an existing bridge with a single span bridge. Cable ducts associated with the wind farm internal collector circuit will be built into the bridge deck, which will be pre-fabricated off site.

As per table above manmade agricultural and forest drains will be crossed using 450mm diameter pipes. Where new cross drains are to be provided to convey the drainage across the track, the minimum sizes of these cross drains will be 300 mm diameter pipes, and the maximum size will be 600 mm diameter pipes. The location of cross drains is shown on the Planning Drawings Series- 0100.

Silt Protection Controls (SPCs) are proposed at the location of the drain crossings. It is recommended that the SPCs will consist of a minimum of silt traps containing filter stone and filter material staked across the width of the swales and upstream of the outfall to any watercourse. Silt traps will be maintained throughout the construction stage, ensuring that they are clear of sediment build-up and are not severely eroded. Any excess build-up of silt levels at silt traps, dams , the settlement ponds will be removed.

10.6.5 Drainage of On-site Substation

It is proposed to drain the substation using shallow swales, with a settlement pond at the end of the swale run. The settlement pond will remain in place following the construction period.

At the upslope side of the substation, interceptor drains will be installed.

The runoff from roofs will be collected to water harvesting tanks. A foul system is proposed within the station to cater for the wastewater generated in the welfare facilities of the control building. The foul system will consist of an underground pipe network, foul manholes and an 18m3 full retention foul effluent storage tank. The tank will have an associated high level alarm which will be connected to the control building. A foul holding tank to be maintained and emptied bi-annually is the most preferable means of treating and disposing of foul waste from the site. The licensed contractor charged to empty and dispose of the waste will be the holder of a valid waste collection permit. More details are provided in the SWMP contained in Appendix 10.2.

A suitable permanent petrol and oil interceptor will be installed to deal with substation surface water drainage. Details on petrol and oil interceptor unit is provided in SWMP contained in Appendix 10.2.

10.6.6 Drainage of Temporary Site Compound

The site layout includes two temporary site compounds. The compound is set back from the drains.
Drains around the hardstanding areas of the site compound will be in the form of shallow grassed swales to minimise the disturbance to sub-soils.

Surface water runoff from the compound will be directed through a Class 1 Full Retention Oil Interceptor before discharge to water drainage system for the site. This drain flows to a settlement pond before final discharge over land via a diffuse outfall. More details are provided in SWMP contained in Appendix 10.2.

During the construction phase, it will be necessary to provide bottled water for potable supply for the construction personnel. A water tanker will supply water used for other purposes.

Portaloo and/or containerised toilets and welfare units with storage tanks will be used to provide toilet facilities for site personnel during construction.

All portaloo units located on site during the construction phase will be operated and maintained in accordance with the manufacturer's instructions and will be serviced under contract with the supplier. All such units will be removed off-site following completion of the construction phase.

The southern compound (north of T12) will be downsized and used as a gravel surfaced car park for the recreational trails during operational phase. It is proposed to construct a french-drain around the footprint of the car park area with a diffuse outfall at the downslope side of the car park.

10.6.7 Drainage of Borrow Pits

The borrow pit is set back a minimum 50m from streams. At the upslope of the borrow pit an interceptor drain will be installed. It is proposed to drain the borrow pit to settlement ponds.

The site drainage system will be put in place prior to excavation, therefore the discharge routes from any temporary stockpiling will be via the site drainage system as detailed in the planning drawings. There will be no permanent stockpiling of material on the site.

10.7 Mitigation Measures and Residual Impacts

Proposed drainage measures to reduce, and protect the receiving waters from, potential impacts during the construction of the proposed development are as outlined in Section 10.6. These include measures to prevent runoff erosion from vulnerable areas and consequent sediment release into the nearby watercourses to which the proposed development site drains. This section provides proposed mitigation measures and evaluate the significance of residual impacts. As discussed in Section 10.4., the construction of the wind farm has potential to have a negative impact on water quality status if appropriate mitigation measures are not applied.

10.7.1 Proposed Mitigation Measures During Construction

Increase in Surface Runoff

Permanent roadside drainage will be installed as part of the construction stage. This will include the use of interceptor drains, swales, check dams and settlement ponds. These measures will buffer site runoff during periods of high rainfall by retaining the water until the hyetograph has receded. A hyetograph is a graphical representation of the distribution of rainfall intensity over time.

In Section 10.5.3 it was calculated that the proposed drainage network has enough capacity to retain volumes generated from the construction of the wind farm site.

Post-mitigation Impact (residual impact): Neutral, Direct, Negligible, Reversible, Likely.

Not significant residual impacts on local or downstream hydrology are anticipated, which included Blackwater River (Cork/Waterford) SAC. As demonstrated in 10.5. the proposed drainage has enough capacity to retain all volumes generated due to the construction of the wind farm site.

Suspended Solids

The key mitigation measure during the construction phase is locating the proposed turbines 75m from the watercourse. No construction activities or drainage will be within 50m of the watercourses, with an exception for watercourse crossings. The proposed buffer zones will:

- Avoid physical damage to watercourses, and associated release of sediment.
- Avoid excavations within close proximity to surface water courses.
- Minimise the potential for the entry of suspended sediment from earthworks into watercourses.
- Minimise the potential for the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

The following measures shall be implemented during the construction phase:

- Settlement ponds with a diffuse outflow detail will be put in place as construction progresses across the site. Erosion control and retention facilities, including settlement ponds will be regularly maintained during the construction phase by Environmental Clerk Of Works (ECOW). The three-stage treatment train (swale – settlement pond – diffuse outflow) proposed to retain and treat the discharges from hard surface areas as a result of the development will reduce any risk of flooding downstream.
- The developer will ensure that erosion control, namely silt-traps, silt fencing, swales are visually checked on a weekly basis and following a heavy rainfall event during the construction phase. Heavy rainfall event is defined as:
    - >10 mm/hr (high intensity local rainfall events).
    - >25 mm in a 24 hour period (heavy frontal rainfall lasting most of the day).
    - >half monthly average rainfall in any 7 days.
- Settlement pond will be daily visually checked by ECOW.
- A water quality monitoring programme will be established to ensure that water quality is maintained throughout the construction phase. The details of this programme are outlined below. This programme will ensure that designed measures including settlement ponds are working, and existing water quality is maintained.
- Where haul roads pass close to watercourses, silt fencing will be used to protect the streams.
- Silt traps (detailed in CEMP) will also be provided at outfalls from roadside swales to settlement ponds.
- Interceptor cut-off drains will be provided on the upslope side of the access roads to prevent the mixing of overland flows with the drainage for the proposed development. These interceptor drains will cross access roads via cross drains and discharge diffusely over land to avoid concentration of runoff. The roadside drains will therefore only carry the site access road runoff and so avoid carrying large volumes of water and concentrating flows.
- Interceptor cut-off drains will be provided around borrow pits to divert overland flow to the nearest watercourse and prevent it from entering the borrow pits.
- Where new cross-drains are proposed on this site to convey surface water from roadside swales to settlement ponds, these will be sized at a minimum of 300 mm diameter to avoid blockages.
- Cross drains of 450 mm will be provided to prevent a risk of clogging for drainage crossings and conveying flow from agricultural drains and forestry drains under access track roads due to the potentially bigger debris potentially being drained from agricultural and forestry area.
- Standing water, which could arise in excavations, has the potential to contain an increased concentration of suspended solids as a result of the disturbance to soils. The excavations for turbines will be pumped into the site drainage system (including settlement ponds), which will be constructed at site clearance stage, in advance of excavations for the turbine bases.
- All open water bodies adjacent to proposed construction areas will be protected by fencing including the proposed settlement ponds.
- Excavated subsoil material not required for in-site reinstatement will be removed to the designated material storage areas at the borrow pit location.
- Silt fencing will be erected at the locations of the drain crossings for the duration of the construction period.

- Site access tracks have been laid out to reduce longitudinal slope of roadside drains where possible. Where roadside drains are laid at slopes greater than 2%, check damns will be provided. This will reduce effective slope and runoff velocities and any consequent potential for erosion.
- Silt fencing will be erected at the location of stream crossings along the grid connection. Details regarding maintenance are provided in the CEMP.
- The temporary storage of excavated material on site will be put at least 50 m from watercourses and therefore outside the 50m buffer zone. Silt fencing will be erected at the locations of the piles for the duration of the construction period. This is to prevent the runoff flushing sediments into a watercourse.
- An ECOW will be appointed by the developer to ensure the effective operation and maintenance of drainage and other mitigation measures during the construction process. The operations management of the Site will include daily monitoring operation of settlement ponds, and of the drainage system and maintenance as required.
- Additional protection will be provided in the form of silt fencing downslope during construction of new watercourse crossings, to further ensure that there is no impact from the development to streams and rivers downslope of the site. All open water bodies adjacent to proposed construction areas will be protected by silt fencing.
- Daily visual inspections of drains and streams will be performed during the construction period of the new crossing structures to ensure suspended solids are not entering the streams and rivers alongside the work area, to identify any obstructions to channels, and to allow for appropriate maintenance of the existing roadside drainage regime.
- Weather warnings will be monitored, and no construction will take place during extreme events. Large excavations and movements of subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast. Works will be suspended if forecasting suggests either of the following is likely to occur:
    - >10 mm/hr (high intensity local rainfall events).
    - >25 mm in a 24 hour period (heavy frontal rainfall lasting most of the day).
    - >half monthly average rainfall in any 7 days.

Water Quality Monitoring Programme

A monitoring programme will be established to ensure that water quality is maintained. The details of this programme are outlined below. This programme will ensure that designed measures are working, and water quality is not affected.

An ECOW will be on-site during construction to monitor water quality. Turbidity meters will be installed prior to construction upstream and downstream of the site. Levels of turbidity will be monitored prior to construction to determine pre-construction levels in the waterbodies. A visual check of turbidity of watercourses will be carried out daily during construction. Should the turbidity levels measured during construction be higher than the existing levels or daily visual inspection show high level of turbidity, construction will be stopped, and remediation measures will be put in place immediately. Emergency procedures are provided in Appendix 10.2.

Water samples will be taken weekly during ground disturbance works and will include measurement of the parameters provided in Table 10-11 below.

Table 10-13: Surface Water Quality Monitoring Parameters

Parameter	Maximum Value	Regulation
Turbidity	-	-
pH	6.0 < pH < 9.0	Surface Water Regulations 2009
BOD	High Status < 1.3 (mean) or <2.2 (95%ile) Good Status <1.5 (mean) or < 2.6 (95%ile)	Surface Water Regulations 2009
Total Suspended Solids (mg/l)	<25	Salmonid Water Regulations 1988
Total Ammonia (mg/l N)	High Status < 0.04 (mean) or <0.09 (95%ile) Good Status <0.14 (mean) or < 0.065 (95%ile)	Surface Water Regulations 2009
Nitrite (NO_2) (mg/l)	<0.05	Salmonid Water Regulations 1988
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)	Surface Water Regulations 2009

Post-mitigation Impact (residual impact): Direct, Negative, Not Significant, Short Term, Unlikely.

Regardless of their 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 water quality status of surface waterbodies in the vicinity of the site will be maintained regardless of their existing status. The proposed mitigation measures will ensure the water quality status is not deteriorated.

According to Chapter 8B- Aquatic Ecological Assessment, potential impacts to aquatic qualifying interests of the downstream-connecting Blackwater River SAC (002170) (including freshwater pearl mussel) are considered not significant negative and short-term in in context of the European site, in the presence of mitigation.

Given the level of protection provided by the hydrological buffer zones and the proposed drainage measures, **not significant** residual effects are anticipated. There will be no impact on Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8b Aquatic Ecology.

Release of Hydrocarbons

- Refueling of mobile plant during construction will only be carried out at designated refueling station locations on site. However, where mobile fuel bowsers are used the following measures will be taken:
    - Any flexible pipe, tap or valve will be fitted with a lock and will be secured when not in use;
    - The pump or valve will be fitted with a lock and will be secured when not in use;

- All bowsers will carry a spill kit and operatives must have spill response training; and
- Portable generators or similar fuel containing equipment will be placed on suitable drip trays.

- Storage of fuels, lubricants and hydraulic fluids will occur at the contractor's compound, which will be fenced and have a lockable gate, thereby ensuring that the area in which fuels, lubricants and hydraulic fluids are stored will be properly secured against unauthorized access or vandalism.
- Any diesel, fuel or hydraulic oils stored on site will be stored in bunded storage tanks – the bund area will have a volume of at least 110 % of the volume of such materials stored.
- Emergency drip trays and spill kits will be kept available on site vehicles, to ensure that any spills from vehicles are contained and removed off site. The emergency response procedure is provided in Section 1.8 of SWMP.
- Contractors' personnel will be trained in oil spill control and clean up procedures, and in the proper and safe disposal of any waste generated through such an event.
- Designated contractors' personnel will be certified in oil spill control and clean up procedures, and in the proper and safe disposal of any waste generated through such an event.

Post-mitigation Impact (residual impact): Direct, Negative, Imperceptible, Temporary, Unlikely.

Given the level of protection provided and emergency response procedure, **not significant** residual effects are anticipated. There will be no impact on Blackwater River (Cork/Waterford) SAC. as assessed in Chapter 8b Aquatic Ecology.

Contamination from Wastewater Disposal

- During the construction phase, portaloos and/or containerised toilets and welfare units will be used to provide toilet facilities for site personnel. Sanitary waste will be removed from site via a licenced waste disposal contractor.

Post-mitigation Impact (residual impact): Direct, Negative, Imperceptible, Temporary, Unlikely.

Given the above, **not significant** residual effects on hydrology and water quality are anticipated.

Release of Cement-Based Products

- Prior to leaving the site, every truck delivering concrete to the site wash the chute only to a lined pit provided at each turbine location and substation compound.
- There will be no on-site batching of concrete on the site and no storage of cement will be permitted within 50 m of the crossing construction areas.
- Where possible, pre-cast elements will be used to minimise the need for wet concrete works within the site. Wet concrete will be used for turbine foundations construction, construction of substation compound, supports for the proposed bridge crossing HF-WF4. Box culverts will be pre-cast.
- Weather forecasting will be used to plan dry days for pouring concrete. Met Éireann describes days with rainfall less than 1.0mm as 'Dry Days', and days with 1.0mm of rainfall or more as 'Wet Days'.

- It will be ensured that the concrete pour site is free of standing water prior to concreting and plastic covers will be available in case of a sudden rainfall event.

Post-mitigation Impact (residual impact): Negative, Direct, Imperceptible, Brief, Unlikely.

Not significant residual impacts on hydrology and water quality are anticipated.

Proposed Mitigation Measures for Tree Felling

Tree felling will be permitted under limited felling license(s) from the Forest Service and will be subject to the conditions of such a license. A Limited Felling License will be in place prior to works commencing on site. 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:

- Felling and Reforestation Policy, Forest Service, Department of Agriculture, Food and the Marine, Dublin. May 2017
- Standards for Felling and Reforestation, Forest Service, Department of Agriculture, Food and the Marine, Dublin. October 2019
- Forestry Standards Manual (Agricultural, Food and the Marine, 2015)
- Forestry Act 2014 and the Forestry Regulations 2017 (SI No 191 of 2017) and SI 31 of 2020 - Forestry (Amdmt) Regs 2020 re reg 19AA procedures (pdf 99Kb)
- Forest Service. 2000a. Forestry and Water Quality Guidelines. Forest Service, Department of the Marine and Natural Resources, Dublin.
- Forest Service. 2000b. Code of Best Forest Practice – Ireland. Irish National Forest Standard. Forest Service, Department of the Marine and Natural Resources, Dublin.
- Forest Service. 2000c. Forest Harvesting and the Environment Guidelines. Forest Service, Department of the Marine and Natural Resources, Dublin.

In particular the following mitigation measures are proposed:

- Before operations commence, identify a 10m wide exclusion zone along the edge of all aquatic zones. Please note this exclusion zone has nothing to do with a 50m buffer zone defined for the construction of the wind farm. Exclusion zone refers to machinery associated with tree felling. No machinery is allowed to enter this area. However, they can fell in the exclusion zone if a tree felling machinery has a long arm. Trees that can't be reached will be felled with a chainsaw.
- Ensure all operators are aware of exclusion zone.
- Machine traffic and timber stacking are not permitted within these zones
- Machine traffic and timber stacking are not permitted within these zones.
- Trees within the reach of the harvester arm will be felled by harvester, and shredded and bunched outside the exclusion zone.

- Trees outside machine reach will be felled manually by chainsaw operators. Felled trees to be winched out of the exclusion zone where appropriate and safe to do so, or removed by extended harvester arm, for subsequent snedding and processing outside the exclusion zone.
- In all cases, fell trees away from the water feature.
- Regarding aquatic zones, ensure banks remain undisturbed. No branches or debris are to enter the aquatic zone during operations. Immediately and with care, remove any branches that do fall in.
- Minimise the crossing of drains during felling and extraction, and restrict machine activity to brashed extraction racks and haulage routes.
- Where necessary, deploy a heavy-duty plastic culvert lengthways into the channel and cover with brash material. The culvert must be of a diameter approximating the depth of the drain, to avoid any unnecessary undulation along the extraction route.
- Where required, a solution for smaller drains is to temporarily lay log sections lengthways into the channel and overlay with brash. Again, select logs that approximate the depth of the channel to be crossed.
- When installing and removing the temporary crossing, ensure that no work is carried out within the aquatic zone, and that the stream bed and bankside remain undisturbed.
- Carefully remove temporary crossings as they become no longer needed. Any brash padding used must be peeled back carefully away from the water feature, to avoid dislodging collected sediment.
- Direct crossing over the stream bed is not permitted.
- Ensure the feature is crossed at a right angle to the flow of water.
- Where needed, any necessary crossing shall be via an appropriate structure that spans proud of the flow of water and prevents the breakdown and erosion of the banks.
- Typical solutions include the laying down of a bridge comprising logs overlaid with geotextile and brash to intercept soil falling off wheels.
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed.
- Timber will be stacked in dry areas, and outside a local 50m watercourse buffer. Straw bales and check dams to be emplaced on the down gradient side of timber storage sites.
- Brash mats will be used to support vehicles on soft ground (e.g. during trenching and drainage construction), reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place before they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.
- Prior to the commencement of operations, install silt traps within existing forest drains that connect with aquatic zones, either directly or indirect through other relevant watercourses.
- Silt traps will be staggered along the length of the drain, and not only at the lower reaches towards its outflow.
- Silt trap design can vary, from depressions added to the drain bed, to log sections laid lengthways into the drain, to the use of geotextile barriers
- Apply silt fences where necessary, to block pathway for silt in areas where overland flow is possible.
- Once silt traps and silt fences become functional, check regularly and maintain as necessary, in order to ensure continued effectiveness throughout operations.

- Cease all felling and extraction and other machine operations onsite (or redirect to more stable areas of the site) during and after periods of rainfall which result in the possibility of the surface mobilisation of silt.
- At least weekly check silt traps and silt fences, and maintain as required, to ensure their continued effectiveness throughout works. All excess silts to be removed and disposed of appropriately.
- Undertake daily visual checks of relevant watercourses (primarily at their outflow from the site) and adjoining aquatic zones, to confirm (or otherwise) that no sediment or silt discharge is arising from site works.
- Keep a record of the above monitoring, and retain for possible inspection.

Post-mitigation Impact (residual): Direct, Negative, Not significant, Temporary, Likely.

Not significant residual impacts on the hydrology and water quality are anticipated.

Proposed Mitigation Measures for Biodiversity Enhancement and Management Plan Lands

The potential impacts associated with the BEMP is discussed in Section 10.4.2.7. It is concluded that the main impact on hydrology and water quality comes from the activities associated with tree felling. Tree felling will also be required for the construction of the wind farm site. Tree felling associated with the BEMP will utilize mitigation measures listed in Section 10.7.1.6.

Post-mitigation Impact (residual): Direct, Negative, Not significant, Temporary, Likely.

With the proposed mitigation measures being applied**, 'Not significant'** residual impacts on the hydrology and water quality are anticipated. There will be no impact on Blackwater River (Cork/Waterford) SAC.

10.7.2 Proposed Mitigation Measures During Grid Connection or HDD

In Section 10.4.3 it is noted that the release of suspended solids and hydrocarbons could have an effect on receiving waters. The following mitigation measures are proposed:

Suspended Solids

- Grid connection cables will be installed in trenches within or adjacent to the wind farm access roads when leaving the on-site substation and laid within the public road carriageway corridor for the remainder of the route with the exception of where the cable terminates at Clashavoon substation where a short section of the route will be located within private lands owned by the network operator. Trenches will be excavated during dry days in short sections and left open during dry days, to avoid acting as a conduit for surface water flows.
- The temporary storage of excavated material on site will be put at least 50 m from watercourses as detailed in soil management plan provided in CEMP. Please refer to Appendix 3.1.
- Weather warnings will be monitored, and no construction will take place during extreme events to mitigate against potential flooding.
- Trenches will be excavated during dry periods where possible in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows.

- For sections of the gird connection route within the wind farm site the excavated material can be used for reinstatement of the cable trenches. However, for sections within road carriageway all backfilled material will be imported from a licenced quarry and all excavated material will be removed to the licensed waste facility as identified in Chapter 13. There will be no permanent stockpiling of excavated material. For trenching within the domain of public roads, approved fill material will be imported as required to avoid stockpiling.
- All excavated soil material will be managed on site in accordance with the CEMP provided in Appendix 3.1.
- Silt fencing will be provided around any exposed areas to prevent the ingress of suspended solids into adjacent watercourses. These mitigation measures will prevent surface water contamination and will prevent subsequent flows of contaminated water into watercourses.

Post-mitigation Impact (residual impact): Negative, Direct, Imperceptible, Brief, Unlikely.

Not significant residual impacts on hydrology and water quality are anticipated. There will be no impact on Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8b Aquatic Ecology.

Hydrocarbons

Please refer to Section 10.7.1.3 for the proposed mitigation measures.

Post-mitigation Impact (residual): Negative, Direct, Imperceptible, Brief, Unlikely.

Not significant residual impacts on hydrology and water quality are anticipated.

10.7.3 Proposed Mitigation Measures For Turbine Delivery

Modifications along the TDR involves the temporary removal of street furniture, trimming and removal of vegetation and the temporary local widening of public roads and junctions which will involve the stripping of topsoil and laying and compacting of graded aggregates. These works are confined to relatively small, localised areas and it is not anticipated that this will have any significant hydrological impact.

The most significant temporary accommodation works from a hydrological point of view are required at POI-36 and POI-44 as described in Section 10.3.8. As discussed in Section 10.4.4 the significance of the impacts associated with POI-36 is **Not significant**. Therefore, no mitigation measures are required at this location.

Ground reprofiling and placement of load bearing surface will be required at POI-44 as described in Section 10.4.4. The significance of the effect of the release of the suspended solids into the receiving waters is "**Slight**". No other significant impacts are envisaged.

The proposed mitigation measures to control the surface runoff from the construction area are set out below.

The following measures are proposed:

- The earthwork activities will be completed in dry conditions only.
- Exposed slopes formed by the earthworks will be covered with a biodegradable erosion control blanket immediately following excavation. This will provide cover for bare soil and support for vegetation.
- The hard standing providing load bearing surface for the delivery vehicles shall be covered with compacted aggregate immediately following formation.
- Following formation of the hard standing, the road shall be swept clear of soils which may have been dragged across the carriageway during the formation of the hardstanding.
- The hardstanding area will be fenced off when not in use for turbine component deliveries.
- Excavated soil will be removed immediately to a licensed waste facility or to a suitable material storage area within the wind farm site in accordance with the soil management plan for the project.

Post-mitigation Impact (residual): Negative, Direct, Imperceptible, Temporary, Unlikely.

With mitigation measures taken in the place, it is anticipated that there is a **not significant** impact on hydrology and water quality during TDR works. There will be no impact on Blackwater River (Cork/Waterford) SAC. as assessed in Chapter 8b Aquatic Ecology.

10.7.4 Proposed Mitigation Measures during Operation and Maintenance

The main hydrological impact of the project is an increase in runoff. This is mitigated by the drainage system installed during construction which will remain in place, besides the settlement ponds which will be removed after the construction stage. It is anticipated that the drainage system will provide an increased time of concentration and consequently the peak runoff will be decreased. The drainage system will be left in-situ during operational stage.

When operational, the project will have a negligible effect on surface water quality as there will be no further disturbance of soils post-construction.

The following mitigation measures are proposed for replacing or removal of the wind turbine blades:

- Emergency drip trays and spill kits will be available on main wind farm site, to ensure that any spills from vehicles are contained and removed off site.
- Refuelling or maintenance of machinery will not occur within 50mof a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required.

Mitigation measures listed in Section 10.7.2.1 are proposed for replacing the grid connection cable if necessary as part of maintenance.

During the operation stage, small quantities of oil will be used in cooling the transformers associated with the facility. There is therefore a potential for small oil spills. Risks of potential oil leakage and pollutions draining to the watercourse from the installed transformer is mitigated with transformer interceptor bund wall.

It is not envisaged that the maintenance period will involve any significant impacts on the hydrological regime of the area. The maintenance will incorporate effective maintenance of the drainage system. The maintenance regime will include inspecting the following post extreme storm event:

- Drains, cross-drains and culverts for any blockages
- Outfalls to existing field drains and watercourses
- Existing roadside swales for any obstructions
- Swales
- Progress of the re-establishment of vegetation.

The maintenance regime will also include implementing appropriate remedial measures as required after the above inspections and testing the water quality at the outfalls at appropriate intervals. Visual inspections will be undertaken during the maintenance period in accordance with maintenance schedule in CIRIA C753.

With mitigation measures in place, it is anticipated that there is a **not significant** impact on hydrology and water quality during Operation and Maintenance stage of the project. There will be no impact on Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8b Aquatic Ecology.

10.7.5 Proposed Mitigation Measures during Decommissioning

In the event of decommissioning of the wind farm site, the access tracks will be used in the decommissioning process. Mitigation measures applied during decommissioning activities will be similar to those applied during construction.

With mitigation measures in place, it is anticipated that there is a **not significant** impact on hydrology and water quality during Decommissioning stage of the project.

10.8 Summary of Residual Impacts

The residual impacts are summarised below for each stage of the proposed development.

10.8.1 Residual Impacts during Construction Stage

The potential impacts associated with the construction of the wind farm site, grid connection, TDR include:

- Increased runoff,
- Release of sediments,
- Release of hydrocarbons,
- Release of cement based-products,
- And release of nutrients to receiving waters.

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 impact on Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8b Aquatic Ecology.

10.8.2 Residual Impacts during Operational and Maintenance Stage

There are no significant residual impacts relating to hydrology and water quality as the increased surface runoff measures are implemented and sedimentation release to watercourses is unlikely to occur as there is no disruption in soils.

With mitigation measures being in place, the residual impacts during Operational and Maintenance stage are **Not significant**. There will be no impact on Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8b Aquatic Ecology.

10.8.3 Residual Impacts during Decommissioning Stage

Decommissioning stage impacts will be much less than construction stage as drainage system is already in place and much less ground disturbance works as new tracks and hardstanding areas will be left in place and/or covered over and revegetated.

Infrastructure associated with the grid connection will form part of the national transmission network and will be left in-situ. Therefore, no impacts are envisaged.

With mitigation measures being in place, the residual impacts during Decommissioning stage are **Not significant** and there will be no impact on Blackwater River (Cork/Waterford) SAC as assessed in Chapter 8b Aquatic Ecology.

10.9 Cumulative Impact

The full list of existing and permitted projects and the methodology for determining this list are identified in Chapter 1. The majority of the projects were of a scale and/or distance that they would not cause a cumulative effect in relation to Hydrology and Water quality and have been ruled out for further consideration on that basis.

Cumulative impact from a hydrological point of view can only occur if assessed developments are hydrologically linked. The major developments which are in the same sub-basin and within 10km from the proposed wind farm are listed below and therefore require a review in terms of potential for in combination effects:

- Tree Felling of the surrounding commercial forest
- Boggeragh Wind Farm (1)
- Boggeragh Wind Farm (2)
- Esk Wind Farm
- Carriganimmy Wind Farm
- Bawnmore Wind Farm

- Extension to 110kV Substation to include Battery Storage
- Met Mast – Existing
- Met Mast - Granted
- Extension to Substation to include Battery Storage
- Solar Farm at Knockglass & Kilberrihert, Coachford, Co. Cork

Designated Sites
In Section 10.8. it is concluded there will be no impact on Blackwater River (Cork/Waterford).

Cork Harbour SPA (004030) is approximately 60km downstream of the proposed development. Due to the hydrological distance no impact on Cork Harbour SPA is envisaged.

The access road at the northern part of the site which runs through Boggeragh Mountains NHA (002447) does not require road widening. The existing road is drained via a drainage ditch which is appropriate and does not require any upgrade. The wind farm collector circuit cable will be buried within this road before it exits the site onto the public road. The entirety of the associated works will be contained within the footprint of the existing road. The trench will be backfilled with suitable imported material and reinstated to match the existing road surface. When the trench is backfilled, the existing road surface will be improved by way of a layer of compacted stone which will match the existing surface aggregate. Therefore, there will be no impact on Boggeragh Mountains NHA

Tree felling of the surrounding commercial forest

The residual impact of the project is concluded to be not significant on hydrology and water quality. For each stage of the project mitigation measures are proposed to achieve 'not significant' impact on hydrology and water quality. Tree felling will be permitted under limited felling license(s) from the Forest Service and will be subject to the conditions of such a license. Tree felling of the surrounding commercial forest will implement similar measures as proposed for the project. Therefore, no cumulative impact is envisaged.

Boggeragh Wind Farm (1)
The Boggeragh Wind Farm (1) is located approximately 2km North of the proposed wind farm site and is hydrologically linked to it. The Boggeragh Wind Farm is operational, therefore, no soil disruption and release of suspended solids is anticipated. As stated in Section 10.4.2 the increase in runoff due to the construction and operational stage of the project is 'not significant'. This will be further reduced with the drainage system within the wind farm site. The release of suspended solids and pollutants during the construction of the proposed wind farm will be mitigated by proposed mitigation measures described in Section 10.7. The cumulative impact on hydrology and water quality with the existing Boggeragh wind farm is not significant.

Boggeragh Wind Farm (2)
The Boggeragh Wind Farm (2) is operational and located approximately 1km east of the proposed wind farm site and is not hydrologically linked to it. The Boggeragh Wind Farm (2) is located in Dripsey_010 sub-basin. Therefore, there is no cumulative impact.

Esk Wind Farm
The existing Esk Wind Farm is located approximately 6km North East of the proposed wind farm site and is hydrologically linked to it. Due to the nature of the operation stage of an existing wind farm, disturbance of soil and earthworks are not expected.

The release of suspended solids and pollutants during the construction of the proposed wind farm will be mitigated by proposed mitigation measures described in Section 10.7. Thus, cumulative impact on hydrology and water quality with the existing Esk wind farm is not significant.

Carriganimmy Wind Farm
The Carriganimmy Wind Farm is located approximately 5km west of the proposed wind farm site and approximately 5km northwest of GCR-WCC8. The Carriganimmy wind farm is hydrologically linked with the proposed wind farm site. It is located in Awboy_010 sub-basin. The grid connection runs through this sub-basin. In Section 10.7.2 it is concluded that the impact of grid connection on hydrology and water quality is not significant. The Carriganimmy wind farm is operational, therefore, no soil disruption and release of suspended solids is anticipated. Therefore, the cumulative impact is not significant.

Bawnmore Wind Farm
The Bawnmore Wind Farm is located approximately 5km south of the proposed wind farm site and is hydrologically linked to it. The Bawnmore wind farm is located in Laney_040 sub-basin. The grid connection runs through this sub-basin. In Section 10.7.2 it is concluded that the impact of grid connection on hydrology and water quality is not significant. The Bawnmore wind farm is operational, therefore, no soil disruption and release of suspended solids is anticipated. The cumulative impact is not significant.

Extension to 110kV Substation to include Battery Storage, Crinnaloo South, Millstreet, Co. Cork
The extension to 110kV Substation to include Battery Storage has been completed. The subject substation is located approximately 1km north of the proposed wind farm site. Therefore, no soil disruption and release of suspended solids is anticipated. As stated above, the impact on hydrology and water quality of the proposed wind farm site is not significant. Thus, cumulative impact is not significant.

Met Mast – Existing
There is an existing Met Mast approximately 50m east of the proposed turbine T6. The impact of an existing met mast on hydrology and water quality is not significant. As stated in Section 10.4.2 the increase in runoff due to the construction and operational stage of the project is not significant. The release of suspended solids and pollutants during the construction of the proposed wind farm will be mitigated by proposed mitigation measures described in Section 10.7. Therefore, the cumulative impact is not significant.

Met Mast – Granted
A met mast will be installed approximately 200m east of the proposed turbine T17. The construction of met masts will require concrete pouring for foundation which will be constructed in line with the Plans and particulars submitted with that planning application. As stated above, the impact on the proposed wind farm is not significant. Therefore, the cumulative impact is not significant.

Extension to Substation to include Battery Storage at Kilberrihert, Coachford, Co. Cork
An extension to the Substation to include Battery Storage is proposed approximately 1.9km north of Clashavoon Substation. This substation is not in the same sub-basin as the proposed wind farm site. The works will take place in Laney_030 sub-basin. The grid connection runs through this sub-basin. In Section 10.7.2 it is concluded that the impact of grid connection on hydrology and water quality is not significant. The substation at Kilberrihert has its own drainage network to manage the surface runoff. Therefore, the cumulative impact is not significant.

Solar Farm at Knockglass and Kilberrihert, Coachford, Co. Cork
The proposed solar farm is located approximately 1.9 km north of Clashavoon Substation The solar farm is located in Laney_040 sub-basin. The grid connection runs through this sub-basin.

In Section 10.7.2 it is concluded that the impact of grid connection on hydrology and water quality is not significant. Based on that, it is concluded that the cumulative impact is not significant.

10.10 Conclusion

As a result of the construction of the wind farm site, surface water runoff is likely to increase by 0.483 m^3/s (or 0.16 %) for 1%AEP event due to changes to hard surfaces if unmitigated. Increase in runoff due to construction of the development is not significant and the peak runoff will be mitigated by the drainage system. Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise significant adverse impacts on water quality and downstream designated sites. The key mitigation measure during the construction phase is locating the proposed turbines 75m from watercourses. No construction activities or drainage will be within 50m of the watercourses, with an exception for watercourse crossings.

The proposed layout of the wind farm site will utilize 4 new crossings over the River Laney and its tributaries. There are 2 existing fords within the proposed development. However, it is proposed to construct new crossing structures. This will have a positive impact on water quality as there is no potential for oil, grease, and other pollutants from the vehicles to be flushed into the watercourse when the vehicles enter the fords.

During the construction of the wind farm site there will be disturbance of the soils. Earthwork activities can result in the release of suspended solids into the receiving bodies. This can have significant negative impact on water quality status and Freshwater Pearl Mussel (FWPM). FWPM are known to be particularly sensitive to the presence of fine sediments. The nearest downstream record for freshwater pearl mussel in the River Blackwater is approx. 14.7km from a proposed turbine base excavation, along the Glen River pathway. The impact of the project on FWMP is discussed in detail in Chapter 8B- Aquatic Ecological Assessment. Releasing surface runoff without implementing sediment control measures is not acceptable for receptors and it is against WFD since it has a potential to deteriorate water quality status. With the proposed mitigation measures detailed in Section 10.7 the impact of the release of suspended solids is **Not significant**.

During the construction period there is also a potential release of the hydrocarbons and cement base products. With the proposed mitigation measures the significance of the impacts are **Not Significant**.

When operational, the wind farm will have a negligible effect on surface water quality as there will be no further disturbance of soils post-construction. In the event of decommissioning of the wind farm site, the access tracks will be used in the decommissioning process. Mitigation measures applied during decommissioning activities will be similar to those applied during construction but will be of reduced magnitude. Thus, the significance of the impacts is **Not Significant**.

The receiving waters of the wind farm site are classified as ‘High’ and ‘Good’ Quality’ and ‘Not at Risk’. By implementing the mitigation measures outlined in Section 10.7, the water quality status will not be deteriorated for the waterbodies described in Section 10.3, which includes the Blackwater River (Cork/Waterford) SAC. This is in accordance with the Surface Water Regulations. In Section 10.9 it is concluded that there will be no impact on Cork Harbour SPA (004030) and Boggeragh Mountains NHA (002447).

The grid connection route will cross 13 watercourses. These watercourses are listed in Table 10-8. For each crossing point a suitable method of crossing is proposed. With the implementation of the proposed mitigation measures, the significance of the impacts associated with the grid connection route is **Not significant**.

Turbine components will be delivered along the route as described in Section 3 of this report. In total 80 waterbodies will be crossed, and these are listed in Table 10-9. Minor works (furniture removal, vegetation trimming, tree removing, placement of temporary load bearing surface) will be required along the TDR to accommodate the delivery. Significant works will be required at POI-36 and POI-44 (Point of Interest).

At POI-36 a temporary aggregate hardstanding and access tracks will be constructed and at POI-44 ground reprofiling will be undertaken. With the implementation of the proposed mitigation measures, the significance of the impacts associated with the TDR is **Not significant**.

The flood risk assessment has been detailed in Section 10.5. The proposed turbines and substation are located in Flood Zone C and it is at low risk of flooding. The proposed new crossings are designed to convey 1%AEP MRFS flows with a 300mm freeboard elevation. The proposed development will not increase the risk of flooding within and downstream of the site.

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

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