9 HYDROLOGY AND HYDROGEOLOGY

9.1 INTRODUCTION

This chapter assesses the effects of the Project on the Hydrology and Hydrogeology environment associated with the Site. The Development refers to all elements of the application for the construction of Letter Wind Farm **(Chapter 2: Project Description).** Where adverse effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment considers the potential effects during the following phases of the Project:

- Construction of the Project
- Operation of the Project
- Decommissioning of the Project

Common acronyms used throughout this EIAR can be found in **Appendix 1.2.** This chapter of the EIAR is supported by the following Figures provided in **Volume III** and the following Appendix documents provided in **Volume IV.**

- **Appendix 9.1-** Letter Strategic Flood Risk Assessment (SFRA)
- **Appendix 9.2 –** Letter Wind Farm Project Site Photographs
- **Appendix 9.3 -** Surface Water Hydrochemistry Database
- **Appendix 9.4 -** Surface Water Sampling Laboratory Certificates
- **Appendix 9.5 –** Conceptual and Information Graphics

A Construction and Environmental Management Plan (CEMP) is appended to the EIAR in **Appendix 2.1.** This document will be a key construction contract document, which will ensure that all mitigation measures, which are considered necessary to protect the environment during the construction phase are implemented. It will include and apply all of the construction phase mitigation described within the EIAR where relevant, and by relevant competent engineers at the detailed construction design phase of the Project. For the purpose of this application, a summary of the mitigation measures is included in **Appendix 17.1.**

9.1.1 Project Description

A full description of the Project is given in **Chapter 2: Project Description**.

9.1.1.1 Wind farm

The proposed Letter Wind Farm Project will consist of the following project elements:

- Four wind turbines; there are two candidate turbines for the Site. The Candidate turbines and specifications are outlined below.
  1. Vestas V117 which has a rating of 4.2 MW. Vestas V117 has the following specifications:
     - Three bladed, horizontal axis type turbine;
     - Height of 150m from the top of the foundation to blade tip height;
     - Rotor diameter of 117m;
     - Hub height of 91.5m.
  2. Enercon E115 which has a rating of 4.2MW and has the following specifications:
     - Three bladed, horizontal axis type turbine;
     - Height of 149.85m from the top of the foundation to blade tip height;
     - Rotor diameter of 115.7m;
     - Hub height of 92m.

- Construction of permanent turbine hardstands and turbine foundations.
- Construction of a bottomless bridge culvert across a minor stream on site (EPA River Segment Code: 26_4053).
- Construction of one temporary construction compound with associated temporary site offices, parking areas and security fencing.
- Installation of one (40-year life cycle) meteorological mast with a height of 50m and a 4m lightning pole on top.
- Construction of new internal site access tracks and upgrade of a section of existing internal Site track, to include all associated drainage.
- Improvement of existing site entrance with access via the L4282.
- Development of an internal site drainage network and sediment control systems.
- Construction of 1 no. permanent 20kV electrical substation
- All associated underground electrical and communications cabling connecting the wind turbines to the wind farm substation.
- All works associated with the connection of the wind farm to the national electricity grid, which will be via 20kV underground and partially overhead cable connection approximately 6.4km in length to the existing ESB Corderry 110kV Substation in the townlands of Letter, Greaghnadarragh, Stangaun, Corralustia, Turpaun,

Gortnasillagh West, Lugmeeltan, Leckaun, Lisgaveen, Treannadullagh, Drumcashlagh and Corderry.

- Ancillary forestry felling to facilitate construction of the development.
- All associated site development works including berms, landscaping, and soil excavation.
- Installation of battery arrays located within container units (2 no. units) and associated electrical plant for grid stabilisation adjacent to the substation building.
- Development of one on-site borrow pit.
- A 10-year planning permission and 40-year operational life from the date of commissioning of the entire wind farm is being sought. This reflects the lifespan of modern-day turbines.

There are one (no 1) watercourse crossings on the Wind Farm site.

Table 9.1 Summary of water course crossing locations on the Wind Farm

ID	Grid Coordinated (ITM)	Category	Downstream SAC/SPA/NHA
WCC8	E 587642.453 N 824049.259	Bridge 1	SAC: Lough Forbes Complex SAC SPA: Ballykenny-Fisherstown Bog

9.1.1.2 Grid Connection Route

Letter Wind Farm Ltd has identified the Corderry 110kV substation as the potential grid connection option for the Letter Wind Farm Project. An underground (and partially overhead) 20kV cable will connect the on-site substation to the existing Corderry 110kV substation. The proposed grid connection route is approximately 6.4 km in length and comprised of local public roads L4282 and L8280. The Grid Connection cable will be buried at 1.22m, with intermittent cable joint bays and other ancillary infrastructure where required. The proposed grid connection route is illustrated in **Figure 9.1b**. The Grid Connection Route description and associated construction methodology is presented in **Appendix 2.1 CEMP.**

9.1.1.3 Cable Joint Bays

It is estimated that 13 Cable Joint Bays (CJBs) will be installed c. every 460-490m along the underground cable route which will be divided into two sections that will be joined together. CJBs will be typically 2.9m long x 1.6m x 1.3m deep pre-cast concrete structures installed below finished ground level. A reinforced concreted slab will be constructed on top of the bay. It is envisioned that CJBs will be located in the non-wheel and weight bearing strip of roadways, however given the narrow profile of local roads this may not always be possible.

9.1.1.4 Turbine Delivery Route

Large components associated with the wind farm construction will be transported to site via the identified Turbine Delivery Route (TDR), shown in orange in **Figure 9.1c.** It is proposed that the turbine nacelles, tower hubs and rotor blades will be landed at Killybegs Harbour, County Donegal. The roads utilised are as follows; N56, N15, N4, R285, R280 before entering the site on L4282. More detailed account of the Turbine Delivery Route is outlined in **Chapter 15: Traffic and Transportation**.

The construction of the Project in its entirety is expected to take between 14 - 15 months. Works will be required to facilitate the delivery of turbine components. These will be minor, for example, temporary removal of street furniture and signage while other works will be more extensive.

9.1.1.5 Watercourse Crossings on Grid Connection Route

There are no. 7 watercourse crossings along the grid connection route to the Corderry 110kV substation **(Figure 9.2).**

The watercourse crossings identified along the Grid Connection Route**,** are as follows:

Table 9.2 Summary of water course crossing locations on Grid Connection Route

ID	Grid Coordinated (ITM)	Category	Downstream SAC/SPA/NHA	Distance
WCC1	E 588702.4612 N 824065.7130	Bridge 1	Lough Forbes SAC	45km
WCC2	E 588448.2828 N 824703.1605	Culvert	Lough Forbes SAC	46km
WCC3	E 588305.4362 N 824876.6361	Culvert	Lough Forbes SAC	46km
WCC4	E 588213.4602 N 825080.8995	Culvert	Lough Forbes SAC	46km
WCC5	E 587846.3763 N 825489.9110	Culvert	Lough Forbes SAC	47km
WCC6	E 587320.5972 N 826193.0651	Culvert	Lough Gill SAC	6.6km
WCC7	E 586786.7619 N 826559.3446	Bridge 2	Lough Gill SAC	6km

The grid connection route will be constructed via trenching in the public roadway, or in the verge, in its entirety. Cabling will be installed without the requirement of Horizontal Directional Drilling (HDD) and there will-be no direct impact on watercourses.

9.1.2 Statement of Authority

RSK (Ireland) Ltd. (RSK), part of RSK Group, is a consultancy providing environmental services in the hydrological, hydrogeological and other environmental disciplines. The company and group provide consultancy to clients in both the public & private sectors. More information can be found at www.rskgroup.com. The principal members of the RSK EIA team involved in this assessment include the following persons;

- Project Manager & Lead Author: Sven Klinkenbergh – B.Sc. (Environmental Science), P.G.Dip. (Environmental Protection). Current Role: Principal Environmental Consultant. Associate, Sven joined RSK Ireland after Minerex Environmental (8 years) were acquired by RSK Group in June 2021. Sven's current workflow consists primarily of EIA Hydrology, Hydrogeology, Land, Soils and Geology assessments for a range of projects, a large proportion of which is in renewable energy i.e. wind farms on peatlands. Sven is a qualified project manager and EIA Lead Author with c. 10 years industry experience in the preparation of environmental, geological, hydrological and hydrogeological reports. Sven has also worked on a large number of surface water and groundwater monitoring projects on IPC and similar sites, was team lead for site investigation and soil waste classification projects and has a number of years' experience on construction dewatering projects.
- Project Scientist: Jayne Stephens - B.S.c (Environmental Science), PhD (Environmental and Infection Microbiology). Current Role: Environmental Consultant. Experience c. 5 years working in microbiology, water, and environmental disciplines. She graduated with a BSc in Environmental Science from National University of Ireland Galway in 2014, majoring in mammal ecology. Following this, Jayne was the successful Irish applicant to the Tropical Biological Association in Cambridge to complete a field course in tropical biodiversity and conservation in Tanzania. She holds a PhD in environmental microbiology, graduating in 2023. Jayne has worked on a large number of bathing water and surface water monitoring investigations, on project Acclimatize, an EU funded project which aimed to bridge the knowledge gap in relation to at-risk urban and rural bathing waters in Ireland and Wales. During this project, Jayne was team lead for site investigations and has a number of years' experience on microbial contamination and public involvement projects for better water quality.
- Project scientist: Conor Campbell – B.Sc. (Environmental Science). Current Role: Environmental Consultant. Experience c. 3 years working in ecotoxicology, environmental monitoring, and consultancy. Conor graduated with a B.Sc. in Environmental Science and Technology in DCU, where he then worked with the Water

Institute in EPA and EU Horizon funded projects involving freshwater ecotoxicology, remote sensor development, and passive sampling method development. Conor has also worked as an environmental engineer, designing and undertaking surface and ground water sampling campaigns, landfill leachate and gas monitoring programs, as well as a variety of hydrometric surveys. Conor joined RSK Ireland in early 2023 as a consultant on the EIAR team, specialising in Hydrology and Hydrogeology, and Land, Soils, and Geology.

- Project Scientist: Lissa Colleen McClung - B.Sc. (Hons.) Environmental Studies, M.Sc. (Hons.) Environmental Science. Colleen has recently joined RSK Ireland as a Graduate Project Scientist under the Hydrology & Hydrogeology and Land, Soils & Geology Team. After attaining an MSc in Environmental Science, with 1.1 First Class Honours, from Trinity College Dublin in 2021. Since coming on board, Colleen has worked on a variety of projects for urban residential development schemes and renewable energy. As a Project Scientist, Colleen has undertaken technical report writing in many forms, such as: Flood Risk Assessments (Stage 1 and Stage 2) (ROI), Drainage Assessments (NI), Water Framework Directive Assessments, Environmental Impact Assessment Reports (ROI) and Environmental Statements (NI). She has also carried out extensive field work around the country. Key capabilities include preparation of Environmental Impact Assessment Reports and running software such as QGIS, Python and Matlab coding languages.

9.1.3 Assessment Structure

In line with the EIA Directive as amended and current EPA (2022) *Guidelines on the information to be contained in Environmental Impact Assessment Reports* the structure of this Hydrology and Hydrogeology chapter is as follows:

- Assessment Methodology and Significance Criteria.
- Description of baseline conditions at the Site.
- Identification and assessment of effects to hydrology and hydrogeology associated with the Development, during the construction, operational and decommissioning phases of the Development.
- Mitigation measures to avoid or reduce the effects identified.
- Identification and assessment of residual effects of the Development considering mitigation measures.
- Identification and assessment of cumulative effects if and where applicable.

9.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

9.2.1 Assessment Methodology

The following calculations and assessments were undertaken in order to evaluate the potential effects of the Development on the hydrology and hydrogeology aspects of the environment at the Letter Site:

- Characterise the topographical, hydrological and hydrogeological regime of the Site from the data acquired through desk study and onsite surveys.
- Water balance calculation.
- Flood risk evaluations.
- Consider hydrological or hydrogeological constraints together with development design.
- Consider drainage issues, or issues with surface water runoff quality as a result of the Development, its design and methodology of construction.
- Assessment of the combined data acquired and evaluation of any likely effects on the hydrology and hydrogeology aspects of the environment.
- Where effects are identified, measures are described that will mitigate or reduce the identified impact.

  Findings are presented and reported in a clear and logical format that complies with EIAR reporting requirements.

9.2.1.1 General Approach

The Environmental Impact Assessment Report (EIAR) is a comprehensive document that assesses the potential impacts of a proposed development on the environment. It typically includes several fundamental components, including an assessment of baseline conditions, identification of site constraints, evaluation of the proposed development layout, identification of potential unmitigated impacts, and the identification and description of mitigation measures which will be incorporated into the Development design and associated management plans to minimise potential impacts to acceptable levels where possible, and to evaluate likely or expected residual impacts posed by the Development.

During the baseline assessment phase, the importance and sensitivity of environmental attributes are qualified relative to each chapter or discipline. This process involves considering available legal instruments, guidance, and relevant information or research to form the basis of qualifying environmental attributes or receptors. Site constraints are also identified during this phase, which are then used to inform the proposed development design.

The Development frozen layout is then evaluated in terms of its likely impact on the receiving environment. Potential unmitigated impacts are identified and qualified by considering the importance and sensitivity of the receiving environment, as well as the nature, scale, magnitude, and duration etc. of the proposed activity or impact arising from the development.

Once potential impacts have been identified, the EIAR then describes mitigation measures that will be applied to minimize impacts to acceptable levels where possible. These measures are objective-driven and are applied with a view to achieving the desired end result. Mitigation by design, such as avoiding constraints, can help minimize the most significant potential impacts, but residual risks will remain. Therefore, adequate application, design and execution of described mitigation measures, ongoing monitoring, management, and escalation of emergency response mitigation where relevant will be required, and the mitigation measures may need to be redesigned, repeated or re-applied until the objectives of mitigation are being achieved.

Once mitigation measures have been established, the likely residual impacts of the development are then reported. This report is typically presented in an objective, transparent, and comprehensive manner, which is essential to ensure that stakeholders have a clear understanding of the proposed development's potential impacts on the environment.

Mitigation measures which are prescribed in EIAR chapters will be further developed and engineered through the Development detailed design and drafting of management plans such as, Construction and Environmental Management Plans (CEMP) and Surface Water Management Plans (SWMP). Those documents, which will be drafted by suitably qualified engineers, will take measures and design considerations outlined in this report and apply it to the final detailed design and CEMP, SWMP and similar management plans.

In some cases, CEMP and SWMP developed at the planning phase of the Development can be incorporated back into the EIAR chapters with a view to adding clarity to the specific site or development. However, the CEMP or other management will be updated when the application is consented and include any planning conditions. It is recommended that CEMP and similar management plans are finalised during and as part of the final detailed design phase prior to commencement of the construction phase. Therefore, it is important to note that management plans referred to in this report are planning stage documents, and where terminology such as "has been done" with reference to mitigation measures applied in CEMP or other management plans, this does not acknowledge the full proper application measures or finalised design, but refers only to indication of what is planned and what will be refined and finalised as part of the detailed design phase. The CEMP, SWMP or other management plans have not been assessed as part of this report / chapter.

9.2.1.2 Objective Led Approach

In the previous section there are two items in particular which will be linked strongly by objectives. For instance, qualifying the importance and sensitivity of an environmental attribute or receptor will align with relevant legal instruments. For example, to qualify surface water features, the EIAR will align with the objectives of the Water Framework Directive (WFD) whereby the objective for surface waters is, member states must achieve or maintain at least 'Good' status in all water bodies. This approach equates to qualifying all surface water features as very important and sensitive receptors and that any adverse impact will be viewed as potentially jeopardising the objectives of the WFD.

Similarly, when assessing the Site and prescribing mitigation measures, the EIAR will set out to achieve mitigation and residual impact in line with the same objectives. For example, mitigation will set out to minimise any potential for contaminants to reach sensitive receptors identified, will monitor the efficacy of mitigation measures applied, and were failing to achieve the objectives set, emergency response and mitigation measures are escalated until such time as the site stabilises and objectives of mitigation are being achieved once more.

9.2.1.3 Striving for Nature Based Solutions and Net Benefit Impacts

Similar to objectives for water quality discussed previously, the objectives of the WFD and other instruments also include for other environmental hazards, for example; flooding. For any new development, Flood Risk Assessment will involve two main components, flood risk on site, and the potential to enhance flood risk downstream. In keeping with the objective of WFD and FRA guidance and policy, a new development in a greenfield site will invariably impact adversely on the hydrological response to rainfall whereby, unmitigated there will be a net increase in runoff rates at the site following a storm event, in turn potentially exacerbating flooding in flood risk areas downstream of the site. Despite the fact that the likely net increase will be relatively tiny compared to the runoff and discharge rates at a catchment scale, the objective set by relevant instruments and guidance is that the cumulative nature of these impacts can have significant adverse impacts, and therefore, all developments will set out to not only neutralise any potential net adverse impact, but to strive to attain a net benefit impact where by the development will attenuate more than the net increase posed by the Development.

The approach to achieving objectives and net beneficial impacts is mainly through the application of Nature Based Solutions. This can include improvements rooted in an ecological context, such as areas designated for ecological improvement, but a development can also be engineered to achieve Nature Based Solutions, for example; the introduction of new drainage networks in greenfield areas has the potential to significantly alter the hydrological regime at the site, but the same drainage network will be engineered to maintain or emulate the baseline hydrological regime in so far as possible. This can be achieved through application of Sustainable Drainage Systems but the design of such systems and drainage network must also be designed and specified in an objective led manner, while also considering constraints that might limit the application or positioning of such features.

9.2.2 Relevant Legislation and Guidance

This study complies with the EIA Directive as amended which requires Environmental Impact Assessment for certain types of development before development consent is granted.

In addition, the following environmental legislation relevant to hydrological and hydrogeological aspects of the environment were referred to:

- Drinking Water Directives (98/83/EC) on the Quality of Water Intended for Human Consumption and resultant SI No. 122 of 2014 (Drinking Water) Regulations and SI No. 464 of 2017 (Amendment) Regulations.
- Quality Required of Surface Water Intended for Abstraction of Drinking Water (75/440/EEC) and European Communities Environmental Objectives (Surface Waters) Regulations 2009 SI No. 272 of 2009 as amended (S.I. No. 327 of 2012, S.I. No. 386 of 2015, S.I. No. 77 of 2019).
- Dangerous Substances Directive (76/464/EEC) and resultant SI No. 12 of 2001: Water Quality (Dangerous Substances) Regulations
- Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life (78/659/EEC) and resultant SI No. 293 of 1988: Quality of Salmonid Waters Regulations
- SI No. 258 of 1998: Water Quality (Phosphorous Regulations)

- The Water Framework Directive (2000/60/EC) and resultant regulations:
- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003) as amended.
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) as amended
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011)
- European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014)

The Water Framework Directive (WFD), which was passed by the European Union (EU) in 2000, requires all Member States to protect and improve water quality in all waters so that we achieve good ecological status by 2015, is a wide-reaching piece of legislation which replaces a number of the other water quality directives (for example, those on Water Abstraction) while implementation of others (for example, The Integrated Pollution Prevention and Control and Habitats Directives) will form part of the 'basic measures' for the Water Framework Directive. The fundamental objective of the Water Framework Directive aims at maintaining "high status" of waters where it exists, preventing any deterioration in the existing status of waters and achieving at least "good status" in relation to all waters by 2021* (WFD). (*Current RBMP cycle).

The Leitrim County Development Plan (2023-2029) was also consulted as part of the EIA process.

This study has been prepared using the following guidance documents, which take account the current legislation and policy:

- CIRIA (2006) Control of Water Pollution from Linear Construction Projects – Technical Guidance
- CIRIA (2015) Environmental Good Practice on Site (fourth edition) (C741)
- Enterprise Ireland (n.d.) "Best Practice Guide (BPGCS005) Oil Storage Guidelines"
- Environmental Protection Agency (EPA) (2014) "Guidance on the Authorisation of Direct Discharges to Groundwater".
- EPA (2015) Advice Notes for Preparing Environmental Impact Statements – DRAFT September 2015

- EPA (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports
- Exploration & Mining Division, Minerals Ireland, Dept. of Communications, Climate Action & Environment (2019) "Exploration Drilling – Guidance on Discharge to Surface and Groundwater".
- Inland Fisheries Ireland (IFI) (2016) "Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters" Inland Fisheries Ireland
- Institute of Geologists of Ireland (IGI) (2002) Geology in Environmental Impact Statements – A guide
- IGI (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements
- Irish Wind Energy Association (IWEA) (2012) Best Practice Guidelines for the Irish Wind Energy Industry
- Law, C. and D'Aleo, S. (2016) Environmental Good Practice on Site Pocket Book. (C762) 4th edition. CIRIA
- Masters-Williams, H. et al. (2001) "Control of Water Pollution From Construction Sites. Guidance for Consultants and Contractors (C532)
- Murnane, E., A. Heap, A. and Swain, A. (2006) "Control of Water Pollution from Linear Construction Projects, Technical guidance (C648)" CIRIA
- Murnane, E., A. Heap, A. and Swain, A. (2006) "Control of Water Pollution from Linear Construction Projects, Site Guide (C649) CIRIA
- Murphy, D. (2004) "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites" Eastern Regional Fisheries Board
- National Roads Authority (NRA) (2008) "Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes"
- NRA (2008) "Environmental Impact Assessment of National Road Schemes" – A Practical Guide – Rev 1
- NRA (2008) "Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes"
- Office of Public Works (2009) "The Planning System and Flood Risk Management, Guidelines for Planning Authorities"
- Office of Public Works (OPW) (2013) "Construction, Replacement or Alteration of Bridges and Culverts" Office of Public Works

- Scottish Environment Protection Agency (SEPA) (2010) "Engineering in the Water Environment: Good Practice Guide – River Crossings" Scottish Environment Protection Agency
- Scottish National Heritage (SNH) (2018) Environmental Impact Assessment Handbook – Version 5
- Transport Infrastructure Ireland (TII) (2014) "Drainage Design For National Road Schemes - Sustainable Drainage Options".

9.2.3 Study Area

The study area is any land soils and geology underlying the landholding and outside the Site, for example the surrounding area. Works such as stability assessments and desk studies were conducted for the landholding and the surrounding area. Constraints within a 10km radius such as Special Areas of Conservation (SACs), Special Protection Areas (SPAs), and National Heritage Areas (NHAs), surface water bodies, springs wells etc were mapped.

9.2.4 Desk Top Study

Desk top study assessments were undertaken on the hydrology and hydrogeology aspects of the Project before and after field investigations. This involved the following components:

- Acquisition and compilation of all available and relevant maps of the Development.
- Study and assessment of the proposed locations of turbines and access roads relative to available data on site topography and slope gradients.
- Study and assessment of the proposed locations of turbines, access roads and other associated infrastructure units relative to available data on hydrology and hydrogeology.
- Study of geospatial data obtained from various sources including; Environmental Protection Agency (EPA), Geological Survey Ireland (GSI), Teagasc, Ordinance Survey Ireland (OSi), National Parks and Wildlife (NPWS) overlain with the Development plan drawings using a Graphic Information System (GIS). Data was assessed at a regional, local and site-specific scale.
- Assessment of relevant additional data was obtained where relevant, for example, rain data obtained from Met Eireann, and river discharge rates and synoptic data sets obtained from the EPA.
- Assessment of site-specific aerial data (Topo survey data (1m)).

9.2.5 Field Work

9.2.5.1 Site Walk Over and Observations

Site walk over surveys were tailored in line with the Development site layout. Photographs obtained during site surveys are presented in (**Appendix 9.2).**

Field inspections were carried out at the Development during March and April of 2023, by Colleen McClung, Jayne Stephens and Conor Campbell. These works consisted of the following:

- Site walk over including recording and digital photography of significant features.
- Drainage distribution and catchment mapping.
- Field hydrochemistry of the drainage network (electrical conductivity, pH and temperature).
- Recording of GPS co-ordinates for all investigation and monitoring points in the study.
- Baseline sampling of surface water for analytical laboratory testing. Two baseline sampling events were carried out i.e., targeting low and high flow conditions.

Baseline sampling and estimating of surface water flow and discharge rates during baseline surface.

9.2.6 Evaluation of Potential Effects

9.2.6.1 Sensitivity

Sensitivity is defined as the potential for a receptor to be significantly affected by a proposed development[1]. The EPA provides guidance on the assessment methodology, including defining general descriptive terms in relation to magnitude of effects however, in terms of qualifying significance of the receiving environment the EPA guidance also states that:

"*As surface water and groundwater are part of a constantly moving hydrological cycle, any assessment of significance will require evaluation beyond the development site boundary*." [2]

To facilitate the qualification of hydrological and hydrogeological attributes, guidance specific to hydrology and hydrogeology as set out by National Roads Authority (NRA) [3], and

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[1] Environmental Protection Agency (EPA) (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports

[2] Environmental Protection Agency (EPA) (2015) Advice Notes for Preparing Environmental Impact Statements DRAFT September 2015. Environmental Protection Agency, Ireland

[3] National Roads Authority (NRA) (2008) Guidelines on the information to be contained in Environmental Impact Assessment Reports

guidance specific to landscape as set out by Scottish National Heritage (SNH) [4], has been used in conjunction with EPA guidance.

The following table (**3**) presents rated categories and criteria for rating site attributes:

Table 9.3: Criteria for Rating Site Attributes – Hydrology and Hydrogeology Specific

Importance	Criteria
Extremely High	Attribute has a high quality or value on an international scale.
Very High	Attribute has a high quality, significance or value on a regional or national scale.
High	Attribute has a high quality, significance or value on a local scale.
Medium	Attribute has a medium quality, significance or value on a local scale.
Low	Attribute has a low quality, significance or value on a local scale.

Considering the above categories of rating importance and associated criteria, the following table **(Table 9.4**) presents rated sensitivity categories (SNH, 2013):

[4] Scottish National Heritage (SNH) (2018) Environmental Impact Assessment Handbook V5

Table 9.4: Criteria for Rating Site Sensitivity - Landscape Character Specific

Importance	Criteria
High Sensitivity	Key characteristics and features which contribute significantly to the distinctiveness and character of the landscape character type. Designated landscapes e.g. National Parks, Natural Heritage Areas (NHAs) and Special Areas of Conservation (SACs) and landscapes identified as having low capacity to accommodate proposed form of change, that is; sites with attributes of **Very High Importance**.
Medium Sensitivity	Other characteristics or features of the landscape that contribute to the character of the landscape locally. Locally valued landscapes which are not designated. Landscapes identified as having some tolerance of the proposed change subject to design and mitigation, that is, sites with attributes of **Medium to High Importance**.
Low Sensitivity	Landscape characteristics and features that do not make a significant contribution to landscape character or distinctiveness locally, or which are untypical or uncharacteristic of the landscape type. Landscapes identified as being generally tolerant of the proposed change subject to design and mitigation, that is, sites with attributes of **Low Importance**.

9.2.6.2 Magnitude

The magnitude of potential effects arising as a product of the Project are defined in accordance with the criteria provided by the EPA, as presented in the following table[5] (**Table 9.5**). These descriptive phrases are considered general terms for describing potential effects of the Development, and provide for considering baseline tends, for example a *Moderate* impact is one which *is consistent with the existing or emerging trends*.

Table 9.5: Describing the Magnitude of Effects

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

[5] Environmental Protection Agency (EPA) (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports

In terms of hydrology and hydrogeology, magnitude is qualified in line with relevant guidance, as presented in the following tables[6] (**Table 9.6** and **Table 9.7**). These descriptive phrases are considered development specific terms for describing potential effects of the Project, and do not provide for considering baseline tends and therefore are utilised to qualify effects in terms of weighting effects relative to site attribute importance, and scale where applicable.

Table 9.6: Qualifying the Magnitude of Impact on Hydrological Attributes

Magnitude of Impact	Description	Example/s
Large Adverse	Results in loss of attribute and/or quality and integrity of attribute	Loss or extensive change to a waterbody or water dependent habitat, or Calculated risk of serious pollution incident >2% annually, or Extensive loss of fishery
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Partial reduction in amenity value, or Calculated risk of serious pollution incident >1% annually, or Partial loss of fishery
Small Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Slight reduction in amenity value, or Calculated risk of serious pollution incident >0.5% annually, or Minor loss of fishery
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	Calculated risk of serious pollution incident <0.5% annually
Minor Beneficial	Results in minor improvement of attribute quality.	Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually
Moderate Beneficial	Results in moderate improvement of attribute quality.	Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually
Major Beneficial	Results in major improvement of attribute quality.	Reduction in predicted peak flood level >100mm

Table 9.7: Qualifying the Magnitude of Impact on Hydrogeological Attributes

Magnitude of Impact	Description	Example/s
Large Adverse	Results in a loss of attribute.	Removal of large proportion of aquifer, or Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or Ecosystems, or

[6] National Roads Authority (NRA) (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes

Magnitude of Impact	Description	Example/s
		Potential high risk of pollution to groundwater from routine run-off
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Removal of moderate proportion of aquifer, or Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or Ecosystems, or Potential medium risk of pollution to groundwater from routine run-off.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Removal of small proportion of aquifer, or Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems, or Potential low risk of pollution to groundwater from run-off.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	Calculated risk of serious pollution incident <0.5% annually

9.2.6.3 Significance Criteria

Considering the above definitions and rating structures associated with sensitivity, attribute importance, and magnitude of potential effects, rating of significant environmental effects is done in accordance with relevant guidance as presented in **Table 9.8**. This matrix qualifies the magnitude of potential effects based on weighting same depending on the importance and/or sensitivity of the receiving environment. In terms of Hydrology and Hydrogeology, the general terms for describing potential effects (

Table 9.5: Describing the Magnitude of Effects) are linked directly with the Development specific terms for qualifying potential effects (**Table 9.6: Qualifying the Magnitude of Impact on Hydrological Attributes** and

Table 9.7: Qualifying the Magnitude of Impact on Hydrogeological Attributes). Therefore, qualifying terms (**Table 9.8**) are used in describing potential effects of the development. This is largely driven by the potential for effects to extend down gradient, beyond the boundaries of the site of the Development in terms of Hydrology and Hydrogeology.

Table 9.8: Weighted Rating of Significant Environmental Effects

Sensitivity (Importance of Attribute)	Magnitude of Impact			
	Negligible (Imperceptible)	**Small Adverse (Slight)**	**Moderate Adverse (Moderate)**	**Large Adverse (Significant to Profound)**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

9.2.6.4 Scoping Responses and Consultation

Information has been provided by a number of consultee organisations during the assessment, and this is summarised in **Table 9.9**. The response to each point raised by consultees is also presented within the table, demonstrating where the design of the Project has changed in response to specific issues indicated by respective consultees.

Table 9.9: Scoping and Responses Table

Consultee	Type and Date	Summary of Consultee Response	Areas in this Chapter that address these points
Irish Water / Uisce	Letter received on 9th January 2022	a) Where the development proposal has the potential to impact an Irish Water Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to Irish Waters Drinking Water Source(s) during the construction and operational phases of the development. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified as part of the report. b) Where the development proposes the backfilling of materials, the applicant is required to include a waste sampling strategy to ensure the material is inert. c) Mitigations should be proposed for any potential negative impacts on any water source(s) which may be in proximity and included in the environmental management plan and incident response. d) Any and all potential impacts on the nearby reservoir as public water supply water source(s) are assessed, including any impact on hydrogeology and any groundwater/ surface water interactions. e) Impacts of the development on the capacity of water services (*i.e. do existing water services have the capacity to cater for the new development*). This is confirmed by Irish Water in the form of a Confirmation of Feasibility (COF). If a development requires a connection to either a public water supply or sewage collection system, the developer is advised to submit a Pre-Connection Enquiry (PCE) enquiry to Irish Water to determine the feasibility of connection to the Irish Water network. All pre-connection enquiry forms are available from https://www.water.ie/connections/connection-steps/. f) The applicant shall identify any upgrading of water services infrastructure that would be required to accommodate the proposed development. g) In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an Irish Water collection network. h) In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks and potential measures to minimise and or / stop surface waters from combined sewers. i) Any physical impact on Irish Water assets – reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets. j) When considering a development proposal, the applicant is advised to determine the location of public water services assets, possible connection points from the applicant's site / lands to the public network and any drinking **Uisce Éireann** Irish Water abstraction catchments to ensure these are included and fully assessed in any pre-planning proposals. Details, where known, can be obtained by emailing an Ordnance Survey map identifying the proposed location of the applicant's intended development to datarequests@water.ie. k) Other indicators or methodologies for identifying infrastructure located within the applicant's lands are the presence of registered wayleave agreements, visible manholes, vent stacks, valve chambers, marker posts etc. within the proposed site. l) Any potential impacts on the assimilative capacity of receiving waters in relation to Irish Water discharge outfalls including changes in dispersion / circulation characteristics. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified within the report. m) 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 Irish Water for public supply should be identified within the report. n) Where a development proposes to connect to an Irish Water network and that network either abstracts water from or discharges wastewater to a "protected"/ sensitive area, consideration as to whether the integrity of the site / conservation objectives of the site would be compromised should be identified within the report. o) Mitigation measures in relation to any of the above ensuring a zero risk to any Irish Water drinking water sources (Surface and Ground water). *This is not an exhaustive list.* **Please note;** • Where connection(s) to the public network is required as part of the development proposal, applicants are advised to complete the Pre-Connection Enquiry process and have received a Confirmation of Feasibility letter from Irish Water ahead of any planning application.	**Section 9.2.2.** The suggested relevant legislation and guidance used. b) – **Sections 9.5.2.1 & 9.5.2.2** c) – **CEMP and Section 9.5.2.15** d) – **Sections 9.5.1.1 & 9.5.1.2** e) – **Sections 9.5.2.6 & 9.5.2.7** l) – **Section 9.4.4.11** m/n) – **Section 9.3.11** o – **Section 9.4.4.10**

Consultee	Type and Date	Summary of Consultee Response	Areas in this Chapter that address these points
		• Irish Water will not accept new surface water discharges to combined sewer networks.	
Geological Survey of Ireland (GSI)	Letter Received on 8th February 2023	*"Please see attached a submission on behalf of Geological Survey Ireland (a division of the Department of the Environment, Climate and Communications) for the subject entity."* The attached letter dated 8th Feburary provides useful information and GIS resources held by GSI on the geological and hydrogeological resource of the locality with particular focus on geoheritage, groundwater, geological mapping, geotechnical database resources, geohazards, and natural resources (minerals/aggregates). **Groundwater** Geological Survey Ireland's Groundwater and Geothermal Unit, provides advice, data and maps relating to groundwater distribution, quality and use, which is especially relevant for safe and secure drinking water supplies and healthy ecosystems. Proposed developments need to consider any potential impact on specific groundwater abstractions and on groundwater resources in general. We recommend using the groundwater maps on our Map viewer which should include: wells; drinking water source protection areas; the national map suite - aquifer, groundwater vulnerability, groundwater recharge and subsoil permeability maps. For areas underlain by limestone, please refer to the karst specific data layers (karst features, tracer test database; turlough water levels (gwlevel.ie). Background information is also provided in the Groundwater Body Descriptions. Please read all disclaimers carefully when using Geological Survey Ireland data. **The Groundwater Data Viewer indicates an aquifer classed as a 'Poor Aquifer - Bedrock which is Generally Unproductive' underlies the proposed wind farm development.** **The Groundwater Vulnerability map indicates the range of groundwater vulnerabilities within 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 assessments, as any groundwater-surface water interactions that might occur would be greatest in these areas.** Recommended guidelines to adhere to **Guidelines** The following guidelines may also be of assistance: • Institute of Geologists of Ireland, 2013. Guidelines for the Preparation of the Soils, Geology and Hydrogeology Chapters of Geology in Environmental Impact Statements. • EPA, 2022. Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR)	**Section 9.2.2.** The suggested relevant legislation and guidance used. All available data is used in the baseline descriptions of the site **Sections 9.3.7 – 9.3.13.** Mitigation measures have been outlined in Section 9.5, these measures ensure that all risks to surface and ground water receptors are reduced.
Leitrim County Council	Letter received on 19th May 2023	The preparation of the EIAR shall have regard to the guidance document, ***Guidelines on the information to be contained in Environmental Impact Assessment Reports*** (Environmental Protection Agency, 2022) in terms of the content and structure of the EIAR and prescribed environmental factors. Moreover, the relevant assessments, conclusions, recommendations and proposed mitigation measures to be presented in the EIAR shall be prepared by suitably qualified specialists within their respective environmental expertise. **Planning Policy Considerations** Any prospective planning application for the proposed development shall be assessed against the policies and objectives contained within the **Leitrim County Development Plan 2023-2029**. In this regard, the policies and objectives addressed in the following, but not exclusive, sections of the Plan are considered to be of particular relevance: **Section 2.2 – *Vision and Strategic Aims*** sets out a range of strategic aims and complementary strategic objective for the sustainable development of the county, including "*development that addresses climate change in terms of adaptation and mitigation measures including increasing flood resilience, the promotion of sustainable transport options and the development of renewable energy technologies where possible to achieve a successful transition to a low carbon economy".*	**Section 9.2.2.** The suggested relevant legislation and guidance used. Nature based solutions **Section 9.5.1.3** have incorporated vison and strategic aims in setting out ways of tackling surface water runoff and various effects caused by any developments.

9.3 BASELINE DESCRIPTION

9.3.1 Introduction

An investigation of the existing hydrologic and hydrogeologic characteristics of the study area was conducted by undertaking a desk study, consultation with relevant authorities and site-based fieldwork surveys. All data collected has been interpreted to establish the baseline conditions within the Study Area and the significance of potential adverse effects have been assessed. These elements are discussed in detail in the following sections**.**

9.3.2 Site Description

The Northern portion of the Site is connected via partially existing and proposed new access tracks. The Southern portion of the Site requires new access tracks which includes for connection to a substation at the site. The Site is characterised by relatively complex (hilly) topography with associated elevations ranging between c. 170 to 260 metres above datum (mAOD). The Site can be broken up into two sections, the north-western section is mostly forestry and has elevations around 250-260maOD, the south-eastern section is mostly peatland and ranges from 170 – 240maOD.

With reference to **EIAR Chapter 8: Soils and Geology,** landcover at the proposed Site is predominantly comprised of blanket peatlands, turbury, mature forestry and isolated areas of semi-improved grassland throughout the Site boundary. Land cover along the Grid Connection Route (Corine 2018)is noted as; 'land principally occupied by agriculture with natural vegetation', 'transitional woodland scrub', 'peat bogs'. The Turbine Delivery Route traverses the previously described land use as well as areas of 'discontinuous urban fabric', 'continuous urban fabric', 'pastures', 'beaches, sand dunes', 'intertidal flats', and 'industrial and commercial units'.

The Site is characterised by primarily mixed forestry, peatland, farmland habitat man-made drains and ditches. The area in which the turbines will be located, outside the setback buffer, ranges in elevation from 230m AOD in the south to 260m AOD in the north.

9.3.3 Regional and Local Hydrology

Surface water associated with the Site, GCR and TDR are mapped and presented in **Figure 9.6a, 9.6b.** The Regional Hydrology of elements related to the Project are presented in **Figure 9.2.**

Surface water networks associated with particular turbine locations are presented in the Surface Water Flow Chart in **Figure 9.3.**

The Site and the southern part of the and Grid Connection Route are situated within the Upper Shannon Catchment (ID:26; Area: 604.47km^2). The Northern part of the and Grid Connection Route is situated in the Sligo Bay Catchment (ID:35, Area: 1605.94km^2). The Turbine Delivery Route passes through the Donegal Bay North Catchment (ID:37, Area: 807km^2), the Erne Catchment (ID:36, Area: 3440.55km^2) the Sligo Bay Catchment (ID:35, Area: 1605.94km^2), the Upper Shannon Catchment (ID:26B, Area: 674.13km^2), the Upper Shannon Catchment (ID:26; Area: 604.47km^2) near the red line boundary of the Site.

Surface water runoff associated with the Site drains into two sub catchments and/or three river sub basins, or three no. rivers, 1 no. lough:

- Sub Catchment: Owengar (Leitrim)_SC_10, River Sub Basins: Owengar (Leitrim)_SC_010 and Diffagher_10, Rivers: Owengar (Leirtim)_010, Owengar (Leitrim)_020, Diffagher_010
- Sub Catchment: Shannon Upper_SC_020; River Sub Basin: Shannon Upper_040, Lough: Lough Allen

All surface waters draining from the Site eventually combine into Lough Allen, from which waters eventually flow to the Upper Shannon, Lough Corry, Tap North and Lough Boderg, Lough Forbes, Lough Ree, the Lower Shannon, Lough Derg, and Shannon Estuary through to the mouth of the Shannon and into the South Western Atlantic Seaboard.

9.3.4 Water Framework Directive Water Body Status, Risk & Objectives

Details in relation to the Water Framework Directive (WFD) 2016-2021 status assigned to surface waterbodies associated with the Development are presented in **Figures 9.4a-c,** and **Figure 9.3.** WFD Risks assigned to waterbodies associated with the Development are presented in **Figure 9.5 a-c** and **Figure 9.3** The WFD status

(2016-2021) for surface water bodies / rivers and streams directly draining the Site range are Good.

Rivers in Owengar (Leitrim)_SC_010:

- **Owengar (Leitrim)_010 (Code: IE_SH_26O020100)**
- Current Status: 'Good';
- WFD Water Quality Status 2013-2018: 'Good;
- WFD Risk: 'Not At risk'.

- **Owengar (Leirtim)_020 (Code: IE_SH_26O020200)**
- Current Status: 'Good'
- WFD Water Quality Status 2013-2018: 'Good;
- WFD Risk: 'Under Review' without any significant pressures.

- **Diffagher_010 (Code: IE_SH_26D020200)**
- Current Status: 'Moderate';
- WFD Status 2010-2015: 'Good'
- WFD Risk: 'Not At risk'

Surface water draining from site then flows downstream to Lough Allen and onwards to the River Shannon. Below are the first two Sub Catchment breakdowns.

Rivers and Lakes in Shannon Upper_SC_020:

- **Lough Allen (Code: IE_SH_26_716)**
- Current Status: 'Moderate';
- WFD Status 2013-2018: 'Moderate'.
- WFD Risk: 'At Risk' with Agriculture and pasture as significant pressures.

- **Shannon Upper_040 (Code: IE_SH_26S020500)**
- Current Status: 'Moderate';
- WFD Status 2013-2018: 'Moderate'.
- WFD Risk: 'At Risk' with significant pressures from 'Anthropogenic pressure'.

- **Shannon Upper_050 (Code: IE_SH_26S020550)**

- Current Status: 'Moderate;
- WFD Status 2013-2018: 'Moderate'.
- WFD Risk: 'Under Review' with Urban Waste Water as a significant pressures.

Rivers and Lakes in Shannon Upper_SC_030:

- **Shannon Upper_060 (Code: IE_SH_26S021010)**
- Current Status: 'Moderate;
- WFD Status 2013-2018: 'Poor'
- WFD Risk: 'At risk' with Domestic Waste Water, Urban Waste Water and Agriculture as significant pressures
- Protected Areas in River Waterbodies: Article 7 Abstraction for Drinking Water

- **Lough Corry (Code: IE_SH_26_710)**
- Current Status: 'Poor';
- WFD Status 2013-2018: 'Moderate'.
- WFD Risk: 'Under Review' with Domestic Waste Water and Urban Waste Water as significant pressures.

The groundwater body (Lough Allen Uplands – Code: IEGBNI_SH_G_002) underlying the Site (T1, T2, T3 and T4) is classified as 'Good' according to the WFD 2016-2021 assessment.

9.3.5 Site Drainage

The Site is characterised by a network of non-mapped natural and artificial drainage channels which are often found in forestry plantations and peat turbary areas. Commercial forestry inherently possesses extensive drainage networks, and for the purpose of this assessment these drains have not been mapped comprehensively due to access. Some forestry drains have been mapped on site visits, however other forestry drainage can be categorised as indicative / inferred drains, and all have been included in the constraints map. Historic peat cutting activities have left drains present on the site as seen and mapped on site visit. These can be categorised as both non-mapped significant drains (which feed into the mapped river for example) and minor drains. Drainage channels identified during desk study assessment and during site surveys are presented in **Figure 9.13a and 9.13b**. Photographs of some significant drainage features are presented in **Appendix 9.2**.

Existing surface water crossings associated with surface water features and relatively significant drainage features are also identified are presented in **Figure 9.13a**. It should be noted that the River Subbasins as mapped by the WFD do not correspond/line up with drainage ditches mapped from onsite surveys. While some drains were generally dry during site visits, the Site is considered to have a flashy regime with low permeability soils and standing water in some areas, **Appendix 9.2 – Tile 10**. A flashy regime is where intense rainfall periods will raise the levels of the rivers significantly as the groundwater recharge will reach capacity quickly.

9.3.6 Surface Water Hydrochemistry

Baseline surface water sampling was carried out at five locations, that can be seen in **Figures 9.6a** and **9.6b**, representative of drainage and surface water network channels associated with the Site (**Figure 9.6a**). With reference to **Appendix 9.3**, data on surface water flow and hydro-chemistry at representative baseline sampling locations during two sampling events do not indicate excess amounts of the nutrients tested, in all five locations. Laboratory certificates are presented in **Appendix 9.4**. Surface water quality observed at all five monitoring locations is generally of similar standard and is generally of good quality when screened against relevant reference concentrations.

- Ammoniacal Nitrogen as N was at the relevant reference concentration (0.02mg/l Ammoniacal Nitrogen as N) at all five monitoring locations during the dry sampling event and at SW2 during the wet sampling (Min Max Range; <0.01 – 0.02mg/l Ammoniacal Nitrogen as N). Elevations occurred during both monitoring events.

Elevated concentrations of Nitrogen (Ammoniacal Nitrogen) compound as observed at all monitoring locations is indicative of current land pressures and practices at the Site, i.e., agriculture.

9.3.7 Hydrogeology – Bedrock Aquifer

Bedrock aquifers associated with the Wind Farm Site and GCR are mapped and presented in (**Figures 9.7a).**

Consultation with GSI Groundwater maps (2022) indicate that the entire Site is underlain by a 'Poor Aquifer (Pu), that is ''*bedrock which is bedrock which is generally unproductive''* **Figure 9.7a.**

The Grid Connection Route is underlain by the same classification of aquifers 'Poor' (Pu), Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones (Pl) **Figure 9.7b.**

With reference to **EIAR Chapter 8 Soils and Geology**, there are no karst features are found within the Site. However mapped karst features have been identified within 10km of the Site. Various karst features (i.e., enclosed depressions and swallow holes and caves) have been identified by the GSI (2022) c.5.2km south-west from the Site. No mapped karst features are within 5km of the Grid Connection Route. The Turbine Delivery Route does not require any intrusive ground works; therefore the underlying geology does not pertain to the scope of the project.

9.3.8 Groundwater Vulnerability & Recharge

Vulnerability depends on the quantity of contaminants that can reach the groundwater, the time taken by water to infiltrate to the water table and the attenuating capacity of the geological deposits through which the water travels. These factors are controlled by the types of subsoil that overlie the groundwater, the way in which the contaminants recharge the geological deposits (point or diffuse source) and the unsaturated thickness of geological deposits from the point of contaminant discharge.

Where low permeability subsoil overlies the bedrock, it is the thickness of subsoil between the release point of contaminants and bedrock that is considered when assessing vulnerability of bedrock aquifers, regardless of whether the low permeability materials are saturated or not. The GSI vulnerability mapping guidelines allow for the assignment of vulnerability ratings from "extreme" to "low", depending upon the subsoil type and thickness. With regard to sites where low permeability subsoil is present, the following thicknesses of unsaturated zone are specified.[7]

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[7] Geological Survey Ireland (2022) Story Map Series. Available at: <https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228>

Table 9.10: Groundwater Vulnerability Ratings

Vulnerability Rating	Thickness of unsaturated zone (m)
Rock at or Near Surface (X)	0
Extreme (E)	0 to 3
High (H)	3 to 5
Moderate (M)	5 to 10
Low (L)	>10

Consultation with the GSI Groundwater Map Viewer (2022) indicates that the Wind Farm Site is underlain by areas classified as 'Moderate (M)' vulnerability rating (**Figure 9.8a – Groundwater Vulnerability**).

The Grid Connection Route traverses land with similar groundwater vulnerability ratings ranging from 'Low Vulnerability' to 'Extreme Vulnerability', **Figure 9.8b.** Groundwater vulnerability for the Turbine Delivery Route is presented in **Figure 9.8c.** The groundwater vulnerability along the Turbine Delivery Route ranges from 'Low Vulnerability' to 'Extreme Vulnerability'.

The potential groundwater recharge rate (recharge coefficient) for the local area, as mapped by GSI, ranges significantly depending on the underlying soil / subsoil type and varies significantly relative to the thickness of overburden or aquifer vulnerability, and corresponds to the recharge capacity of the underlying bedrock aquifer as presented in **Section 9.3.9**. The entire Site is underlain by a 'Poor Aquifer - Bedrock which is generally unproductive' and will therefore have an inferred maximum recharge capacity per annum assigned, that is; effective rainfall available for recharge but in excess of maximum recharge capacity will form rejected recharge once conditions become saturated.

Groundwater Recharge for the proposed Wind Farm as mapped by the GSI (2022) is presented in **Figure 9.9a.** The maximum recharge capacity of the aquifer will limit recharge to groundwaters.

Peat has very low permeability, however peat stores large amounts of water, that is; bog water levels in intact peatland areas are generally near the surface [8]. Combining

[8] Labadz J, et al (2010) Peatland Hydrology. Draft Scientific Review, IUCN UK Peatland Programme's Commission of Inquiry on Peatlands. UK.

these factors results in the Site being characterised by low recharge rates and high surface water runoff rates. In this case recharge coefficient is 4.00, which is extremely low.

In peat areas associated with the Site the mapped groundwater recharge coefficient is as low as 10% of effective rainfall **(Appendix 9.1 SFRA).** This recharge coefficient is considered very low [9]. Whereas areas where bedrock is at or near the surface the mapped groundwater recharge coefficient is 85% of effective rainfall. This recharge coefficient is considered very high. However, the maximum recharge capacity of the aquifer will limit recharge to groundwaters.

Areas underlain by Poor Aquifer (Pu) possess a maximum recharge capacity of 100mm effective rainfall per annum (**Figure 9.9a**). For additional context, the maximum recharge capacity or 100mm per annum equates to a recharge coefficient of approximately 7.5% of effective rainfall respectively, in line with peat which is considered highly impermeable with a recharge coefficient <20%.

Considering all of the above, the Site is characterised by very low recharge rates in overburden (soils/subsoils) and very high recharge capacity in the underlying bedrock aquifer.

Baseline Site Run-off Volumes

There are limited hydrometric stations situated on the above river systems and limited data where available. Therefore, preliminary water balance calculations will use approximate catchment areas associated with the Site upstream of baseline surface water sampling locations (**Appendix 9.1 Strategic Flood Risk Assessment**) to estimate baseline storm runoff discharge rates (outlined in **Section 9.3.9** below) at the Site.

9.3.9 Flood Risk Identification

A Site Flood Risk Assessment (SFRA) Stages 1 & 2 for the Wind Farm Site is presented in **Appendix 9.1**. Conclusions are summarised as follows;

[9] Williams N. H., et al. (2011) A NATIONAL GROUNDWATER RECHARGE MAP FOR IRELAND. National Hydrology Conference 2011, Ireland.

- The Site is not within a probable flood zone, however the Site has the potential to adversely affect areas liable to flooding elsewhere downstream, if proper mitigation measures are not followed.
- The development at the Site will lead to a net increase in runoff equating to 30.06/s/ha (litres per second) 0.102 m^3/second or 2.61% relative to the site area. This is considered an adverse but imperceptible impact of the Development.
- The associated drainage will be attenuated for greenfield run-off and the Development will not increase the risk of flooding elsewhere in the catchment.

A summary of the preliminary flood risks can be identified in **Figure 9.11**.

9.3.10 Wells

Consultation with GSI (2022) well database indicates there are no mapped wells within the Site boundary, **Figure 9.10a**. Governing industry guidelines stipulate a buffer zone of 250m is required of from boreholes used for drinking water abstraction when assessing excavations for turbine foundations. The closest mapped wells are more than 5km from the boundary of the wind farm Site in the townland of Derrynahinch and c. 6km away from any works associated with the development during the construction phase, suggesting that any potential impact from the Development is low risk for wells in the immediate vicinity.

With reference to the Baseline Description in this report, the groundwater aquifer underlying the entire Site is a Poor Aquifer (PU).

There are no mapped wells within a 250m buffer zone of the Grid Connection Route. The majority of the Grid Connection Route traverses land underlain by both a LI aquifer and a PU aquifer. Any identified boreholes along these routes will highlight the significant potential for the Development to impact groundwater supplies in local zones. However, when a 250m buffer is applied to each induvial well they do not intersect with the proposed works, therefore governing industry guidelines for groundwater buffer zones required for boreholes used for drinking water abstraction do not apply **(Figure 9.10)**.

Consultation with GSI (2022) well database for the Turbine delivery Route is presented in **Figure 9.10,** however as the Turbine Delivery Route does not require any intrusive ground works, the wells along the route does not pertain to the scope of the project.

9.3.11 Groundwater Levels, Flow Direction & Groundwater Hydrochemistry

Groundwater flow patterns, or the water table of an entire aquifer, can often mimic surface water flow patterns. Overall, groundwater will follow the regional topographical gradient of a given area, moving along flow paths from areas of recharge to areas of discharge, i.e., surface waterbodies. Therefore, groundwater flow directions at the Site are presumed to follow the topography of the area, and flow paths are considered to be short due to the poorly productive underlying bedrock aquifer. Groundwater flow likely circulates in the upper overburden saturated zone, recharging and discharging in local zones; thus, the groundwater is considered to be 'young'.

Due to the absence of any recorded groundwater quality data within or proximal to the study area, no published data on groundwater quality for the Site is available. However, the 2016-2021 WFD Groundwater status for groundwater underlaying the Site is 'Good' (Groundwater unit: Lough Allen Uplands) and is considered not at risk. Peat at the Site is generally Peat Depth Range **0.10 – 5.50m**. Average peat depth = **1.98m** (**Chapter 8: Soils & Geology**). Moderate peat depths were recorded within the Site, ranging from 0m to 2.5m in thickness.

The majority of the northern part of the site is covered by forestry and peat depths in excess of 5m were recorded. No evidence of peat cutting was recorded in the northern part of the Site. Peat Depth distribution is outlined in **Chapter 8: Soils and Geology**.

9.3.12 Designated Sites & Habitats

Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), often referred to as "European Sites" or "Natura 2000 Sites", are the means by which European legislation protects threatened or rare habitats and species. Candidate sites (i.e. cSAC or cSPA) have the same level of protection as fully designated sites under Irish Law. Candidate sites are those that are currently under consideration by the Commission of the European Union for SAC or SPA status in accordance with the Habitats Directive. Natural heritage areas (NHAs) are designated areas that are protected under the Wildlife Act 2000 for areas considered important for the habitats present or which hold species of plants and animals whose habitat needs protection. Proposed natural heritage areas (pNHAs) are sites not yet offered the same statutory protection as NHAs but which may become NHAs in due course and are sites of significance for wildlife and habitats.

Designated and Protected Areas associated with the Project are detailed in **Figure 9.3** and presented in **Figure 9.12a-c.**

9.3.12.1 Wind farm

The Site is not positioned within or directly adjacent to or immediately upstream of any designated or protected area (SPA, SAC, NHA). Downstream European Sites which are hydrologically connected to the Site are displayed in **Figure 9.3.** The nearest designated area in relation to the Site is the Corry Mountain Bog NHA (**Figure 9.12a**):

- Corry Mountain Bog NHA (EPA/NPWS Site Code: 002321) situated approximately c. 0.9km south of the Site.
- Carrane Hill Bog NHA (EPA/NPWS Site Code: 002415) situated approximately c.4.5km south-west of the Site.
- Boleybrack Mountain SAC (EPA Site Code: 002032): situated approximately 6.5 km to the north-east of the Site .
- Lough Gill SAC (EPA/NPWS Site Code: 0001976) is approximately 10km north-west of the Site .
- Cuilcagh – Anierin Uplands SAC (EPA Site Code: 000584): located 16km east of the Site
- Lough Arrow SPA (EPA/NPWS Site Code: 004050) and Lough Arrow SAC (EPA/NPWS Site Code: 001673) are situated c. 15km south-west of the proposed Site.

9.3.12.2 Grid Connection Route

Presented in **Figure 9.12b** are the nearest designated or protected areas (SPA, SAC, NHA), which consists of the Corry Mountain Bog NHA as the Wind Farm.
Downstream Protected areas associated with the Grid Connection Route are outlined in **Table 9.2** in **Section 9.1.1.4**.

9.3.12.3 Turbine Delivery Route

Sections of the proposed Turbine Delivery Route intersects various SACs, SPAs, and NHAs. These designated sites are listed below;

- Unshin River SAC (ID: 001898)

- NHA Cummeen Strand/Drumcliff Bay (Sligo Bay)
- Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (ID: 000627)
- Cummeen Strand (ID:004035)
- Lough Melvin NHA/SAC (ID:000428)
- Lough Eske and Ardnamona Wood SAC (ID:000163).

The TDR works will be relatively minor, consisting of the modification of street furniture, tree pruning etc. However, some areas will require more extensive works such as road widening on the R285, R280, and L-4282 to accommodate the transport of wind turbine elements.

9.3.13 Water Resources

There are no mapped rivers designated for drinking water in accordance with European Communities (Drinking Water) (No. 2) Regulations 2007 (SI no. 278/2007) present within the Development footprint. The nearest downstream drinking water is a drinking water lake; Lough Forbes 45km Downstream.

Groundwater is, however, nationally protected under the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. no. 278/2007).
Groundwater in the entire area (nationally) is protected under the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. no. 278/2007). From data examined on the EPA maps, beneath the site the drinking water - groundwater is named Lough Allen Uplands.

9.3.14 Receptor Sensitivity

All receptors associated with the Development i.e., groundwater, streams and rivers, are considered highly sensitive receptors when considering;

- Water Framework Directive (WFD) status (2016-2021) generally ranging from Moderate to Poor. The principal objective of the WFD is to achieve good status or higher in all waters and to ensure that status does not deteriorate in any waters.
- The down-stream designations (sensitive protected areas e.g., SAC, SPA) associated with the catchment and the sensitive habitats and species associated with same.

- The designation of all waterbodies within the boundary of the Site and downstream surface water bodies and all groundwater bodies as sources of drinking water.

Ultimately, all surface waters and groundwaters associated with the Site are considered sensitive and important attributes in their own right and must be protected in accordance with the WFD to achieve and maintain at least 'Good' status. However, waterbodies associated with additional receptor sensitivities such as designated and protected areas (e.g., SAC, SPA), should be considered at the highest level on the sensitivity scale, due to the increased risk associated with specific additional ecological attributes they possess. For instance, while a potential effect, e.g. sediment stock pile collapse into a surface waterbody, could have a temporary impact on the river or stream itself where suspended solids would be washed away from the incident and 'diluted' with the assimilative capacity of the river; on the other hand, the effects could be long lasting and potentially lead to the collapse of a species.

Risk to receptors must consider both the hazard, and likelihood of adversely impacting on any given sensitive receptor, and therefore parameters such as, distance from potential source of hazard to receptor, pathway directness and/or connectivity, and assimilative capacity of the receiving water body will also be considered.

In terms of groundwater sensitivity and susceptibility, as discussed in previous sections, all groundwater associated with the Site is protected as a source of drinking water, under the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. no. 278/2007). Data from the EPA maps have indicated that there are no pressures on the groundwater of the site (Groundwater unit: Lough Allen Uplands) in comparison to the nearby groundwater unit: Geevagh which is currently in 'Good' status but is 'At Risk' and faces agricultural and anthropogenic pressures.

However, the bedrock aquifers underlying the site and surrounding area range from Poor aquifer except for local zones (PI) to Locally Important (LI), which can be expressed as an aquifer with relatively poor production and low connectivity (PI) and relatively low to moderate production and connectivity (LI) respectively, and therefore the risk of potential adverse effects on groundwater will be limited to localised zones within the Site.

In terms of surface water sensitivity, as stated above, the vast majority of potential contaminants or unmitigated adverse effects will infiltrate to surface water bodies, however sensitive receptors are of variable distance from the Project and the pathways are of variable condition for each proposed turbine location and for any part of the Project.

There are no Salmonid protected rivers hydrologically linked to the Site when investigated with EPA map viewer, there are however identified Shellfish areas in the West Shannon Ballylongford (IE_SH_060_0000), West Shannon Poulnasherry Bay (IE_SH_060_0000), West Shannon Carrigaholt (IE_SH_060_0000), West Shannon Rinevella (IE_SH_060_0000).

9.3.15 Do Nothing Impact

The "Do Nothing Impact" is the effect on the Site should the Project not be constructed. Site investigations and assessment of the baseline hydrological and hydrogeological conditions at the Site indicate that parts of the Site have already experienced effects to baseline conditions through the planting and the installation of drainage networks associated with forestry (**Appendix 9.2 Tile 10**).

Agriculture / land reclamation activities (reconstitution of soils and drainage) have had an impact to the Site relative to absolute baseline or (hypothetically) perfect natural conditions with regard to the hydrology or hydrogeology of the Site in terms of drainage infrastructure in particular. Those activities are likely to apply pressure to the receiving surface water network and potentially regularly contribute nutrients and/or suspended solids to the receiving surface water systems. Release of contaminants will likely peak on occasion particularly during intrusive activities such as tillage or after heavy rainfall events.

Should the Project not proceed, the existing land-use practice of agriculture and cattle grazing, will continue with associated gradual alteration of the existing environment and associated pressures on surface water and groundwater quality.

9.4 ASSESSMENT OF POTENTIAL EFFECTS

9.4.1 Introduction

This section will outline all potential effects arising from the Project and assess these effects using legislation and guidelines outlined in **Sections 9.4.2** and **Section 9.4.3**. Mitigation measures for these potential effects are addressed in **Section 9.5** of this Chapter.

9.4.2 Qualifying the Magnitude of Potential Effects – Surface Water

The European Communities Directive 2000/60/EC established a framework for community action in the field of water policy known as the Water Framework Directive (WFD). Ireland has published the draft River Basin Management Plan (2022-2027) which defines the actions that will be taken to improve water quality and achieve "good" ecological status in rivers, lakes, estuaries and coastal waters by 2027. The WFD is the overarching mechanism by which water quality management areas are divided and assessed.

The receiving environment in terms of surface water associated with the Development is considered as being of Very High Importance and Highly Sensitive, and therefore classification of any potential effects associated with the Development will be limited to Magnitudes associated with Very High Importance, as presented in the following table.

Table 9.11: Weighted Rating of Significant Environmental Effects – Surface Water Systems

Sensitivity (Importance of Attribute)	**Magnitude of Impact**			
	Negligible (Imperceptible)	**Small Adverse (Slight)**	**Moderate Adverse (Moderate)**	**Large Adverse (Significant to Profound)**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

In terms of determining and assessing the magnitude of effects on surface water features, categories of magnitude relate to the potential effect on the status of the attribute, that is; the attribute driving the classification of sensitivity such as the WFD status , and condition of the surface water feature/s, the risk of not reaching WFD objectives and the potential for the surface water system to support, or function as part of designated and protected areas (SAC, SPA, NHA etc).

9.4.3 Qualifying the Magnitude of Potential Effects – Groundwater

The receiving environment in terms of groundwater associated with the Development is considered as being of High Importance and Medium Sensitivity, and therefore classification of any potential effects associated with the Development will be limited to Magnitudes associated with Medium Importance as a conservative approach which is presented in the following table.

Table 9.12 Weighted Rating of Significant Environmental Effects – Groundwater Systems

Sensitivity (Importance of Attribute)	Magnitude of Impact			
	Negligible (Imperceptible)	**Small Adverse (Slight)**	**Moderate Adverse (Moderate)**	**Large Adverse (Significant to Profound)**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

In terms of determining and assessing the magnitude of effects on groundwater features, categories of magnitude relate to the potential effect on the status of the attribute, i.e. the attribute driving the classification of sensitivity is the aquifer potential classification and use as a drinking water source, the proximity of the Site to groundwater wells, condition of the groundwater feature/s, the risk of not reaching WFD objectives, the GSI groundwater vulnerability classification and the potential for the groundwater system to support, or function as part of designated and protected areas (SAC, SPA, NHA etc).

9.4.4 Construction Phase Potential Effects

9.4.4.1 Increased runoff from site

The Site has the potential to result in increased rates of runoff during the operational phase relative to baseline conditions. This is a function of increased hydraulic loading, the progressive excavation and removal of vegetation cover and replacement with hardstanding surfaces (effectively or assumed impermeable) and installation of constructed drainage along the Site redline boundary and thus removing the hydraulic absorption / buffer control from this part of the Site. Such an increase in surface water runoff, or an increased hydrological response to rainfall, has the potential to exacerbate flooding events and impact on hydro morphology of waterbodies downstream of the development, and/or to exacerbate flooding and erosion within the boundary of the Site.

Minimal land take is associated with the Grid Connection Route, considering all proposed works will traverse already existing public roadways.

Land take will be required for the Turbine Delivery Route in the form of widening of existing portions of roads, however, considering the small scale of disturbance (shallow excavation, superficial paving) the impact is considered slight. Similarly, there is unlikely to be a significant increase in the rate of runoff from the construction of both these routes due to utilisation of pre-existing road infrastructure. None the less, mitigation and best practice construction activities will be implemented, minimising the potential impact on Hydrology and Hydrogeology.

9.4.4.2 Ground Disturbance and Diffuse sediment laden run-off

The construction phase of the Development will involve the following primary excavations and earthwork activities which may have the potential to adversely impact on surface water and groundwater:

- Construction of site access tracks
- Temporary Construction Contractor Compound and Welfare Facilities
- Turbine Foundations and hardstand areas
- Foundations for the proposed substation

- Foundations for the proposed Met Mast
- Trenching for underground electrical cabling, including along the proposed Grid Connection Route.
- Temporary stockpiling of subsoils and bedrock.
- Widening areas along the TDR.

All of the above mentioned excavations which will be required will necessitate the removal of vegetation, the excavation of underlying tills and mineral subsoils. Such excavations and associated ground disturbance may increase the risk of either point source or diffuse sediment laden run-off to sensitive receptors via drainage channels and discharge routes. The proposed earthworks therefore have the potential to result in the release of elevated suspended solids to surface waters, particularly during prolonged heavy rainfall events. The release of elevated suspended solids to watercourses would adversely affect water quality and potentially adversely affect aquatic habitats downstream of the discharge source point if not mitigated against. The most vulnerable areas to surface water quality deterioration through the release of elevated suspended solids are considered to be:

- Turbine Hardstand and infrastructure Development particularly in close proximity to existing drainage channels (T2, T3 and site access tracks from T3 to T4), refer to **Figure 9.13a.**
- Proposed Grid Connection Route the 7 water course crossing points along with any existing culverts identified along the route.

The potential unmitigated release of elevated suspended solids to surface waters is considered to be a **direct, moderate to significant in scale, adverse, potentially Significant / Profound weighted significance**, impact of the Project. This potential impact is considered to be in **contrast to baseline** conditions, considering the mobility characteristics of surface waters to downstream receptors, it is not considered reversible. However, with appropriate mitigation measures outlined in **Section 9.5.2.1** and **9.5.2.2** in place and via the implementation of environmental engineering controls, this impact will be reduced to within water quality regulatory limits. Potential effects impacting on water quality are discussed in greater detail in the following sections of this chapter.

9.4.4.3 Clear Fell of Afforested Areas

Felling of forestry at the Site will be necessary for areas of the Development in afforested sections within the Redline Boundary. This is an **unavoidable** consequence of the Development. Turbines T1 and T2 are within afforested areas. Subsequently, tree felling will be required as part of the Development. To facilitate the construction of site access tracks, civil works, Temporary Construction Compound, spoil storage areas, ecological enhancement area and Turbine Hardstands, approximately c.2ha coniferous forestry will need to be clear-felled, as detailed in **Appendix 2.4.** The likely felled area of approximately c.2ha will represent approximately 4.4% of the proposed Site area (Redline Boundary of c.45ha). In a spatial or land use context this is considered a **slight** effect.

The clear fell of afforested areas is in line with baseline conditions and future activities as part of Do-Nothing impact. Therefore, in the context of the Development, the clear fell of forestry overall is considered **neutral**, however there is a range of potential **adverse** impacts associated with the activity which will require management and mitigation. Potential effects include.

1. Soil erosion, compaction and degradation: The removal of trees and underbrush during clear-felling can expose soils to wind and water erosion, leading to soil loss, compaction and degradation. This is mainly caused by vehicular movements (**Section** Error! Reference source not found. **Figure 9.1a**).
2. Geology: Clear-felling can cause changes in the geology of an area, leading to soil instability, landslides, and other geological hazards (**Chapter 8 Soils and Geology)**
3. Hydrology & Hydrogeology: The removal of trees and vegetation can lead to changes in hydrological processes, causing changes in water flow rates and patterns, such as the lowering of water tables.
4. Water quality: Clear-felling can cause increased sediment runoff and nutrient pollution in waterways, which can impact water quality, negatively affecting aquatic ecosystems and downstream water users.
    - Soil nutrient loss and nutrient loading of receiving waters: Clear-felling removes vegetation and leaves soil bare, exposing it to weathering, which can cause the entrainment of solids and/or the loss of soil nutrients, essential for plant growth. This in turn will lead to an increase in nutrients i.e., Nitrogen and Phosphorous compounds, dissolved organic carbon,

potassium etc. in receiving waters flowing from the Site, which is considered a negative impact of the Development.

The overall potential effects here are considered to be of **moderate** significance**, permanent but reversible**, and **adverse**, though this is of a minor scale in comparison to the normal forestry activities taking place at the Site (i.e., **small-scale** felling proposed). If the Development does not take place, it is likely that the forestry at the Site will eventually either be clear felled or felled in larger volumes than the amount proposed as a function of this Development. Therefore, the resulting incremental felling of the afforested area will benefit the receiving environment, namely the receiving surface water network by means of reducing the potential magnitude of impacts, namely erosion, solids entrainment, and shock nutrient and sediment loading. With appropriate mitigation measures **Section 9.5.2.9**, planning and management this impact can be reversed, and disturbance minimised.

9.4.4.4 Release of Suspended Solids

Excavation and construction activities, associated with the Development, such as stockpiling material and vehicular movements of plant machinery introduce the risk of solids being entrained in runoff. Runoff contaminated with suspended solids will add turbidity to the receiving surface water body, can block fish gills and smother spawning grounds, reduce light penetration for flora growth, and promote bacteria and algae production. Nutrients that are associated with the solids (inorganic nutrients such as phosphorus and organic such as hydrocarbons, and sewage if present) can lead to eutrophication of the water environment and eventually to fish-kills due to lowering of oxygen supply.

The degree to which inorganic solids are entrained in runoff is related to the particle sizing of the soil components. Smaller inorganic particles (e.g. clay) will be easily entrained and will remain in suspension for a longer period than larger particles (silt / sand), and will require lower flow rates and longer retention rates to settle out of the water column when given the opportunity, dramatically impacting on water quality.

- Forestry operations will continue at the Site., forestry operations, harvesting and planting, will likely lead to a release of solids and nutrients entrained in surface water runoff.
- Peat soils behave differently to mineral soils, when it comes to some nutrients such as phosphorous. High organic matter soils (OM > 20%, i.e. peat) do not

adsorb Phosphorous (P) in the same way that mineral soils do. Therefore, P does not bind to peat soil particles, however mineral soils associated with forestry do have the capacity to build up or increase the store of phosphorous they hold.

- Release of suspended solids can be attributed to enhanced nutrient enrichment. This is highly dependent on the type of soil, and given the historical land use of the Site, i.e., forestry, and peat cutting in the vicinity of the Site. Soils / subsoils have the potential contribute varying degrees of loading of various compounds and nutrients, including Nitrogen (N) and Phosphorous (P) compounds, which are attributed to Nutrient Enrichment, or excessive loading of N and P in waters leading to eutrophication and potentially profound adverse effects on ecological attributes downstream of the Site.

During excavation, storage and reuse of materials, it is likely that a high volume of suspended solids will be entrained by surface water runoff and intercepted by surface water networks associated with the Project, particularly during sustained rainfall events and when in close proximity to receptors, i.e. temporary material storage areas.

The aspects of the development most likely to impact surface water quality and result in deterioration are:

- Exposed soils / subsoils generally, including new drainage channels, temporary stockpiles.
- Turbine hardstand and infrastructure development, particularly in relatively close proximity to surface water receptors, and in areas characterised by extensive existing drainage networks which present a direct connection to mapped surface water features.
- Construction of infrastructure within drainage buffer zones (site tracks and internal cabling will cross buffers in a perpendicular direction i.e., so as to minimise any potential effects), and/or instream works associated with proposed watercourse crossing locations.

Earthworks in relation to reinstatement must also be considered. In addition to potentially direct adverse effects on ecological sensitivities down-gradient of the Site, runoff of suspended solids will potentially impact on the WFD status and objectives associated with the surface water networks both within and downstream of the

Project. Considering the '*Moderate'* quality of the baseline surface waters draining from the Site and the spoil storage areas, in addition to the sensitivity and 'Very High' importance of the associated surface water networks, any introduction of contaminants is considered an adverse impact of high significance.

Mechanism/s

- Construction activities; Excavation, handling/transport, temporary storage of soils / subsoils / bedrock, vehicle tracking.
- Erosion in areas impacted by construction activities.
- Erosion in areas with newly formed preferential pathways for water runoff.
- Peat / slope stability, significant or localised.
- Reinstatement activities; similar to construction.

Impact

- Release of suspended solids and nutrients entrained in runoff, intercepted by surface water network.

Receptor/s:

- Surface Water. Surface water quality, ecological sensitivities and WFD status.

The potential release of elevated suspended solids to surface waters is considered an **unavoidable, direct and indirect, adverse, moderate to profound significance, moderate scale** impact of the Project This potential impact is considered to **conform to baseline** conditions when considering the intensive nature of the construction phase, however forestry practices (felling activities will occur on Site, and therefore occasional temporary release. Considering the long ranging mobility of surface waters, this potential impact **is not considered reversible** and can have indirect impacts upon receptors downstream (i.e., potential regionally). However, with the implementation of mitigation measures and appropriate environmental engineering controls, **Section 9.5.2.3**, this impact can be reduced to within water quality regulatory limits.

There is not likely to be a significant effect posed by entrained solids on groundwater due to the natural process of filtration associated with percolation of water through soils. This principle is particularly pertinent at a Site of this nature where a combination of low permeability subsoils beneath the peat and low recharge rates at the Site are anticipated.

Chapter 8: Soils and Geology indicates that peat depths are generally moderately deep as well as shallow. With reference and upon review of the Peat Stability Hazard Assessment (**Section 8.3.8 Chapter 8**) indicate that the Factor of Safety is generally acceptable and very low stability risk across the Site.

The Development will invariably alter drainage at the Site which if unmanaged has the potential to create new preferential pathways for runoff potentially leading to erosion of soils / construction materials and entrainment of solids in runoff in the process.

9.4.4.5 Reduction in Site Stability

During the construction phase of the Development, vehicles will cross over or excavate into areas in order to construct the proposed access tracks, hardstands, and gain access to the proposed Development areas. There is the potential for soil compaction, erosion and degradation during such vehicular movements. Localised stability issues, and erosion or degradation of soil by e.g., vehicular movements, have the potential to increase the potential for entrainment of suspended solids in surface water runoff, impact or obstruct established drainage networks, and increase the amount of excavation works required generally which in turn increases the potential for standard effects associated with earthworks. Earthworks in relation to reinstatement must also be considered.

Potential localised peat stability issues, and erosion or degradation of peat such as by vehicular movements have the potential to increase entrainment of suspended solids in surface water runoff, impact or obstruct established drainage networks, and increase the amount of excavation works required generally which in turn increases the potential for standard effects associated with earthworks. This is considered an **unavoidable, direct and indirect, adverse**, **moderate to significant**, **localised and potentially regional** effect on receiving surface waters. However, with the implementation of mitigation measures and appropriate environmental engineering controls (**Section 9.5.2.4**), this impact can be reduced. While **small to moderate** in scale this effect is considered to **conform to Baseline** (e.g., forestry operations).

[1] Assuming mitigation measures described in **Chapter 8 – Soils and Geology** and in this chapter are implemented and adhered to, localised stability issues are unlikely to give rise to effects on surface water networks associated with the proposed Development.

[2] With reference to **Section 8.3.8 Slope Stability** in **Chapter 8 – Soils and Geology**, the risk of mass movement of peat is considered to be low. Of the 146 No. peat probe localities surveyed, under both FoS Scenario A and FoS Scenario B yield a result that the risk of a peat slide occurring at any proposed turbine or infrastructure element location are considered to be "Low''.

9.4.4.6 Release of Hydrocarbons and Storage

Hydrocarbons are a pollutant risk due to their inherent toxicity to all flora and fauna organisms. Hydrocarbons chemically repel water and do not readily dissolve in polar solvents such as water. Most hydrocarbons are light non-aqueous phase liquids (L-NAPL's) that they are less dense than water. If hydrocarbons are accidentally released to water, they will therefore float on the water's surface. Hydrocarbons adsorb onto the majority of natural solid objects they come in contact with, such as soil, vegetation and animals. Hydrocarbons will burn most living organic tissue they come in contact with due to their volatile chemistry. Hydrocarbons also represent a nutrient supply for adapted micro-organisms, this process in turn can rapidly deplete dissolved oxygen and thus result in fish kills or mortality of water based vertebrate and invertebrate life.

During the construction phase, vehicles and plant associated with excavation, material transport, and construction activities introduce the risk of hydrocarbon spillages and leaks from fuels and oils. The risk is increased when regular refuelling is required which in turn implies the requirement of a designated refuelling area which will likely require fuel storage on Site. Alternatively, the fuel could be supplied by fuel tanker scheduled to refuel the plant and equipment directly.

Hydrocarbons or any other forms of toxic chemicals such as paints or adhesives etc. accidentally released to the environment will likely be intercepted by drainage and surface water networks at the Site. The low permeability subsoils beneath the peat and low recharge rates at the Site will inhibit the spatial distribution and temporal variation of hydrocarbon mass and concentration should an accidental spill occur.

This results in limited potential for contaminant movement through peatland. Therefore, the risk to subsoils / peat is limited, and in turn the risk to groundwater at a significant scale is also limited.

Mechanism/s:

- Lubricants and other construction consumables – minor in scale.
- Fuel leak from personnel vehicle – minor in scale.
- Fuel leak from plant machinery – minor in scale.
- Fuel spill during refueling – significant in scale.
- Fuel leak from storage - significant in scale.

Impact:

- Release of hydrocarbons in runoff, intercepted by surface water network.
- Release of hydrocarbons to ground, intercepted by groundwater.

Receptor/s:

- Surface Water. Surface water quality, ecological sensitivities and WFD status.
- Groundwater. Groundwater quality for the purposes of extraction.

With regards to surface waters at the Site, an accidental hydrocarbon spillage is considered a likely, adverse, direct, significant to potentially profound, Profound weighted significance, medium to long term impact of the Project, which is in contrast to baseline conditions. However, with implementing mitigation and best practice the risk of an accidental spill can be greatly reduced.

In terms of groundwater associated with the Site an accidental hydrocarbon spillage is considered to be a **likely, adverse, significant, Significant weighted significance, localised medium to long term** impact of the Project, which is in **contrast to baseline** conditions. With the implementation of appropriate mitigation measures and environmental engineering, these potential risks can be significantly reduced.

9.4.4.7 Release of Waste Water Sanitation Contaminants

The installation of permanent sanitation facilities at the Site will not be required for the operational phase of Development. The Development does however include for temporary sanitation facilities for site workers during the construction phase.

Therefore, the Development has the potential to result in the accidental leakage of wastewater or chemicals associated with wastewater sanitation onto soils and ultimately into surface waters during the construction phase of the project.

Accidental release of wastewater to surface waters would likely result in an increase in biochemical oxygen demand (BOD) which in turn would lower the dissolved oxygen concentration and adversely impact on aquatic life. Wastewater sanitation chemicals are also pollutant risks due to their inherent toxicity to aquatic flora and fauna and their potential to adversely impact on the productivity or status of surface water systems. The level of risk posed by such temporary facilities is dependent upon the following key factors:

- The location of the proposed temporary sanitation facilities relative to sensitive receptors
- The condition, emptying schedule and maintenance of the facilities
- The level of toxicity of the chemical agents used to aquatic flora and fauna.

In addition to direct adverse effects on ecological sensitivities downgradient of the site, runoff of suspended solids and/or other contaminants will potentially impact on the WFD status and objectives associated with the receiving surface water networks associated with the Project. Considering the quality of the surface water draining from the site (baseline), and the 'Very High' sensitivity and importance of the associated surface water networks downstream, any introduction of contaminants is considered a potentially profound adverse impact of the Project.

Potential incidents of release contaminants at the Site will likely be short lived or temporary, however the potential effects to downstream receptors can be long lasting, or permanent. With appropriate environmental engineering controls and mitigation measures these potential effects can be significantly reduced.

A potential worst-case scenario(s) associated with wastewater sanitation is the potential for wastewater or sanitation chemicals to accidentally spill or leaking and to be intercepted by surface water drainage features, ultimately discharging to surface waters. This is considered to be an **unlikely, adverse, significant, Profound weighted significance, medium to long term** impact of the Development, which is in contrast to baseline. With the implementation of appropriate mitigation measures and environmental engineering, these potential risks can be significantly reduced.

9.4.4.8 Release of Construction or Cementitious Materials

The construction phase of the Development has the potential to result in the accidental spillage or deposition of construction waste into the surrounding soil environment. This in turn has the potential for waste materials to leach out toward preferential drainage flow paths that may ultimately be connected to the surrounding surface water network.

The accidental leaching of cementitious wastes such as concrete, lean mix or cement etc., can result in an adverse change to hydrochemistry which can adversely impact on sensitive aquatic flora fauna. Cementitious materials are highly alkaline and if accidentally released to surface waters can significantly elevate the pH concentration above the tolerance range of fish such as cyprinid and salmonid species. Freshly poured or wet concrete has greater potential to leach out towards preferential flow paths when compared to set concrete which is considered inert in comparison, the risk from wet concrete is further increased during periods of heavy rainfall. Surface water runoff that comes into contact with concrete will be impacted to a lesser extent than water percolating through lean mix concrete which will be impacted significantly. Regardless of the nature of the construction waste in question, the deposition of any construction materials or waste deposited at the Site that does not form part of the constructed development, even if inert, is considered contamination.

This process also gives rise to result in the accidental spillage or deposition of construction waste into soils and in turn impact on surface water runoff, or accidental spillages directly intercepted by drainage or surface water networks associated with the Development. The accidental spillage or deposition of construction materials such as wet or lean mix concrete which is intercepted by drainage or surface water networks is considered a **direct, adverse, moderate to significant, Significant / Profound weighted significance, temporary to medium term** impact of the Development, which is in **contrast to baseline**.

With the implementation of appropriate mitigation measures and environmental engineering controls, these potential risks can be significantly reduced and considered unlikely.

9.4.4.9 Excavation Dewatering & Construction Water

The dewatering of excavations during construction is likely to have significant adverse effects on surface water runoff quality in the absence of mitigation measures. Should dewatering of open excavations, Turbine Foundations etc. be required, the receiving engineered drainage and attenuation features will likely receive water discharges elevated in suspended solids. The potential overflow of such sediment laden water into the receiving downstream surface waters is considered to be a **likely, direct, adverse, potentially moderate to significant, potentially Significant / Profound weighted significance** of the Development.

This impact is considered to be in **contrast to baseline** conditions although it is also temporary. Although temporary, considering the mobility characteristics associated with flowing surface waters, it is not considered reversible. However, with the implementation of appropriate mitigation measures and environmental engineering controls, this potential impact can be reduced to within water quality regulatory limits. Potential effects impacting on water quality are discussed in greater detail in the following sections of this report.

Mechanism/s:

- Removal of surface water from excavations.
- Removal of groundwater – minor in scale.
- leak from plant machinery – minor in scale.
- spill during refuelling – significant in scale.
- leak of surface water or groundwater through pipes.

Impact:

- Release of suspended solids in runoff, intercepted by surface water network.
- Release of suspended soils to ground, intercepted by groundwater.
- Significant alteration of the hydrology of the area.

Receptor/s:

- Surface Water. Surface water quality, ecological sensitivities and WFD status.
- Groundwater. Groundwater quality for the purposes of extraction.

Potential dewatering through drainage in advance of excavation activities, or dewatering via pumping during excavation activities, will likely impact on groundwater and hydrogeological flow regimes at a localised scale but not at a regional scale. This is considered to be a likely, adverse, Slight weighted significance, localised impact of the Development which is in contrast to the baseline conditions.

The potential effects on groundwater during the proposed operational phase of the Development is considered to be not significant.

Considering the nature of the site i.e. greenfield, it is assumed that there is no significant source of ground contamination at the Site and therefore the potential to draw in contaminants during dewatering activities is not significant.

9.4.4.10 Diversion and Enhancement of Drainage

The Development will likely result in the diversion, alteration and/or enhancement of the existing drainage networks at the Site during the construction of the project relative to baseline conditions. The existing drainage network at the Site is mapped and presented in **Figure 9.6a**. Diversion of artificial drainage channels will be required at locations where the Development layout intercepts existing artificial drainage networks.

Diversion of drainage will be done under similar conditions to that described for instream works. While some of the existing drainage channels are observed to be dry during meteorological conditions which implies that over pumping or diverting of water flow may not be necessary. Nonetheless the methodology described for instream works will be implemented to mitigate the risk of any flow through the construction area or for unforeseen wet meteorological events.

Any newly installed drain will be fully formed prior to the diversion of existing drainage (**Appendix 9.5 – Tile 1**). Erosion control will be incorporated into the design (**Appendix 9.5– Tile 2),** this requires minimising the area of exposed soil in existing and newly established channels. This will include a combination of the use of coarse aggregate / crushed rock (non-friable / non-weak), engineered solutions and/or revegetation.

A series of temporary silt fences will be installed to mitigate against the entrainment and mobilisation of solids during key events during the construction process, for example, the initial use of the new diverted channel, or the infilling of the original channel made redundant **(Appendix 9.5 – Tile 12 & 13).** The use of silt screens as a form of mitigation during watercourse crossing works is considered a precautionary measure.

Considering that pre-existing natural and artificially established drainage networks are present at the Site, the diversion, enhancement or introduction of additional drainage features is considered a **likely, adverse, moderate, localised** impact of the Development which conforms to baseline conditions. However, there are potential risks associated with the earthworks required to carry out such drainage works, and it is very important to recognise the drainage and surface water network are connected, that is in terms of assessing source pathway receptor, the construction or diversion of drainage is connecting source, pathway, and receptor. The potential effects of excavations are addressed in **EIAR Chapter 8: Soils and Geology**. Management of storm and construction water runoff to prevent loading of the receiving network with contaminants in detailed in **Section 9.5.2.10**

9.4.4.11 Hydrologically Connected Sensitive Receptors

9.4.4.11.1 Designated Sites

Contaminants arising as a product of the Development will potentially be intercepted by the drainage and surface water network associated with the Site. The proposed Site is hydrologically connected to the SACs, SPAs and NHAs designated sites which are discussed in detail in **Section 9.3.14** and **Figure 9.3**).

Drinking Water

The geographical scale of catchments upstream of designated areas downstream of the Site (**Figures, 9.2 and 9.10b**) should be considered in terms of the assimilative capacity of the surface water systems which will buffer against any potential contaminants introduced at the Site, that is; contaminants will be 'diluted' in receiving waterbodies. This does not lessen potential adverse effects in the immediate vicinity of the Site and does not reduce the need for mitigation measures to be implemented but is considered a 'last line of defence' for the protection of designated areas downstream of the Site. This line of theory cannot be applied to drinking water rivers, though none are affiliated with the Site.

Surface waters, under the scope of the objectives of the WFD are considered attributes with the 'Very High' sensitivity and importance and will be protected in their own right. Although potential contamination incidents will be temporary in terms of the waters themselves, it is important to consider the potentially long lasting or potentially permanent impact/s of contaminants on the ecological attributes dependent on the surface water bodies associated with designated areas. Similarly, potential effects on drinking waters do not override the necessity to protect the river in its own right due to the fact that any abstracted water will be treated regardless of varying low levels of contaminants, but it is important to consider the societal impact of a catastrophic environmental incident whereby waters are potentially unsuitable for abstraction for a period of time due to excessive contaminant loading.

9.4.4.12 Effects on Watercourse Crossings

The Development has the potential to result in the release of contaminants, particularly suspended solids during the construction phase due to the proposed instream works (i.e., culverting), careful consideration is recommended in terms of potential direct effects arising from the Development when considering instream works.

As identified during field work investigations and illustrated in **Figure 9.6b**, watercourse crossings will be required for the Site access tracks and the proposed infrastructure as part of facilitating access to the proposed turbines. Culverts will be installed as identified at the pre-commencement phase. Designs considerations are shown in **Appendix 9.5 – Tile 2.** These crossings require detailed planning and consideration to ensure potential effects are assessed adequately and in turn mitigated against.

There is 1 new watercourse crossing required over an existing WFD mapped river. This will consist of a 4m high bridge and 14m wide infrastructure, with material fill required to bring the track to the elevated height.

Construction of any new watercourse crossing will have an inherent risk of resulting in adverse effects to surface waters due to the required ground disturbance through excavations and the movement of heavy plant and machinery and the proximity to the primary sensitive receptor which is the watercourse itself. Release of elevated suspended solids to surface waters due to excavations or other earthworks etc., or the accidental release of any form of anthropogenic contaminant such as fuels or chemicals during construction of new watercourse crossings are both potential significant adverse effects. This is considered a likely, adverse, significant, but temporary impact of the Development which contrasts to baseline conditions. The effects relating to the release of contaminants during earthworks is addressed in **Section 9.4.4.2** of this chapter.

Poor planning, design and construction methodology of new watercourse crossings can potentially result in significant changes in flow, erosion and deposition patterns and rates associated with the surface water feature. This in turn can potentially lead to flow being restricted leading to increased risk of flooding locally. In the absence of mitigation measures, these effects are considered a **likely, adverse, significant, Profound weighted significance, localised** effect of the Development which contrasts to baseline conditions.

9.4.4.13 Waterway disturbance from Instream Works

In stream works will be avoided as far as possible, however, infrastructure such as culverts over natural or artificial drainage channels and non-mapped rivers will require instream works.

In stream works have the potential to cause significant disturbance within the riverbed, or introduce contaminants directly to the surface water feature, potentially leading to significant effects to water quality, and potentially catastrophic effects to downstream ecological attributes sensitive to contaminant loading, including suspended solids. Works associated with the diversion, or enhancement of existing drainage features will also have similar effects.

Poor design of drainage features, including culverts, can also lead to gradual effects such as erosion, or changing of hydro morphological characteristics, including bottle necks or small diameter culverts, and elevated to rapid velocity discharge in areas with no attenuation features. In the absence of mitigation measures, these effects are considered a **likely, adverse, significant, Profound weighted significance, localised** effect of the Development which contrasts to baseline conditions.

However, with appropriate the design and construction of any parts of the Development involving in stream works can be controlled and managed in a way so as to minimise the potential for accidental releases of contaminants to the surface water receptor. Mitigation measures are outlined in **Section 9.5.2.11**.

9.4.5 Operational Phase Potential Effects

The Operational Phase (OP) of the Development will include maintenance and monitoring with a minor quantity of site presence in terms of personnel, welfare, and vehicles. In the context of operational staff / contractors during the OP, residual risk following the Construction Phase (CP) include the potential for; vehicular movements, accidental hydrocarbon or contaminant releases, wastes streams etc. The scale of potential impacts during the OP are small relative to the CP, however relevant mitigation measures outlined for the CP will be applied to maintenance and monitoring operations during the OP.

Other Operational Phase specific mitigation are described in the following sub-sections.

9.4.5.1 Increased runoff from Site

The Development has the potential to result in increased rates of runoff during the operational phase relative to baseline conditions. This is a function of the increased hydraulic loading, progressive excavation and removal of vegetation cover and replacement with hardstanding surfaces (effectively or assumed impermeable) and installation of constructed drainage along the Development footprint and thus removing the hydraulic absorption / buffer control from this part of the Site. The completed site footprint will comprise of Site Entrance, Turbine Hardstand areas, site access roads, Onsite Substation & Control Building, 2 no. Battery storage arrays, and Met Mast.

During prolonged heavy rainfall events, additional surface water runoff at increased flow velocity could increase hydraulic loading. Increased runoff, or an increased hydrological response to rainfall has the potential to exacerbate flooding events and impact on hydro-morphology of waterbodies downstream of the development (which in turn has the potential to result in enhanced erosion of watercourses and adverse impact on aquatic ecosystems), and/or to exacerbate flooding and erosion within the boundary of the Site. The installation of constructed drainage for the purposes of collecting either clean water or construction run off have the potential to alter the natural hydro morphology of the Site.

Preliminary water balance calculations indicate that the Development will lead to a net increase of surface water runoff of approximately 30.06/s/ha (litres per second) or 0.102 m3/sec (or 2.61 % relative to the area of the Site) during a 1 in 100-year storm event including 20% increase for climate change. This calculation, as shown in **Table 5** of the FRA **(EIAR Chapter 9 - Appendix 9.1),** assumes that all road and hardstand surfaces would be fully impermeable as a precautionary scenario which is unlikely to be considered as an option during the detailed design phase. Therefore, the actual runoff scenario is likely to result in a net increase of less than 2.00%. This is considered to be a **likely, adverse, imperceptible or not significant, imperceptible weighted significance, permanent** impact of the Development. The increase in hardstand area associated with the Development will likely impact on groundwater and hydrogeological flow regimes at a localised scale but not at a regional scale. This is considered a likely, adverse, imperceptible or not significant, Imperceptible weighted significance, permanent impact of the Development.

With appropriate environmental engineering controls and mitigation measures, i.e. attenuation features, these potential effects can be significantly reduced. Furthermore, if considered adequately, mitigation measures have the potential to have a positive impact on the hydrological response to rainfall at the Site, whereby, if the Development can reduce discharge rates at the Site below estimated greenfield or baseline runoff rates, the Development will have a beneficial impact by reducing the Site hydrological response to rainfall and mitigate against potential flood events downstream. Additionally, these measures promote the recovery and development of blanket peat habitats (e.g., Wet Heath and Blanket Bog), **EIAR Chapter 5 Terrestrial Ecology**. This is considered a beneficial impact in areas of existing cutover peat and a neutral impact in areas of intact blanket peat habitats. Assessment of hydraulic loading changes is presented in The Flood Risk Assessment.

Minimal land take is associated with the Grid Connection route, considering all proposed works will traverse already existing public roadways (i.e., Site access tracks to be constructed as part of the Project.

9.4.6 Decommissioning Phase

Decommissioning of the Development would result in the cessation of renewable energy generation at the end of the operational life of the wind farm with the removal of various infrastructural elements. The drainage network of the Site will be inspected by a SuDS hydrologist prior to any works commencing. The Decommissioning phase will involve the removal of the above ground elements of the wind farm which will require:

- De-energising of the Site via a high voltage (HV) disconnection followed by low voltage (LV) disconnection of turbines
- Controlled dismantling of turbine components such as blades, blade hub & nose cone, tower, nacelle (generator and gearbox) and transformer
- Controlled removal of the Met Mast
- Removal of de-energised underground cables and electrical control systems from ground and disposed of to a licensed recycling facility.

It is anticipated that the following elements of the wind farm will be removed during Decommissioning:

- 4 No. wind turbines and concrete plinths.
- Permanent meteorological mast.
- All associated underground electrical and communications cabling connecting the wind turbines to the wind farm substation. Ducting is to remain in-situ
- Removal of 2 No. battery storage units.

All other elements of the proposed development will remain in-situ. The Site Access Roads and associated drainage systems will serve ongoing forestry and agriculture activity in the area.

There will not be a requirement for additional drainage measures to be implemented during the Decommissioning phase of the Project. With the passage of time, the constructed drainage network will likely become full of deposited sediment and revegetation will naturally occur which has the potential to render the drainage system less effective over time. The Site will therefore revert over time to a more natural drainage regime. All anticipated effects are similar in nature to those already highlighted during the construction phase of the Development (**Section 9.4.4**), i.e., release of hydrocarbons, wase water / sanitation and suspended soils through the excavation of material in order to remove cabling from joint bay locations.

9.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

The Development has associated potential effects as described in the previous sections of this report. The following sections outline mitigation measures to be implemented during the design, construction, operational and decommissioning phases of the Development. Potential residual effects after mitigation measures are implemented are also described in the following sections.

9.5.1 Design Phase

9.5.1.1 Mitigation by Avoidance

The fundamental mitigation measure to be implemented during each stage of the Project will be avoidance of sensitive hydrological or hydrogeological receptors wherever possible, this key principle is referred to as "mitigation by avoidance". This principle has been adopted during the design of the turbine and associated infrastructure layout across multiple design iterations. Hydrological constraints maps have been developed which identified areas of the Site where surface water and drainage constraints resulted in areas of the Site being deemed less suitable for development. The constraints map is presented in **Figure 9.13a, 9.13b**.

The final Site layout plan has been identified as the optimal layout design available for protecting the existing hydrological regime of the Site, while at the same time incorporating and overlaying engineering and other environmental constraints.

9.5.1.2 Mitigation by Design

The descriptive mitigation measures outlined in this report will be applied to the development design and construction methodologies with a view to avoiding and/or minimising any potential adverse effects to water quality in the receiving surface water network. Details on how such measures will be applied (objectives, design considerations, layout) will be contained in a Surface Water Management Plan (SWMP) (see Management Plan 3 appended to the CEMP, EIAR **Appendix 2.1**). The aims and examples of important considerations in relation to mitigation measures described in the EIAR are further clarified here.

9.5.1.3 Nature Based Solutions

Nature Based Solutions (NBS) will be adopted at the Wind Farm site where possible, Refer to **EIAR Chapters 5,6,** and **7** for additional information. NBS include Sustainable Drainage Systems (SuDS), which will be employed to attenuate runoff and reduce the hydrological response to rainfall at the Site. Extending or maximising this approach sufficiently has the potential to attain net beneficial effects i.e., a net reduction in runoff rates at the Site, beneficial effects to water quality and reducing flood risk to downstream flood risk areas. Coupling SuDS with ecology and biodiversity mitigation can also provide opportunities to attain net biodiversity gain. One of the main objectives of Nature Based Solutions and SuDS is to create an array of runoff stilling areas / standing water and promote diffuse discharge and recharge of runoff at the proposed Site. The objective of nature-based solutions will be to reverse the impact of the Development where there is the opportunity and where it is appropriate through surveying and risk assessment.

Runoff attenuation features or SuDS will be included as part of the Development as detailed in the following sections of this report. It is important to follow best practice and relevant guidance in the design and construction of drainage features. The following sections outline design considerations for working towards effective nature based solutions and net beneficial impact, for example; maximising the distribution of check dams and stilling ponds and similar features where appropriate *, with the objective of attenuating as much water as possible safely, and to promote diffuse discharge to vegetated lands where valued *.

* Much of the mitigation outlined in the following sections is intended to attenuate water on site and promote the diffuse discharge and recharge of runoff on peatland at the site. Nature based solutions including SuDS will be designed in a manner that respects the ongoing land uses and stakeholder values, where valid and in line with local, national, and international, law, policy and guidance. That is, where stakeholders have a right, and value the peatland, and intend to maintain existing drainage arrangements, the Development drainage design will incorporate checks on suitability particular features at given locations, and to direct runoff on site to suitable locations for targeting rewetting, or the promotion and maintaining of high bog water levels.

9.5.1.4 Constructed Drainage

Drainage features constructed at a site as part of a windfarm development have the potential to significantly adversely impact on the baseline hydrological regime, particularly in areas of intact habitat such as Wet Heath or Blanket Bog, but equally in peatland areas impacted by peat cutting there is the potential for the development to have a beneficial impact to the hydrological regime and to peatland regeneration. Peatland groundwater levels are generally dependent on rainfall. Rainfall infiltrates and percolates into peat/soil (recharge), initially through vegetated / root conduits in the acrotelm peat (living vegetated layer) or upper soil horizons, however percolation and/or permeability rates in peat, particularly the catotelm (decomposing lower layer) are poor and therefore peatland areas are characterised by rapid hydrological responses to rain fall i.e., rapid surface water runoff intercepted by the receiving drainage and surface water network. Due to this characteristic, peatlands require consistent rainfall to ensure adequate wetting of water dependant blanket peat habitats such as Wet Heath and Blanket Bog. Poor drainage design has the potential to drain excess surface water runoff and draw water away from areas of peatland, thus reducing the potential of recharge to ground in those areas, and creating an even greater hydrological response to rain fall in the receiving surface water network via more direct connections to the surface water network i.e., bypassing the peatland. Furthermore, uncontrolled surface water runoff interacting with the development footprint has the potential to lead to adverse effects including the development of new preferential pathways, erosion and peat degradation – particularly during and immediately after construction phase whereby unvegetated soils are exposed and wetting and/or drying of peat areas potentially occurs.

The drainage design for the proposed site (**Surface Water Management Plan, Appendix 2.1**) will be such that drains are positioned adjacent to the footprint of the development, therefore the proposed drainage infrastructure can be considered part of the Development footprint. The scale of the impact a shallow drain poses on the surrounding peatland area is minor particularly in areas impacted as baseline. Therefore, the potential magnitude or scale of impact to waters posed by the introduction of the proposed drainage extends to a minor extent beyond the footprint of the development. However, it is important to consider the gradual degradation over time.

The design of the proposed drainage network will facilitate:

- The collection of surface water runoff from upgradient of the development footprint (clean runoff interceptor drains) and the buffered redistribution of clean runoff downgradient of the development footprint by means of culverts and buffered outfalls to vegetated areas with a view to maintaining or improving the hydrological regime at the site.
- The collection of surface water runoff from the footprint of the development i.e., the construction area (construction runoff interceptor drains) and management of potentially contaminated runoff in the constructed treatment train. Where possible the buffered outfalls from the treatment train / stilling ponds will be

redistributed with a view to maintaining or improving the hydrological regime at the site.

- To achieve separation, clean water infiltration collector drains or silt fences are positioned on the upslope and dirty water v-drains positioned along the verge, with site surfaces sloped towards dirty water v-drains.
- Where extensive drainage networks exist, collected / diverted runoff will likely be diverted back into the existing network. In such instances it is important to include the existing drainage network in designing and specifying the treatment train and attenuation features, including improving, modifying, and constructing attenuation features in drainage channels. Similar to considerations for newly constructed drainage channels, the modification and/or improvements of existing drainage will be designed with a view to maintaining or improving the hydrological regime at the site.

Maintaining or improving the hydrological regime at the site implies achieving the objectives of the development Surface Water Management Plan (SWMP) (**Appendix 2.1**) i.e., mitigating against potential adverse effects to the hydrological response to rainfall at the site (related to flood risk), and water quality in the receiving surface water network.

9.5.1.5 Attenuation Features:

There remains the risk of the proposed drainage to increase the rate of runoff from respective upgradient areas, to reduce potential runoff to respective downgradient areas, and to increase the rate of hydrological response to rainfall in the receiving surface water system (increase hydrological response will also be driven by introduction of nearly impermeable hardstand).

Mitigation measures to address surface water runoff and drainage include in line attenuation features such as check dams and stilling ponds and buffered outfalls). Both check dams and stilling ponds provide mitigation against potential effects to water quality, erosion, and discharge velocity, however they also facilitate buffered and diffuse percolation of surface water runoff into the receiving environment along the permitter of the development footprint. Attenuation features have been designed to take account of a 1 in 100-year rainfall event and additional 20% for Climate Change.

9.5.1.6 *Check Dams:*

Check dams will be constructed along the length of constructed drainage at regular intervals in line with relevant guidance (**Section 9.2.2)**. Check dams (**Appendix 9.5.– Tiles 3-6**), will be permanent (for the life of the project / drainage network), made of suitable locally sourced coarse aggregate (similar geology), and are intended to attenuate (impede) surface water runoff in the drainage channel, therefore slowing the velocity of the runoff in turn reducing the potential for erosion in the channel and allowing suspended solids to settle out if present. At low velocity, the runoff has increased opportunity to percolate through the coarse aggregate and into the surrounding peat area, effectively contributing to bog water levels at that location.

9.5.1.7 *Stilling Ponds:*

Stilling ponds with buffered outfalls will be constructed at drainage outfalls associated with the construction runoff drainage network (**Figure 9.6a**). Buffered outfalls (**Appendix 9.5– Tiles 3-6, 15**), will be established at intervals along the clean runoff drainage network. Multiple outfalls along the drainage routes facilitates the strategic management of runoff with a view to maintaining the baseline hydrological regime in so far as possible. Similar to check dams; stilling ponds will be permanent (for the life of the projects / drainage network), made of suitable coarse aggregate, and are intended to attenuate surface water runoff in the drainage channel, slowing the velocity of the runoff before discharging to vegetated areas (buffered outfall). Slowing the water velocity allows suspended solids to settle out if present. At low velocity the runoff has increased opportunity to percolate through the coarse aggregate and into the surrounding landscape.

9.5.1.8 *Watercourse Crossings*

Construction of new, or upgrading of existing watercourse crossings will involve similar impacts as described in previous and following sections e.g., excavations and earthworks and entrainment of suspended solids etc. However, considering the proximity to surface water associated with this type of infrastructure the risk is elevated.

Poor design of new bridges or watercourse crossings can result in significant changes in flow, erosion and deposition patterns and rates in the watercourse, which can potentially lead to flow being restricted leading to increased risk of flooding locally, or water diverting and increasing the risk of flooding elsewhere. These effects would likely be significant adverse and permeant. These adverse effects are also likely during construction of a new bridge, however if the new bridge is well designed and facilitates or maintains the watercourses' characteristics, including for excessive flow events e.g. 1 in 100 year etc, such adverse effects would likely be temporary.

The bottomless bridge design will ensure the protection of the riparian bank structure, minimisation of sedimentation to the watercourse by use of silt fencing, sandbags or other sediment reducing measures, and minimisation of instream activity.

All mitigation measures are in line with IFI (2016) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters, Section 6 – River and Stream Permanent Crossing Structures. More details on this Watercourse crossing can be found in **Section 9.5.2.10.**

9.5.1.9 Constraints

The descriptive mitigation measures outlined in this report will be applied to the Development design and construction methodologies with a view to avoiding and/or minimising any potential adverse effects to water quality in the receiving surface water network. Details on how such measures will be applied (objectives, design considerations, layout) will be contained in the Surface Water Management Plan (**Appendix 2.1**). The aims and examples of important considerations in relation to mitigation measures described in the EIAR are further clarified here.

As part of mitigation by avoidance during the design phase of the Development, groundwater, surface water, and drainage buffer zones were established where applicable. Buffer zones are intended to drive the design process by minimising or avoiding the risk to surface water features by restricting construction disturbance to outside these zones, in turn protecting riparian vegetation and providing potential for filtering of runoff from the Site and maintaining the baseline hydrological and drainage regime at the Site. The prescription of surface water and groundwater buffer zones (sometimes referred to as setback distances), is in line with relevant guidance relating to forestry, agriculture, water resources, direct discharges and wind farm development guidance documents **(Section 9.2.2)**.

The available guidance stipulates varying surface water buffer widths depending on type of activity, receptor type and sensitivity, and riparian zone characteristics including topography (steepness). Recommended surface water buffer widths range from 5m to 50m depending on Site specific and activity specific characteristics. For the purposes of this assessment the following conservative approach has been applied:

- 50m Surface Water Buffer Zone - Mapped surface water features i.e., mapped streams, rivers, lakes. Source for mapped surface water features; EPA.
- 15m Drainage Buffer Zone - Non-mapped drainage features i.e., non-mapped streams, natural and artificial drainage features. Source for non-mapped surface water features desk study and aerial photography assessment, Lidar topographic data and field observations.

Wind Farm Surface Water Buffers are presented in **Figure 9.13a**. Grid Connection Route Surface Water Buffers are presented in **Figure 9.13b.**

Significant drainage features have been identified and mapped in so far as practical. Such drainage features, while not mapped or prescribed buffer zones, will be treated with the same consideration as mapped drainage during the design and construction phase of the development i.e., mitigating for the potential for drainage connection to receiving surface water network.

Groundwater buffer zones are dependent on the characteristics of the receptor e.g., private well, or public supply source protection zone, and the characteristics of the underlying geology and associated aquifer e.g., poor unproductive aquifer, or regionally important karstified aquifer. Recommended groundwater buffer zones range from e.g., 15m (exclusion zone karst swallow holes) to entire catchments, depending on site specific characteristics. For the purpose of this assessment the following conservative approach has been applied:

- 250m Groundwater Buffer Zone – Groundwater abstraction points in relation to foundations, proposed access tracks and cable trenches. Source for mapped abstraction points: GSI. Not applicable, none within 250m of the Site (**Section 9.3.13, Figure 9.10b**)
- Source Protection Areas – The entire area mapped as a public or group groundwater supply protection area. Source: EPA. This is applicable.
- Entire Catchment (poor aquifer) – The entire catchment associated with a public or groundwater supply protection area which is underlain with a poor aquifer. This will be assessed in detail as applicable. Not applicable.
- Karst Features – Not applicable. No karst features were identified on Site.

While not applicable to this Development, some of the Development infrastructure footprint could typically fall within buffer zones due to the unique and limiting circumstances associated with the Site and the Development, such as constraints related to other environmental disciplines including; ecology, ornithology, etc. restricted due to the proposed infrastructure itself whereby the proposed turbines require a minimum distance from each other to ensure the potential for wind turbulence impacting on downwind locations is minimised.

None of the proposed turbines or Turbine Hardstands fall within a buffer zone associated with a mapped stream / river.

The proposed Site Access Roads, associated widening where required, at watercourse crossings etc. naturally fall within buffer zones associated with mapped streams / rivers.

Some of the proposed Turbine Hardstands, and Site Access Tracks fall within buffer zones associated with existing natural and constructed drainage features at numerous locations (**Figure 9.13a**). These features pose an elevated risk in terms of connectivity to surface water receptors; streams and rivers, and also means that some of these features will require diversion.

Following site surveys, significant natural and artificial drainage features observed which are relatively well connected to the mapped surface water network have been included in considering constraints. Given the extensive drainage network existing at the Site the construction activities associated with the development will invariably be in close proximity to surface water / drainage features, including within the buffer zones such that there will be a requirement for further mitigation measures.

No groundwater buffer zones are required for the proposed Letter Development, refer to the baseline **Section 9.3** of this report. **NOTE:** With reference to **Chapter 8: Soils and Geology,** areas have been identified as Geo-Hazards and an effective drainage buffer zone will be applied whereby it is intended to divert runoff away from those areas. The areas in question are characterised as having steep incline, potential for deep till deposits and iron pan. These have elevated stability risk particularly in potential instances where hydrogeological conditions are adversely impacted, i.e., where the enhancement of recharge of groundwater and the perching of groundwater occurs in higher risk areas increasing pore water pressure against potentially parallel failure planes. Particular areas are discussed in **Chapter 8: Soils and Geology**, however in terms of drainage constraints, mapped High Landslide Susceptibility (GSI) (**EIAR Figure 8.6**) is used to indicate constraints in relation to hydrogeology and stability (**Appendix 8.1**). For example, areas which are particularly sensitive include:

- One mapped extent for a landslide is recorded within the landholding of Letter Wind Farm. The location of this mapped landslide is highlighted on the drawings contained in the appendix. The following details are recorded by GSI for this feature:
- The south portion of the site (T3 and T4). This area possesses high landslide susceptibility (GSI), extensive existing drainage channels.
- The Northern portion of the site has evidence of deeply eroded drainage channels in till with evidence of iron pan **(Appendix 9.2 – Tile 7).**

In the scenarios above, the Turbine Hardstands and associated drainage will divert runoff away from these higher risk areas and design the drainage network to place buffered outfalls in more favourable areas adjacent to the Development footprint.
Some of the Development footprint will fall within buffer zones due to the unique and limiting circumstances associated with the Site and the Development, including; the proposed infrastructure itself whereby the Grid Connection Route is limited to local road networks.

Portions of the Grid Connection Route pass through numerous surface water and 1 no. groundwater buffers **(Figure 9.13b).** Of note are the several watercourse crossings, which by their nature will be within surface water buffer zones. Given the extensive drainage network existing at the Site the construction activities associated with the Development will invariably be in close proximity to surface water / drainage features, including within the buffer zones.

Careful consideration and special attention to planning is required for the identified locations within the surface water buffer zones. The Surface Water Management Plan **(Appendix 2.1)** details multiple mitigation measures for works proposed within buffer zones. Each proposed construction location will possess unique characteristics and will require assessment on a case by case basis to ensure adequate measures are implemented. Method statements and the proposed design of any road crossings will also require agreement from Inland Fisheries Ireland (IFI) in advance of construction which invariably must be constructed within the buffer zones. The mitigation measures described in the following sections will also be applied.

9.5.2 Construction Phase

9.5.2.1 Ground Disturbance and Diffuse sediment laden run-off Proposed Mitigation Measures – Wind Farm

- Management and mitigation for earthworks is covered in further detail in **Chapter 8: Soils and Geology**. Mitigation measures to reduce the potential for adverse effects arising from earth works and management of excavated material – A Spoil Management Plan has been prepared and forms **Management Plan 4** of the CEMP (**Appendix 2.1**) which adopts the mitigation measures outlined below.
- No permanent stockpile will remain on the site during the construction or operational phase of the Development. Excavated materials will be stored temporarily at designated spoil areas.
- Temporary stockpile locations have been identified and will be used to avoid the temporary placement of any excavation arisings outside of the footprint of the development. Temporary stockpile areas will be managed to facilitate the orderly segregation of material types, be isolated from the receiving surface water network by the use of silt screens etc. and are limited in height (1m).
- Earthworks will be limited to seasonally dry periods and will not occur during sustained or intense rainfall events. Similar to measures outlined in relation to ground stability during excavation works (**Chapter 8: Soils and Geology**), an emergency response system has been developed for the construction phase of the project (see **Management Plan 1 – Emergency Response Plan** and **Section 5.10 of Management Plan 3, Appendix 2.1)**, particularly during the early excavation phase. This involves 24-hour advance meteorological forecasting (downloadable from Met Éireann) linked to a trigger-response system. When a pre-determined rainfall trigger levels is exceeded (e.g., sustained rainfall (any foreseen rainfall event longer than 4-hour duration) and/or any yellow or greater rainfall warning (>25mm in 24 hour) issued by Met Éireann), planned responses will be undertaken. These responses will include;
- Cessation of construction until the storm event including storm runoff has passed over,

- Following heavy rainfall events, and before construction works recommence, the Site construction areas and infrastructure will be inspected by and Environmental Clerk of Works to confirm no additional escalation of response is required; and
- Corrective measures implemented to ensure safe working conditions, for example, dewatering of standing water in open excavations, repair works to drainage features if necessary.
- Exposed soils (exposed temporary stockpiles) will be covered with plastic sheeting during all heavy rainfall / storm events and during periods where works have temporarily ceased before completion at a particular area (e.g., weekends, overnight, etc).
- Sediment fencing will be erected along proximal and paralleling areas of watercourses, channels and drains spanned by the works to reduce the potential for sediment laden run-off to reach sensitive receptors.
- No direct flow paths between stockpiles and watercourses will be permitted at the Site.
- All drainage infrastructure required for the management of surface water runoff will be established before excavation works commence. Similarly, mitigation measures related to surface water quality will be implemented before excavation works commence.
- Conceptual and information graphics presented in **Appendix 9.5 – Tile no. 8 - 9** present indicative layout and specification for both passive treatment trains (clean water interceptor drains), active management treatment trains (management and treatment of construction water) and emergency response and intervention.

9.5.2.2 Ground Disturbance and Diffuse sediment laden run-off Mitigation Measures – Grid Connection Route

The Grid Connection Route will require excavation of cable trenches in existing roadways. With reference to general excavation practices discussed above, excavation of cable trenches in close proximity to surface water features will require special consideration in terms of managing movements, spoil arising from excavations, and entrainment of solids and contaminants in surface water runoff.

Mitigation measures to reduce the potential for adverse effects arising from earth works and management of spoil include the following:

- In sensitive areas, excavation of material will be conducted in a controlled manner whereby any temporary deposit of the material in buffer zones can be minimised. For example, vacuum excavation techniques or similar will be used for excavations within Surface Water Buffer zones and other sensitive areas (constraints) (**Figure 9.12b and 9.13b)**. Excavated soil will be removed to temporary storage areas.
- Management of excavated material will adhere to the measures related to the management of temporary stockpiles outlined in **Chapter 8: Soils and Geology**, a Peat and Spoil Management Plan has been established and forms part of the Construction & Environmental Management Plan (CEMP, **Appendix 2.1, Management Plan 4**) with a view to establishing material balance during the proposed construction phase, thus minimising the potential for, or the length of time excavated materials are exposed and vulnerable to entrainment by surface water runoff. No permanent, or semi-permanent stockpile will remain on the site during the construction or operational phase of the Development.
- All spoil from trenches in public roadways will be removed form Site as it is excavated and transported to a licenced facility for soil and stones.
- Temporary stockpile locations will be situated outside of Surface Water Buffer Zones (as seen in **Figure 9.13b)**. Temporary Soil stockpiles shall have side slopes battered back to a safe angle of repose, e.g., 1:1. Silt fencing is to be erected around the base of the temporary mound. Soil will be reinstated on completion of drilling and jointing operations. Temporary storage areas will require bunding and management of runoff likely contaminated with suspended solids (**Appendix 9.5 – Tile 8**). Management of construction waters is discussed in following sections, **Section 9.5.2.7**.
- All unused spoil from trenches in public roadways will be removed from Site as it is excavated and transported to a licenced facility for soil and stones.
- Earthworks will be limited to meteorologically dry periods and will not occur during sustained or intense rainfall events. Similar to measures outlined in relation ground stability during excavation works (**Chapter 8: Soils and Geology**), and as discussed in this chapter, an emergency response system has been developed for the construction phase of the project (see **Management Plan 1** appended to the CEMP, **Appendix 2.1**), particularly during the early excavation phase. This, at a minimum, will involve 24 hour advance meteorological forecasting (Met Éireann download) linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g., 1 in 100 year storm event or very heavy rainfall at >25mm in 24 hours), planned responses will be undertaken. These responses will

include cessation of construction until the storm event including storm runoff surge has passed over. Following heavy rainfall events, and before construction works recommence, the site will be inspected and corrective measures implemented to ensure safe working conditions, for example dewatering of standing water in open excavations and transfer to treatment train.

9.5.2.3 Release and Transport of Suspended Solids Proposed Mitigation Measures

Conceptual and information graphics associated with mitigating runoff quality are presented in **Appendix 9.5 – Tiles 8 - 9.**

In order to mitigate the impact posed by release of suspended solids to the surface water environment, the following mitigation measures will be implemented. The drainage, attenuation and other surface water runoff management systems will be installed concurrent with the main construction activities to control increased runoff and associated suspended solids loads in runoff during intensive construction activities e.g., excavation of turbine base. Vehicular movements will be restricted to the footprint of the Development and advancing ahead of any constructed hardstand will be minimised in so far as practical. For example, excavation ahead of established hardstands will be in line with expected phases of Turbine Hardstand and Site Access Road construction in terms of both delivery of and installation of material and site activity periods whereby excavations will not be opened ahead of site shut down periods. This will be done with a view to minimising soils / subsoils exposure to rain and runoff. Drainage infrastructure will be installed during meteorologically dry ground conditions **(Section 9.5.2.1**).

Diffuse surface water runoff will be managed as follows:

- Collector drains and/or soil berms **Appendix 9.5 – Tile 7,** will be established to direct/divert surface water runoff from development areas, including temporary stockpiles, and direct same into established treatment trains including stilling ponds **Appendix 9.5 – Tiles 8 - 9**, buffered discharge points **Appendix 9.5 – Tiles 8 – 9,** or other surface water runoff control infrastructure as appropriate. This is particularly important for effective surface water management associated with proposed infrastructure within the 50m surface water buffer zones.
- Silt fences will be established along the perimeter of source areas e.g., stockpiles, within the drainage network, and in existing natural drains which

are likely to receive surface water runoff, **Appendix 9.5 – Tiles 12 & 13.** This will reduce the potential for surface water runoff loaded with suspended solids to rapidly infiltrate towards and be intercepted by drainage or significant surface water features. Where possible multiple silt fences will be installed at multiple locations in drains / treatment trains discharging to the surface water network. multiple silt fences / screens will be deployed at drains/outfalls discharging to surface waters. Silt fences will be temporary features but will remain in place for a period following the completion of the Construction Phase until such time that site conditions are stable.

Waters arising as a product of excavation activities will be managed as follows:

- Waters arising from dewatering practices during excavation works will be significantly loaded with suspended solids. As such, constructed stilling ponds **Appendix 9.5 – Tiles 8 – 9,** followed by buffered outfalls, **Appendix 9.5 – Tiles 8 – 9,** may be insufficient in controlling the release of suspended solids to the surface water network. Routine monitoring will prevent the possibility of clogging from significant volumes of settled or attenuated solids. Therefore, any water pumped from excavations, or any waters clearly heavily laden with suspended solids will be contained and managed and pumped through the preestablished Active Management treatment train (**Appendix 9.5 – Tile 8 and 9).** This will include continuous active monitoring of water quality by turbidity measurement on an hourly basis.

Waters (likely loaded with suspended solids) intercepted by the established drainage network will be managed as follows:

- In line Stilling Ponds **Appendix 9.5 – Tiles 8 – 9, Tile - 16,** will buffer the run-off discharging from the drainage system during construction, by retaining water, thus reducing the hydraulic loading to watercourses. Stilling ponds are designed to reduce flow velocity to 0.3m/s at which velocity, silt particle settlement occurs. Stilling ponds will be permanent (life of development at minimum). The locations of stilling pond have not been chosen as a part of the drainage design at this time**.** Flow control devices such as weirs and baffles will facilitate achieving better attenuation, particularly when considering fluctuating runoff rates.
- In line Check Dams will be constructed across drains (**Appendix 9.5 - Tiles 3 – 6)**. Check dams will reduce the velocity of run-off in turn facilitating the settlement of solids upstream of the dam. Check dams will also reduce the potential for

erosion of drains. Rock filter bunds may be used for check dams however, wood or straw/hay bales (**Appendix 9.5 – Tile 14**) can also be used if properly anchored, that is; supported with rock or fitted timber to reduce potential for material to be swept away by incoming water. Multiple check dams will be installed, particularly in areas immediately downgradient of construction areas. Check dams will only be constructed in drainage infrastructure and not in significant surface water features i.e., streams or rivers. Check dams (comprised of rock) established will be permanent. The following will be implemented in the design of check dams and their deployment (CIRA, 2004):

- Permanent rock filter bunds (coarse aggregate) will be used for check dams however, temporary wood or straw/hay bales can also be used if properly anchored and if the need arises. Permanent rock filter bunds are preferred as this will ensure that rapid surface water runoff is mitigated against for the life of the Development.
- Check dams will be installed at c. 20m intervals within the length of drainage channels. This is dependent on the slope angle and height of check dams constructed, refer to **Appendix 9.5 – Tile no. 3**.
- Check dams will include a small orifice / pipe at the base to allow the flow of water during low flow conditions i.e., maintain hydrological regime during low flow conditions. Note: the use of coarse aggregate will facilitate some infiltration.
- Erosion protection will be established on the downstream side of the check dam i.e., cobbles or boulder (100-150 mm diameter) extending at least 1.2m (**Appendix 9.5 – Tile no. 3 and 4)**.
- Check dams will be constructed as part of the drain i.e., reduce the potential for bypassing between the drain wall and check dam.
- Further details and design considerations are presented in **Appendix 9.5 – Tile no. 3 to 6.**
- Surface water runoff will be discharged to land via buffered drainage outfalls (refer to **Appendix 9.5 - Tiles 7 -8 and 15**. Buffered drainage outfalls will contain hard core material of similar or identical geology to the bedrock at the site to entrap suspended sediment. In addition, these outfalls promote sediment percolation through vegetation in the buffer zone, removing sediment loading to acceptable levels any adjacent watercourses and avoiding direct discharge to the watercourse. A relatively high number of discharge points / buffered outfalls will be established as part of the design, thus decreasing the loading on any particular outfall. Discharging at regular intervals mimics the natural hydrology by

encouraging percolation and by decreasing individual hydraulic loadings from discharge points.

- Buffered drainage outfalls will be located outside of surface water buffer zones **(Appendix 9.5 – Tile 15)**. Similarly, outfalls will not be positioned in areas with extensive existing erosion and exposed soils. Buffered outfalls will be fanned and be comprised of coarse aggregate (cobbles / boulders) (**Appendix 9.5 – Tile 11**). These structures will be akin to rip raps (coastal erosion defences/ outfall erosion defences). Silt fences **Appendix 9.5 – Tiles 12 – 13,** will be established downstream of buffered outfalls with a view to ensuring the effectiveness of the attenuation train, particularly during elevated flow events. Buffered outfalls established will be permanent.
- Very fine solids, or colloidal particles, are very slow to settle out of waters and the finest of particles require near still water and relatively long periods of time to settle, therefore, such particles are unlikely to settle despite the aforementioned measures. To address this, as required, flocculant will be used to promote the settlement of finer solids prior to redistributing to the treatment train and discharging to surface water networks. Flocculant 'gel blocks' are available and can be placed in drainage channels upstream of stilling ponds. Gel blocks are passive systems, self-dosing and self-limiting, however they still require management (by the Contractor's Environmental Manager and supervised by the Developer appointed Ecological Clerk of Works (ECoW), as per the manufacturer's instructions. Flocculants are made from ionic polymers. Cationic polymers (positive charge) are effective flocculants; however, their positive charge make them toxic to aquatic organisms. Anionic polymers (adverse charge) are also effective flocculants, and are not toxic i.e., environmentally friendly[10]. Therefore, when flocculants are required, the material used must be made from anionic polymer. Gel blocks will be a temporary measure during the construction phase.
- Straw bales (similar to stone check dams) (**Appendix 9.5 - Tile 14**), and silt fences (discussed under diffuse runoff) can also be used within drainage channels for the purposes of attenuating runoff and entrained suspended solids, however these measures should be considered temporary and will be used mainly in managing potential acute contamination incidents (e.g. additional features to control runoff

[10] USEPA (2013) Stormwater Best Management Practice – Polymer Flocculation (Available at: http://www.siltstop.com/pictures/US_EPA_Polymer_Flocculant_Handout__3-14.pdf)

during excavation works) or to facilitate temporary works (e.g. corrective actions, discussed in **Sections 9.5.2.9-10**). Note; the installation of straw bales or silt fences will require checking on a daily basis by the Contractor's Environmental Manager and supervised by the Ecological Clerk of Works (ECoW) to ensure the bypassing does not occur. Coarse stone / boulders could be used in conjunction with these measures to address such issues.

The above measures, buffer zones, constructed drainage, check dams, two-stage stilling ponds design for attenuation, buffered outfalls are referred to as *The Treatment Train*, whereby the runoff will continuously be treated from source (construction area) to receptor (site exit, outfall of attenuation lagoon). Where necessary (>25mg/l suspended solids) the treatment train will be augmented through the use of anionic polymer gel blocks. These measures reduce the suspended sediment and associated nutrient loading to surface water courses and mitigates potential effects to water quality and on plant and animal ecologies downstream of the site.

The precautionary and mitigation measures listed here will avoid, reduce or remedy all potential effects on water quality and will ensure that the sensitive receptors in the catchment of the development do not suffer any deterioration in water quality, either during construction, operation, or decommissioning.

9.5.2.4 Reduction in Site Stability Proposed Mitigation Measures

Mitigation measures for Vehicular Movements are mitigation measures by avoidance and good practices. These are previously detailed in **Appendix 2.1 CEMP.**

9.5.2.5 Release of Hydrocarbons Proposed Mitigation Measures

The following mitigation measures to reduce potential effects from the environmental release of hydrocarbons and other harmful chemicals to the surface waters will be implemented:

- Refuelling of vehicles will be carried out off Site to the greatest practical extent. This refuelling policy will mitigate the potential for effects by avoidance. Due to the remote location nature of the Site, it is unlikely that implementation of this refuelling policy will be practical in all circumstances (e.g., bulldozers, cranes, etc.). In instances where refuelling of vehicles on Site is unavoidable, a designated and controlled refuelling area will be established at the Site. The designated refuelling area will enable low risk refuelling and storage practices to be carried out during the works. The designated refuelling area will contain the following attributes and mitigation measures as a minimum requirement:

- The designated refuelling area will be located a minimum distance of 50m from any surface waters or Site drainage features
- The designated refuelling area will be bunded to 110% volume capacity of fuels stored at the Site
- The bunded area will be drained by an oil interceptor that will be controlled by a pent stock valve that will be opened to discharge storm water from the bund
- Management and maintenance of the oil interceptor and associated drainage will be carried out by a suitably licensed contractor on a regular basis, including Decommissioning following construction.
- Any oil contaminated water will be disposed of at an appropriate Licensed wate disposal site.
- Any minor spillage during this process will be cleaned up immediately
- Vehicles will not be left unattended whilst refuelling
- All machinery will be checked regularly for any leaks or signs of wear and tear
- Containers will be properly secured to prevent unauthorised access and misuse. An effective spillage procedure will be put in place with all staff properly briefed. Any waste will be collected, stored in appropriate containers and disposed of offsite in an appropriate manner.

Notwithstanding the management of refuelling and fuel storage at the designated refuelling area, the potential risk of hydrocarbon spills from plant and equipment or other general chemical spills at other areas of the Site remains. As a precautionary measure, to mitigate against potential spills at other areas of the Site, the following mitigation measures will be implemented:

- Oil absorbent booms and spill kits will be available adjacent to all surface water features associated with the Development. The controls will be positioned downstream of each construction area and at principal surface water drainage features. Oil booms deployed will have sufficient absorbency relative to the potential hazard

- Spill kits will also be available at construction areas such as at turbine erection locations, the Temporary Construction Compound, On site Substation, spoils storage areas and Mast location etc.
- Spill kits will contain a minimum of oil absorbent pads, oil absorbent booms, oil absorbent granules, and heavy-duty refuse bags for collection and appropriate disposal of contaminated matter
- Should an accidental spill occur during the construction or operational phase of the Development, such incidents will be addressed immediately, this will include the cessation of works in the area of the spillage until the issue has been resolved.
- Spill kits will be kept in each vehicle at the Site and will be readily available to all operators
- No materials, contaminated or otherwise will be left on the Site
- Suitable receptacles for hydrocarbon contaminated materials will also be available at the Site
- A detailed spill response plan will be prepared as part of the Site specific CEMP.

Implementation of the above mitigation measures will significantly reduce the risk of hydrocarbon contamination being released to the surface water network. Nevertheless, the potential risk cannot be entirely eradicated. Therefore, precautionary measures and emergency response protocols will be established and outlined in the Site specific CEMP.

9.5.2.6 General Overview of Works Mitigation Measures

- The timing of grid connection cable laying will be carried out during metrologically dry seasons/periods.
- An Ecological Clerk of Works (ECoW)will be onsite in order to lessen environmental disruption and ensure site integrity is maintained. The Ecological Clerk of Works (ECoW) will also be responsible for routine environmental monitoring and report writing.
- Methodology Statements of works, prepared by the Contractor, will be submitted to the local and relevant authorities associated with the Development.

- Any temporary access structures, put in place to allow machinery access to the area will be arranged in discussion with the Ecological Clerk of Works (ECoW) and the site will be fully restored post grid connection route works.

9.5.2.7 Good Practice of Plant Machinery

- Fuels, lubricants and hydraulic fluids for equipment use on Site will be carefully handled to avoid spillage, properly secured and provided with spill containment kits in case of incident to ensure best practice.
- Spill kits, hydrocarbon mats, oil booms etc., will be maintained at areas of works for emergency use and replaced when necessary.

9.5.2.8 Contingency Plan

- The method statements produced by the Contractors(s) will be reviewed by the Ecological Clerk of Works (ECoW) and will be agreed with the appropriate parties, including Leitrim County Council. The developer will employ a project manager to monitor the construction phase of the project and ensure works are being carried out in accordance with the agreed method statements, safety procedures and pollution control measures.
- Emergency contact numbers for the Local Authority Environmental Section, Inland Fisheries Ireland, the Environmental Protection Agency and the National Parks and Wildlife Service will be displayed in a prominent position within the site compound. These agencies will be notified immediately in the event of a pollution incident.

9.5.2.9 Release of Wastewater Sanitation Contaminants

A temporary compound area will be constructed on-site to contain temporary facilities for the construction phase including welfare facilities **Chapter 2: Project Description, Section 2.6.6**. This will be stabilised with the laying of hardcore material on top.

During the construction phase, foul effluent will be periodically removed by tanker (licenced contractor) for offsite disposal at a licenced wastewater treatment plant.

Wastewater/sewerage from the staff welfare facilities located in the Temporary Construction Compound will be collected and held in a sealed storage holding tank, fitted with a high-level alarm. The high--level alarm is a device installed in the storage tank that is capable of sounding an alarm during a filling operation when the liquid level nears the top of the tank. Chemicals are likely to be used to reduce odours.

All wastewater will be emptied periodically, tankered off-site by a licensed waste collector to the local wastewater sanitation plant in Drumkeeran for treatment. There will be no onsite treatment of wastewater. A wastewater or sewerage leakage is not anticipated in a properly managed Site.

9.5.2.10 Release of Construction and Cementitious Materials Proposed Mitigation Measures

In order to mitigate the potential impact posed by the use of concrete and the associated effects on surface water in the receiving environment, the following precautions and mitigation measures are recommended:

- A dedicated, bunded area will be created to cater for concrete wash-out and this will be within the temporary construction compound located to the south of T4. This will be for the wash-out of the chutes only after the pour. Concrete trucks will then exit the Site and return to the supply plant to wash out the mixer itself.
- The procurement, transport and use of any cement or concrete will be planned fully in advance of commencing works by the Contractor's Environmental Manager and supervised at all times by the Developer appointed Ecological Clerk of Works (ECoW). This entails minimising quantities on Site, planning delivery routes and washout stations.
- Precast concrete will be used wherever possible i.e., formed offsite. Elements of the Development where the use of precast concrete will be used include structural elements of watercourse crossings (closed culverts) as well as Cable Joint Bays. Elements of the Development where the use of precast concrete is not possible includes turbine foundations and joint bay pit excavations. Where the use of precast concrete is not possible the following mitigation measures will apply.
- Lean mix concrete, often used to provide protection to main foundations of infrastructure from soil biome, can alter the pH of water if introduced, which would then require the treatment of acid before being discharged to the surrounding environment. The use of lean mix concrete will be minimized, limited to the requirement of turbine foundations. The risk of runoff will be minimal, as concrete will be contained in an enclosed, excavated area.

- Vehicles transporting cement or concrete to the Site will pass through a designated wash out station **Appendix 9.5 - Tile 11** and be visually inspected for signs of excess cementitious material prior to being granted access to the Site. The wheel wash facility will be provided near the Site entrance so that the wheels of vehicles entering or exiting the Site can be cleaned prior to entering or exiting the Site.This will prevent the likelihood of cementitious material being accidentally deposited on the site access tracks or elsewhere at the Site or on the public road network.
- Drivers of such vehicles will be instructed to ensure that all vehicles are washed down in a controlled environment prior to the departure of the source site, such as at concrete batching plants.
- Concrete will be poured during metrological dry periods/seasons in so far as practical and reasonably foreseeable. This will reduce the potential for surface water run off being significantly affected by freshly poured concrete. This will require limiting these works to dry meteorological conditions i.e., avoid foreseen sustained rainfall (any foreseen rainfall event longer than 4-hour duration) and/or any foreseen intense rainfall event (25mm in a 24 hour period, yellow on Met Éireann rain forecast maps), and do not proceed during any yellow (or worse) rainfall warning issued by Met Éireann. This also will avoid such conditions while concrete is curing, in so far as practical.
- Pouring of concrete into standing water within excavations will not be undertaken. Excavations will be prepared before pouring of concrete by pumping standing water out of excavations to the treatment train and buffered surface water discharge systems in place.
- Any shuttering installed to contain the concrete during pouring will be installed to a high standard with minimal potential for leaks. Additional measures will be taken to ensure this, for example the use of plastic sheeting or other sealing products at joints.
- No surplus concrete will be stored or deposited anywhere on site. Such material will be returned to the source location or disposed of off-site appropriately. Concrete washing will be contained and managed similarly.
- Raw or uncured waste concrete will be disposed of by removal from the Site and returned to the source location or disposed of appropriately at a suitably licensed facility.
- Designated washout of concrete trucks shall be strictly confined to the batching facility and will not be located within the vicinity of watercourses or drainage

channels. Only the chutes will be cleaned prior to departure from Site and this will take place at a designated area at the Temporary Construction Compound. The contents will be allowed to settle and the supernatant will be removed off site by licenced generator to a licenced waste water treatment plant.

- Temporary storage of cement bound sand (if required for construction of the substation building) will be on hardstand areas only where there is no direct drainage to surface waters and where the area has been bunded e.g. using sand-bags and geotextile sheeting or silt fencing to contain any solids in run-off.
- Ground crew will have a spill kit readily available, and any spillages or deposits will be cleaned/removed as soon as possible and disposed of appropriately.

9.5.2.11 Excavation Dewatering Proposed Mitigation Measures - Active Construction Water Management

In all instances where construction water, or runoff has the potential to entrain solids during excavation and other construction activities, runoff will be contained by means of temporary berms (lined geotextile of similar), bunds (lined) and sumps. This will be referred to as Dewatering. Construction water (contaminated) will be pumped to the Treatment Train (**Appendix 9.5 Tiles 7-9**).

Contaminated water arising from construction works, namely, excavations, and temporary stockpiling, will be contained and treated prior to release or discharge. The schematic presented here is a conceptual model of measures implemented to manage arisings and runoff (Letter headings align with **Appendix 9.5 – Tile 8):**

A. Arisings. Arisings from the launch / reception pit, or any other significant excavation (e.g., cable joint bays), will be directed the treatment train.
B. Temporary Bund. Arising control area i.e., a temporary bund. Gross solids will be temporarily deposited here. Water arising with the material will be allowed to drain to sump.
C. Sump / Pump. Sump will discharge by gravity / pumped to stilling pond.
D. Temporary Stilling Pond. This can be constructed using soils for bunding in combination with an impermeable liner.
E. Outfall. The outfall from the stilling pond will be buffered (coarse aggregate) to dissipate energy and diffuse discharging water.

F. Silt Screen. A silt screen will be in place down gradient of the Stilling Pond outfall. This is a precautionary measure to mitigate peak loads or surcharges in the system.

G. Monitoring Location/s. Discharge quality will be monitored in real time using telemetry systems. Monitoring of discharge quality will be carried out at the outfall of the stilling pond i.e., before being actually discharged to surface vegetation or surface water (licenced).

H. Sump / Pump. Discharge By-Pass. If water discharging from the stilling pond exceeds quality reference limits water will be diverted (pumped) from the stilling pond to the settlement / treatment tank.

I. Stilling Pond By-Pass. Similar to Discharge By-Pass, if conditions dictate water can be diverted directly to Settlement / Treatment Tank.

J. Settlement / Treatment Tank. A settlement tank will in line and ready to use if required i.e., water quality at stilling pond outfall fails to meet quality reference limits. The tank will be equipped with treatment systems which will be activated as the need arises, for example, very fine particles which are very slow to settle can be treated with a flocculant agent to promote settlement of particles.

K. GAC Vessel/s. As a precautionary measure, GAC (Granulated Activated Carbon) vessel/s will be in line and ready to use if required. GAC vessels are used to filter out low concentrations of hydrocarbons. Significant hydrocarbon contamination is only envisaged under accidental circumstances. If a hydrocarbon spill does occur, normal operations will pause and the treatment train will be utilised to remediate captured contaminated runoff.

L. GAC Vessel By-Pass. If the quality of the water is acceptable in terms of hydrocarbon contamination.

M. Treated water will be discharge by gravity / pump to the stilling pond for additional clarification, monitoring and buffered discharge to vegetated area.

N. Silt Bag. A silt bag can be used as alternative to stilling ponds. However, silt bags must only be used as primary method in lower risk areas i.e., outside of buffer zones, etc. Stilling ponds will be the primary method (D, N) is circumstances where risk is elevated, however a gate vale and silt bag can be included in the treatment train and used as an emergency discharge route in the event that the stilling pond needs remediation or maintenance.

In all instances, stilling ponds (D), Silt Bags (N) and outfalls (E) will be situated outside of surface water buffer zones. At many locations, works will be within buffer zones.

In these instances, waters can be pumped to the treatment train which can be positioned upgradient along the road (Grid Connection route) where discharge to vegetated areas / roadside drains can be managed.

Discharge of non-contaminated storm runoff to vegetated land within the Redline Boundary is not a licenced activity however this methodology is possible only under relatively low flow conditions (e.g., <2 litres per second (l/sec) typical of runoff over a relatively small site area. In the event that the expected incoming flow rate or dewatering rate is relatively high (>2 l/sec) a discharge licence will be acquired.
The discharge points will be identified during the licence application process. As discussed previously, the main components of the treatment will be positioned outside of the 50m surface water buffer zone where possible (**Figure 9.13a Figure 9.13b**). The Developer will identify suitable locations for the establishment of temporary infrastructure considering other variable such as traffic and access management. Similarly, the location of discharge points will be outside of buffer zones and into minor or non-mapped surface water / drainage features where possible. The subject drain will be inspected to ensure connection to the mapped network (not blocked).

The quality of the water being discharged will be monitored. If discharge water quality is poor (e.g., >25mg/l) additional measures will be implemented, for example, pausing works as required and treating construction water by dosing with coagulant to enhance the settlement of finer solids – this can be done in a controlled manner by means of a suitably equipped settlement tank, **Appendix 9.5 Tiles 8-9**). Collected and treated construction water will be discharged by gravity / pump to a vegetated area of ground within the Site, **Appendix 9.5 Tiles 8-9**). Silt fences will be established at the discharge area to ensure potential residual suspended solids are attenuated and the potential for erosion is reduced, **Appendix 9.5 Tiles 8-9**). The discharge area will be outside of 50m surface water buffer areas (similar to dewatering of excavations. The quality of water discharged will be in line with licence discharge limits assigned by the Council and will be monitored in real time (telemetry with 15 min sampling rate), as well as laboratory samples taken, analysed and reported and the frequency indicated in the licence. Daily sampling is recommended given the short duration and temporary nature of the works.

Discharging of construction water (trade effluent) directly to surface waters or groundwater is a licenced activity. (This is in accordance with Local Government (Water Pollution) Act, 1977 as amended).

9.5.2.12 Excavation Dewatering Proposed Mitigation Measures - Passive Construction Water Management

Passive management systems (**Appendix 9.5 – Tile 8**) include some of the features described in active management treatment trains. These include;

- Spoil bunds and/or temporary berms. Spoil bunds and/or berms will be constructed using either crushed rock or clean soils and overlain or lined with an impermeable layer e.g., geotextile or plastic membrane. These features are intended to control the movement of construction water / runoff with a view to;
    - Containing contaminated water (e.g., excavation spoil and runoff laden with solids). Temporary bunds will be used to manage spoil arising from drilling operations or saturated spoil arising from excavations in sensitive areas e.g., within SW buffer zones.
    - To divert runoff i.e., divert clean/storm runoff during construction works or contaminated construction water away from sensitive receptors such as drains/surface waters directly adjacent to construction areas.
- Silt screens, (**Appendix 9.5 -Tile 12 & 13**). These will be utilised in a similar sense to berms whereby, silt screens will be installed between construction areas and sensitive receptors, including:
    - At the outfall of the treatment train where discharging to vegetated ground or within non-mapped drains (within the Site boundary).
    - Along the perimeter of construction areas which are directly adjacent to watercourses or within surface water buffer zones. This includes all watercourse crossings and sections of Grid Connection Route alongside adjacent watercourses.

Passive systems are intended to function with minimal supervision, however in the management of construction water on this Site, in many cases the diverted water will likely require active management to ensure sensitive receptors are protected. For example, diverted storm–water, if clean can discharge to the receiving vegetated areas or existing drains, but any construction waters impacted by contaminants on the Site must be managed, and potentially active management / treatment is required.

9.5.2.13 Watercourse Crossings Proposed Mitigation Measures

The Development of the Wind Farm includes the construction of 1 no. watercourse crossings (**Figure 9.6a**).

The Grid Connection Route will encounter a total of 7 no. culvert crossings or watercourse crossings, **(Chapter 2: Project Description**). These crossings require detailed planning and consideration to ensure potential effects are assessed adequately and in turn mitigated against.

The proposed watercourse crossings are relatively near the head waters of the surface water network therefore, bridge or culvert specification and construction are envisaged to be of relatively low significance in terms of expected flow, etc. However, all watercourse crossings must be designed to facilitate peak, or storm discharge rates so as to avoid localised flooding and associated issues during storm events. Data presented in **Table 4.4** and **Table 4.5** of **Appendix 9.1 – Strategic Flood Risk Assessment,** indicate potential surface water discharge rates during a 1 hour storm event and a 24 hour storm event with a 1 in 100 year return period. Note: Upstream catchment areas are estimated and delineated by assessment of mapped catchment boundaries, topographical contours and existing infrastructure and associated drainage.

The above assessment is a conservative estimation which does not consider evapotranspiration or recharge to ground, or base flow and groundwater discharge to the respective surface water features.

In relation to the design and construction of watercourse crossings risk assessment and prescription of mitigation measures have been designed in accordance with relevant guidance and reference documents (**Section 9.2.2).**

Regulation 50 of the European Communities (Assessment and Management of Flood Risks) Regulations 2010 SI 122 of 2010 requires that: "No Person, including a body corporate, shall construct any new bridge or alter, Reconstruct, or restore any existing bridge over any watercourse without the Consent of the Commissioners or otherwise than in accordance with plans previously approved of by the Commissioners."

The word "watercourse" includes rivers, streams, and other natural watercourses, and also canals, drains, and other artificial watercourses.

The word "bridge" includes a culvert or other like structure.

The OPW is responsible for the implementation of the regulations and consent to construct any bridge will be sought from the OPW via their application process. Details on the application process and guidance / requirements of the bridge design and considerations in terms of flow can be found in the OPW guide Construction, Replacement, or Alteration of Bridges and Culverts (A Guide to Applying for Consent under Section 50 of the EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010 and Section 50 of The Arterial Drainage Act, 1945). The requirements of OPW have been incorporated into the design of the proposed watercourse crossings.

Where existing closed culverts/pipes are in place at existing watercourse crossings extending the existing closed culvert will minimise construction activities required and in turn minimise potential effects when compared to removal and replacing the entire watercourse crossing.

With reference to **Section 4.2** of the **Natura Impact Statement,** 2 No. of the proposed watercourse crossing locations (WCC-6, WCC-7) are associated with areas, or immediately proximate to surface water features with significant ecological sensitivity or importance. The principal risk to ecological sensitivities associated with proposed watercourse crossing works is the potential for adverse effects to water quality downstream of the Site, namely the potential for mobilisation of solids. It is also noted that watercourse crossing methodologies employed will ensure potentially long term / permanent effects downstream (e.g. scouring etc) or upstream (e.g. passage of fish) will be avoided, in line with 'good practice' defined by the Scottish Environment Protection Agency (SEPA).

Considering all of the above and considering baseline conditions – including ecological sensitivity and importance of surface water features associated with each of the watercourse crossings, suspended solid pollution will be avoided by use of a bottomless bridge culvert. Where a Bottomless Bridge Culvert is installed, in line with good practice as defined by relevant guidance (SEPA, 2010) whereby; the course of action serves a demonstrated need, minimises the potential for ecological harm.

- Considering the width of all waterbodies associated with crossings discussed here (<1m width) in stream supports will not be required for the construction of single span structures.
- The design facilitates adequate hydraulic capacity (**Appendix 9.5 – Tile 2**). This ensures that the design will maintain the existing channel and will facilitate peak discharge events (storm events) without flow being constrained and contributing to flooding or other issues. Values presented **Appendix 9.1 – SFRA** indicate the potential discharge rate associated with each watercourse crossing during a 1 in 100-year storm event. For existing crossings, the channel width will be maintained.

The following mitigation is proposed and is in line with IFI (2016) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters, in particular Section 6 – River and Stream Permanent Crossing Structures.
During the construction phase the appointed Contractor(s) shall ensure that:

- No works will take place within the 50m buffer zone of watercourses except for the bottomless bridge culvert, road development and drainage measures as detailed.
- Site compounds and temporary excavation areas will be located at a minimum distance of 50m from any watercourse. All drainage from these facilities will be directed through a settlement pond with appropriate capacity and measures to provide spill containment.
- All site drainage, as described in the **Management Plan 3: Surface Water Management Plan** and shown on associated drawings, will be directed through either sediment traps, settlement ponds and / or buffered drainage outfalls to ensure that total suspended solid levels in all waters discharging to any watercourse will not exceed 25mg/l (IFI, 2016). All construction site run-off will be channelled through a stilling process to allow suspended solids to settle out and through a spill-containment facility prior to discharge.
- In areas of the site where works will take place (example hardstands) the area will be required to be isolated from intercepting drains and drains diverted alternative route while maintaining the same hydrological flow/levels (example ensuring no pinch points).
- Daily monitoring of all sediment traps and settlement ponds will be undertaken by the Environmental Clerk of Works to ensure satisfactory operation and/or maintenance requirements.

- The design minimises the potential for localised bank and bed erosion, refer to **Planning Drawing 5969-PL-500-01**.

In regard to the Grid Connection Route:

There are 7 culvert crossings proposed for the Grid Connection Route.

(*** Note:** Likely to be additional minor culverts).

- With reference to **Section 9.3.9** Flood Risk Identification some portions of the Grid Connection Route are within a mapped probable flood zone. To mitigate against any potential for onsite flood risk and consequences, it will be a strict requirement to carry out works at this location during seasonally dry conditions. Exposed soils and fill materials will be reinstated and/or will have erosion control installed as part of the design and sufficient time as to be in place prior to the next seasonally wet period. This will minimise the potential for flood events to impact on the construction works, plant machinery or operators etc, and will minimise the potential for entrainment of soils or other materials in high water flow during potential flood events.

There remains the potential for the actual construction of such crossings to have significant adverse effects on the receiving watercourse/s through general construction activities such as those outlined in **Section 9.4.4** i.e., the release of suspended solids and hydrocarbons for example. Relevant guidance documents **(Section 9.2.2)** have been consulted and applicable mitigation measures have been incorporated into the design of the proposed bridges and construction methodology of same. These will be adhered to with a view to mitigating and reducing any potential impact on the receiving watercourse.

9.5.2.14 Drainage/Culvert installation

Non mapped drainage features are inherent with forestry and peat cutting (**Section 9.3.5)** will be mitigated using the following methodology. Where works will take place within drainage buffer zones, the area will need to be isolated, and drainage diverted but also managed by attenuation features to ensure that the current hydrological regime is maintained.

All drains will be identified on site, slope direction and flow. New interceptor drains will take existing clean water from the site back into the hydrological network on the site. Temporary blocks will be installed to manage water levels in rain events, similar to isolating the working area for instream works as outlined in **Section 9.5.2.12**.

This development will include clean and dirty runoff drainage networks and associated culverts. If existing drainage on site is intersected by new site access tracks or works, clean water culverts must be installed at suitable locations and connect the runoff back to the downstream receiving surface water network. In line with the baseline hydrological regime. Dirty water drainage will also involve culverts which connects any construction water to attenuation features and filtering systems before being discharged to vegetated areas.

9.5.2.15 Instream Works Proposed Mitigation Measures

Infrastructure such as culverts over natural or artificial drainage channels and non-mapped rivers may require instream works. Where culverts are required and the subsequent in-stream works are necessary, the following will be implemented:

- Contracted operators will draft method statements and risk assessments in line with mitigation outlined in this report and in consultation with relevant guidance prior to commencing works (as part of the watercourse crossing consent application). Relevant guidance referenced is presented in **Section 9.2.2.** Method statements will be included in the CEMP.
- The construction area will be isolated, this means; the water feature (streams / drains) will be temporarily dammed upstream of the watercourse crossing and flow will be diverted by means of a flume / pipe by gravity or pumped (this is referred to as over pumping, **Appendix 9.5 – Tile 1**) downstream of the watercourse crossing and construction area. Following the successful upstream damming, a downstream dam or barrier will also be established. The downstream barrier will ensure contaminated runoff in the isolated work area can be contained and managed and will block surface water back flow in lower lying or flatter areas. **Appendix 9.5 – Tile 1** presents a conceptual plan view of an isolated construction area within a surface water feature. Over pumping of a surface water feature is considered diversion of water runoff only and therefore considered similar to discharge of storm water runoff only to sewer (exempt from licensing), however it is imperative that controls are in place to ensure environmental effects are minimised, particularly in relation to ecological sensitivities (for further information refer to **EIAR Chapters 5,6 and 7**), and also in relation to water quality.

- In order to ensure isolation and over pumping is carried out effectively, the methodology must ensure that dams are secure / sufficiently supported, and that pumping of water can continue uninterrupted and that pumps are capable of keeping up with the discharge rate of the surface water feature. Pumping systems will require backup and fail-safe protocols e.g., backup pumps and generator. At significant surface water features e.g., non-mapped streams, isolation and diversion of drainage will be implemented.
- Provided the construction water within the isolation area is managed effectively, over pumping of the surface water feature does not pose a significant risk to surface water quality downstream of the watercourse crossing.
- Water ingress into the construction area will be managed and collected by established sumps immediately downstream of the works (upstream of the downstream barrier) (**Appendix 9.5 – Tile no. 1**). Runoff within the construction area will likely be heavily laden with suspended solids. Where required, dewatering (pumping out or extracting) of such waters will be discharged to an inline settlement tank **Appendix 9.5 – Tile no. 1**, or preestablished stilling pond **Appendix 9.5 – Tile no. 1** to remove suspended solids before being discharged (**Appendix 9.5 Tiles 8 and 9**). The quality of the water being discharged will be monitored. If discharge water quality is poor (e.g. >25mg/l) additional measures will be implemented, for example treating construction water by dosing with coagulant to enhance the settlement of finer solids – this can be done in a controlled manner by means of a suitably equipped settlement tank. Collected and treated construction water will be discharged by gravity / pump to a vegetated area of ground within the Site (an example is provided in **Appendix 9.5 – Tile 11**). Silt fences (**Appendix 9.5 – Tile 12 & 13**), will be established at the discharge area to ensure potential residual suspended solids are attenuated and the potential for erosion is reduced. The discharge area will be outside of the surface water buffer areas (similar to dewatering of excavations).
- Discharging of construction water (trade effluent) directly to surface waters is a licenced activity. No extracted or pumped or treated construction water from the isolated construction area will be discharged directly to the surface water network associated with the Site (This is in accordance with Local Government (Water Pollution) Act, 1977 as amended). It is noted that all runoff on the site will eventually discharge to the receiving surface water network, however with appropriate management the quality of runoff discharging to the surface water network will be acceptable e.g. <25 mg/l Suspended Solids.

- Works in relation to in stream works will be carried out during periods of sustained dry meteorological conditions and will not commence if sustained wet conditions or if wet conditions are forecast (**Section 9.5.2.1**).
- Works in relation to watercourse crossings will be planned and carried out as efficiently as possible. This means work plans are agreed fully and all equipment and materials are prepared fully before in stream works commence. Works will be completed as quickly as possible and will not pause for the duration of the in stream works e.g., Installation of culverts (24 hour as necessary), with the exception of circumstances related to meteorological and/or health and safety conditions.
- Only precast concrete will be used for in stream works.
- Precautions will be made to mitigate the potential risk of a hydrocarbon spill. Further to measures outlined in **Section 9.5.2.6**, settlement tanks (will be adequately equipped with hydrocarbon removal functionality on standby, for example hydrocarbon absorbent booms, oil skimmers, and GAC (granulated activated carbon) filters, should they become necessary **(Appendix 9.5 – Tile 10 &11).**

9.5.2.16 Groundwater Contamination Proposed Mitigation Measures

A combination of the underlying bedrock geology, the associated aquifer potential, high permeability soils/peat and low recharge rates has resulted in the risk posed to groundwater quality by the Development being considered as medium to low risk. Nevertheless, mitigation measures to reduce potential risks to groundwater will be implemented as a precautionary approach. A primary risk to the underlying groundwater quality would be through the accidental release of hydrocarbons from fuels or oils during the construction phase of the Development. In order to mitigate against potential groundwater contamination by hydrocarbons, implementation of the following mitigation measures is recommended:

- In the first instance, no fuel storage should occur at the Site whenever feasible and refuelling of plant and equipment should occur off Site at a controlled fuelling station.
- In instances where on Site refuelling is unavoidable, then the bunded on Site designated refuelling area must be used. The designated refuelling area must be bunded to 110% volume capacity of fuels stored at the Site.
- The bunded area will be drained by an oil interceptor that will be controlled by a pent stock valve that will be opened to discharge storm water from the bund.
- Management and maintenance of the oil interceptor and associated drainage will be carried out by a suitably licensed contractor on a regular basis.

- Any oil contaminated water will be disposed of at an appropriate oil recovery plant.
- Any minor spillage during this process will be cleaned up immediately.
- Vehicles will not be left unattended whilst refuelling.
- For large machinery such as cranes, a drip tray will be used and spill kits will be on hand.
- A Site specific CEMP will be enforced to ensure that equipment, materials and chemical storage areas are inspected and maintained as required on a regular basis.

The following mitigation measures are recommended in relation to non-hydrocarbon potential contamination of groundwater:

- All other liquid-based chemicals such as paints, thinners, primers and cleaning products etc. will be stored in locked and labelled bunded chemical storage units.
- Sanitation facilities used during the construction phase will be self-contained and supplied with water by tank trucks. These facilities will not interact with the existing hydrological environment in any way and they will be maintained and serviced throughout the construction phase.
- The controlled attenuation of suspended solids in settlement ponds and check dams etc. will result in inorganic nutrients (if present in elevated concentrations) such as phosphorus and nitrogen being absorbed and retained by the solids in the water column. This will allow for a reduction of peak inorganic discharges in a controlled and stable run off rate. It is noted that the presence of elevated contaminants were detected during the four surface water quality monitoring rounds.
- It is considered that there is a low risk of mobilising trace metals that may naturally be present in low concentrations in the baseline environment. The potential for mobilising trace metals is most likely to result from enhanced water percolation associated with excavated bedrock substrate. To mitigate against this potential impact, water quality should be monitored for trace metal concentrations prior to, during and after the construction phase.
- The potential for livestock such as cattle and sheep which have been observed grazing in the vicinity of the Site to cause bacteriological contamination of groundwater will be controlled through the implementation of strict grazing control zones, Site perimeter fencing and exclusion zones around all open excavations.

9.5.2.17 Groundwater Extraction Proposed Mitigation Measures

The extraction of groundwater from boreholes for the purpose of potable water supply will not be required for either the construction or operational phase of the Project. As a result, no potential effects are anticipated from the extraction of groundwater as a potable water supply.

9.5.2.18 Monitoring

9.5.2.18.1 Monitoring - Wind Farm Site

Monitoring of subsoils, bedrock and material management during the construction phase of the Development will be fundamentally important in ensuring that potential suspended solid entrainment in surface waters is minimised. With comprehensive planning and preparation, and implementation of relevant mitigation measures contained in the CEMP (**Appendix 2.1**), the potential for elevated suspended solids to be released to surface waters via runoff is likely to be minimal.

To ensure effective implementation of mitigation measures, environmental auditing, and monitoring of environmental obligations of the Developer, an Ecological Clerk of Works (ECoW) will be assigned by the Developer to carry out monitoring at the Site during the construction and operational phases of the Development. The role of the Ecological Clerk of Works (ECoW) will be to actively and continuously monitor site conditions and advise on environmental issues and monitoring compliance, and will not be responsible for implementing measures, the due duty of implementing measures will be held by the Developer / contracted construction operator. The Ecological Clerk of Works (ECoW) will have the authority to temporarily stop works in a particular area of the site to ensure corrective measures are implemented and adverse environmental effects are minimised if not avoided. The following wind farm Site monitoring recommendations will be undertaken by the ECoW assigned by the Developer to mitigate against potential effects on the surface water and groundwater receiving environment:

- Monitoring site pollution prevention plan.
- Water quality monitoring.
- Advising on required pollution prevention measures (as described in this EIAR) and monitoring their effectiveness.
- Liaison with local authorities in relation to pollution instances if applicable.
- Considering the Ecological Clerk of Works (ECoW) will be responsible for monitoring a broad range of environmental factors at the Site, technical

monitoring and advice will be sought such as from specialist consultants as the need arises e.g., installation and website for telemetry.

The following measures will be implemented for Site monitoring in relation to the hydrological and hydrogeological effects:

- The baseline monitoring undertaken at the Site as part of this study will be repeated periodically before, during and after the construction phase of the Development to monitor any deviations from baseline water quality that occur at the Site. This monitoring along with the detailed monitoring outlined below will ensure that the mitigation measures that are in place to protect water quality are working. Specifically, a construction period and post construction monitoring programme for the Site will include the following:
- During the construction phase, daily inspection of silt traps, buffered outfalls and drainage channels and daily measurement of total suspended solids, electrical conductivity, and pH at selected water monitoring locations on the Site (**Figure 9.6**) (locations close to active working zones). Monitoring of same during times when excavations are being dewatered (likely high in solids) will be done in real time. In this regard, physiochemical properties will be monitored in real time by means of alarmed telemetry e.g., telemetric monitoring at baseline sampling locations and alarm thresholds established in line with water quality reference concentrations/limits which will be set using relevant instruments for example, Surface Water Quality Regulations, <25mg/l Total Suspended Solids (TSS).
- Continuous Monitoring will be carried out as part of Active Management of construction water management and treatment **(Appendix 2.1 CEMP** and the **SWMP**). These monitoring systems will travel with the active construction areas / remain with the Active Management infrastructure. The purpose of this is to recycle water if quality is unfavourable and adjust the dewatering and treatment train accordingly until discharge quality is observed to be acceptable. A small degree of tolerance above reference concentrations is acceptable at this location but only if the discharge from the Active Management train discharges to another Passive Management system or to a non-sensitive vegetated area. If discharging within sensitive areas or buffer zones, the quality of discharge from the Active Management train will be in line with prescribed reference limits (e.g., 25mg/l TSS)

- Continuous Monitoring at downstream Baseline SW Monitoring Locations (**Figure 9.6)** will be carried out using telemetry during the construction phase. Triggering of the threshold at these locations will trigger emergency response and escalation of measures including immediate full site inspection to ascertain to the potential unknown source (bearing in mind that the quality of managed runoff at the site will be known by means of live telemetry and handheld meters). Continuous monitoring at Baseline SW Monitoring Locations will continue into the operational phase until stable conditions are observed e.g., stable conditions in line with baseline conditions for 6 months.
- Post construction: inspection of silt traps, buffered outfalls and drainage channels, measurement of total suspended solids, electrical conductivity, and pH at selected water monitoring locations at the Site will be carried out at a reasonable frequency (weekly initially gradually reduced based on observed stability of conditions), and will also be scheduled following extreme metrological events **(Section 9.5.2.1).** During the operational phase of the project the stilling ponds and buffered outfalls will be periodically inspected e.g., weekly during maintenance visits to the Site initially and gradually reduced based on observed stability of conditions.
- During the construction phase of the project, the Development areas will be monitored daily for evidence of groundwater seepage, water ponding and wetting of previously dry spots, and visual monitoring of the effectiveness of the constructed drainage and attenuation system so that it does not become blocked, eroded or damaged during the construction process. This monitoring will continue at a reasonable frequency (weekly initially gradually reduced based on observed stability of conditions) during the operational phase of the Development, however it is envisaged that any potential issues in this regard will be identified and rectified during the construction phase.
- A programme of water quality monitoring outlining the selected parameters and monitoring frequency should be agreed with Inland Fisheries Ireland and Leitrim County Council prior to the commencement of construction. During the construction phase of the project, the Development areas and adjacent receiving drainage systems will be monitored daily for evidence of erosion and other adverse effects to natural drainage channels and existing degraded areas whereby soils/subsoils are exposed and prone to enhanced degradation. This monitoring will continue at a reasonable frequency during the operational phase of the Development, however it is envisaged that any

potential issues in this regard will be identified and rectified during the construction phase.

- During both the construction and operational phases of the Project, the watercourse crossing within the Site will be monitored frequently (daily during construction and intermittently during operational phase i.e., weekly / monthly inspections initially and reduced gradually in line with observed stability and confidence in longer term data obtained. The water course crossings will be monitored in terms of structural integrity and in terms of their impact on respective watercourses.
- A detailed inspection and monitoring regime, including frequency will be specified in the CEMP (**Appendix 2.1**). This includes an environmental risk register e.g., constraints linked to the development construction schedule, routine reporting on the performance and effectiveness of drainage and attenuation infrastructure, and any actions taken to rectify or enhance the system.
- Site water runoff quality at all surface water monitoring locations will be monitored on a continuous basis during the construction phase of the Development. Monitoring will continue into the operational phase until such time that the Site and water quality have stabilised (stable conditions in line with baseline conditions for e.g., 8 consecutive quarterly monitoring events). This monitoring will be carried out at the downstream surface water baseline sampling locations (**Figure 9.6a**)
- A handheld turbidity meter will be available and used to accurately measure the quality of water discharging from the site at any particular location. The meter will be maintained and calibrated frequently (per the particular unit's calibration requirements / user manual), and will also be used to check and calibrate remote sensors if they are employed. Quality thresholds have been established for the purposes of escalating water quality issues as they arise.
- Rainfall will be monitored (1 no. rainfall gauge required). This unit will be connected with and displayed with other site water quality telemetry data via the telemetry website.
- Surface water runoff control infrastructure will be checked and maintained on an ongoing basis, and stilling ponds and check dams will be maintained (de-sludge / settle solids removed) on an ongoing basis, particularly during the construction phase of the Development. It is important to minimise the agitation of solids during these works, otherwise it will likely lead to an acute significant

loading of suspended solids in the drainage network. This can be achieved by temporarily reducing or blocking inkling flow and vacuum extracting settled solids or *sludge*. Where the drainage feature possesses relatively significant flow rates, isolating and over pumping is the best course of action.

- As part of the CEMP, regular checking and maintenance of pollution control measures are required (in line with frequencies outlined above), with an immediate plan for repair or backup if any breaches of design occur. In the event that established infrastructure and measures are failing to reduce suspended solids to an acceptable level, construction works will cease until remediation or upgrading works are completed.
- All details in relation to monitoring will be included in the Surface Water Management Plan (SWMP) (**Management Plan 3, Appendix 2.1**).

Monitoring of potential hydrological impact of the Development, particularly during the operational phase will be inherently linked to the ecological health of the site (as a functioning ecosystem) and therefore both hydrology and ecology will be considered and monitored in tandem. For example, effects to the hydrological regime at the Site can potentially impact on the ecological health or characterisation of the Site, and vice versa. Ecological indicators can potentially provide useful data in relation to the long-term impact of changes to the hydrological regime at the Site. However, as discussed in earlier section of this report (**Section 9.4**), changes to the management of runoff and in turn the hydrological regime at the site will lead to a positive impact overall when compared to the baseline conditions associated with the site e.g. introduction of intermittent buffered outfalls along the length of the drainage network is in contrast to baseline, this will promote a more even distribution runoff, attenuate runoff and reduce the hydrological response to rainfall, enhanced potential for recharge to ground, and in various areas of biodiversity enhancement.

Routine Surface Water Monitoring

Similar to Wind Farm Site baseline monitoring, baseline surface water samples will be obtained at upstream and downstream sampling locations at each significant construction location over mapped rivers. Baseline surface water samples will be obtained at accessible locations such as existing bridges on public roads. Where upstream access is poor, the upstream baseline sampling location will be directly/immediately upstream of the construction location (e.g., existing bridge / culvert). Sample locations, monitoring frequency and precise hydrochemistry parameters will be agreed in writing with Leitrim County Council, prior to commencement of construction, and following consultation with Inland Fisheries Ireland **(Water Quality Management Plan 3).**

Continuous Monitoring of Active Construction Water Management and Discharge

As a minimum, the monitoring programme will include:

- At least one baseline monitoring visit.
- Daily visual observation in areas of high construction activity or during high rainfall periods to identify any evidence of siltation, oil or silt. Visual inspections will include details of the colour of the water at the time of inspection.
- Weekly visual inspections and monthly field hydrochemistry monitoring.
- One round of post construction monitoring, to be agreed with Leitrim County Council. Post construction will be defined as when the reinstatement phase is completed.
- Monthly analysis of water parameters will be carried out. Construction-stage analytical determinants (including limits of detection and frequency of analysis) will be specified and agreed with the Local Authority and third parties for each sample location. The agreed suite of grab sample determinants will include the following:

Parameters for hydrochemistry analysis

- pH
- Temperature
- Total Suspended Solids (TSS)
- Dissolved Organic Carbon (DOC)
- Conductivity
- Dissolved Oxygen (DO)
- Total Oxidized Nitrogen (TON)
- Ammoniacal Nitrogen
- Ammonia
- Potassium
- Phosphate
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)

- Total Petroleum Hydrocarbons (TPH)*

In line with monitoring objectives in relation to surface water quality, parameter value thresholds or limits when exceeded, the relevant assigned persons of trend anomalies which require investigation, escalation, and corrective mitigation, for example;

- A threshold of 25mg/l Total Suspended Solids (TSS) will be applied at treatment train outfalls/discharge points, in line with legislative reference limits for surface water quality. Exceedance of such threshold will trigger further investigation and escalation of responses on site with a view to identifying potential uncontrolled sources of contaminants. Parameter trend analysis will also inform investigations and response, for example, intermittent spikes in concentrations in line with baseline conditions versus continuously elevated concentrations caused by an ongoing environmental incident.

9.5.2.19 Active Monitoring on Site

Handheld meters (Turbidity / Total Suspended Solids (TSS)) will used by the ECoW / competent operators during construction works. This will be done with a view to managing water treatment and anticipating potential surcharges in water or TSS loading within the treatment train. Handheld meters will also be used to monitor outfall/discharge quality in the event telemetry systems fail or during system maintenance. Handheld probes will be checked and calibrated regularly.

9.5.2.20 Monitoring Under Licence

Where a discharge licence is required, the conditions of the licence will stipulate monitoring requirements in line with licence parameters with associated emission limit values. The frequency of sampling will likely be daily or weekly. Sampling will include obtaining physical samples at an agreed discharge sampling point and will be sent an accredited laboratory for analysis. Where discharge licence is required, monitoring in line with the licence will be done in addition to the other monitoring regimes undertaken as described in sections above. Monitoring under licence conditions will not negate the requirement for the other regimes described.

* Only during construction phase

9.5.2.21 Tailoring of Monitoring Requirements

Monitoring will be tailored at each location in terms of requirements set out in trade effluent discharge licence/s where relevant.

- The baseline monitoring undertaken at the Site as part of this study will be repeated periodically before, during and after the construction phase of the Development to monitor any deviations from baseline hydrochemistry that occur at the Site. This monitoring along with the detailed monitoring outlined below will help to ensure that the mitigation measures that are in place to protect water quality are working. Specifically, a construction period and post construction monitoring programme for the Development site should include the following.
- During the construction phase; daily inspection of silt traps, buffered outfalls and drainage channels and daily measurement of total suspended solids, electrical conductivity, and pH at selected water monitoring locations on the site. Monitoring of same during times when excavations are being dewatered (likely high in solids) should be done in real time.
- Post construction: at a reasonable frequency inspection of silt traps, buffered outfalls and drainage channels, measurement of total suspended solids, electrical conductivity, and pH at selected water monitoring locations at the site. During the operational phase of the project the stilling ponds and buffered outfalls will be periodically inspected during maintenance visits to the site.
- During the construction phase of the project, the development areas should be monitored daily for evidence of groundwater seepage, water ponding and wetting of previously dry spots, and visual monitoring of the effectiveness of the constructed drainage and attenuation system so that it does not become blocked, eroded or damaged during the construction process.
- During both the construction and operational phases of the project, watercourse crossings should be monitored frequently (daily during construction and intermittently during operational phase). The water course crossings should be monitored in terms of structural integrity and in terms of their impact on respective watercourses.
- A detailed inspection and monitoring regime, including frequency has been specified in the Construction and Environmental Management Plan (CEMP).

9.5.2.22 Clear Fell of Forestry

No new impacts or remediation measures are associated with forestry activities. More details on clear felling at the Site is outlined in the **Forestry Report (Appendix 2.4).** However, good practices working in specific environments such as forested areas will be adhered to including working outside of surface water or other buffer zones, and risk assessing on a case by case basis in terms of drainage intercepting run off, ecological sensitivities, etc.

Further mitigation measures in regard to the management of forestry operations include;

- Phased felling approach,
- Minimising erosion by use existing tracks and use of brash for off track areas,
- Follow all relevant forestry guidance and policies, including;
    - Forest Protection Guidelines (2002)
    - Forestry and Water Quality Guidelines (2000)
    - Forest Harvesting and Environmental Guidelines (2000)
    - Forestry and Freshwater Pearl Mussel Requirements - Site Assessment and Mitigation Measures (2018)
    - Forest Biodiversity Guidelines (2000)
    - Forestry and The Landscape Guidelines (2000)
    - Forestry and Archaeology Guidelines (2000)
- The permanent felling of 2ha of forestry is subject to replacement obligations. All felling in State requires a licence.
- Harvest site plans including extraction routes, fuelling areas, stacking areas, turning areas and drain crossings etc. and Hazard Identification and Risk Assessment will be designed and implemented during all harvesting operations.
- All drains, either mound drains, culverts, water crossings crossed during extraction, if necessary, will be cleared of any debris to ensure no drainage issues will occur for the remaining trees, which can be a major attributor to windblow.
- Felling and extraction of timber will, are to be undertaken in dry weather conditions.
- Harvesting operations are scheduled according to the nature of the soil with sites being categorised into winter and summer sites depending on ground

conditions. Also, best practice is to suspend mechanised harvesting operations during and immediately after periods of particularly heavy rainfall.

- Waterways are particularly vulnerable to the effects of harvesting as silt from the movement of machinery can enter streams and rivers causing blockage of gravels which affects insect and fish life. Also nutrients released from decaying branches, particularly from large clear felled sites, can cause enrichment of the waters which in turn causes pollution. To counteract these effects careful planning is required in carrying out harvesting operations. Some of the measures taken to avoid impacts include:
  - Limiting the size of the areas to be felled which reduces the amount of nutrients and silt released.
  - Minimising the crossing of drains and streams, but where necessary installing temporary structures (log bridges, pipes etc) to avoid machines entering the water;
  - Establishing buffer zones around waterways from which machines are excluded.

9.5.2.23 Emergency Response

Mitigation measures outlined in the previous sections of this chapter will significantly reduce the potential for contamination of surface water or groundwater associated with the Development. Nevertheless, as is the case with all construction projects, a risk of accidental chemical spillages, sediment overloading of control measures or leaks of contaminants from plant or equipment remains a possibility. Emergency response procedures to potential contamination incidents have been prepared as part of the Emergency Response Plan (**Management Plan 1** of **Appendix 2.1**) will be implemented at the Site prior to the commencement of the construction phase. The following is a non-exhaustive list of potential emergency scenarios where corrective action may be required, and proposed corrective mitigation measures are included:

- Potential issue; Elevated concentrations of suspended solids in runoff during excavation activities during an unforeseen or low probability storm event, for example a 1 in 100 year event. Proposed measure; Cover exposed stockpiles in plastic sheeting and placement of straw bales and silt fences in associated drainage channels.
- Potential issue; Failure or degradation of stone check dam during a storm event with associated elevated runoff volumes. Proposed measure;

Introduction of straw bales and silt fences in order to regain attenuation capacity of the drainage channel until the maintenance can be completed.

- Potential issue; Localised peat stability issue leading to deposit of peat within an active drainage channel. Proposed measure; Introduction of straw bales and silt fences directly downstream, of the area in order to attenuate gross solids isolate the area and over pump until remedial works and maintenance can be completed, divert all runoff from the area to Active Management area of the treatment train (**Appendix 9.5 – Tile no. 8 to 9**).
- Potential issue; Management of unexpected runoff patterns leading to excessive drying or wetting in a particular area, potentially leading to enhanced erosion. Proposed measure; This type of issue will require assessment on a case by case basis. Solutions might include; decommission, modification, introduction or relocation of buffered outfall, or diversion of runoff volumes to or away from the area. In regard to the potential for erosion and similar physical processes, any such issues will become apparent through monitoring relatively rapidly, whereas effects to ecological sensitivities will become apparent relatively slowly in comparison. It is noted that much of the Site is impacted as part of baseline in this regard e.g., existing artificial drainage networks.

Prior to commencement of construction, the ECoW will prepare a register of corrective action and emergency response sub-contractors that can be called upon in the event of an environmental incident, and/or to give training on escalating incident where useful, including e.g. specialist hydrocarbon spill response, specialist hydrological and/or water quality response.

Mitigations measures as outlined in the previous sections will reduce the potential for contamination of waters during the construction phase of the proposed development, however there remains the risk of accidental spillages and or leaks of contaminants, and excessive loading of surface water mitigation infrastructure.

Emergency responses to potential contamination incidents will be established and form part of the CEMP (**Management Plan 1, Appendix 2.1**). Potential emergencies and respective emergency responses include:

- Hydrocarbon spill or leak – Hydrocarbon contamination incidents will be dealt with immediately as they arise. Hydrocarbon spill kits will be prepared and kept in vehicles associated with the construction phase of the Development. Spill kits will also be established at proposed construction areas, for example, a spill kit will be established and mobilised as part of the turbine erection materials and equipment. Suitable receptacles for hydrocarbon contaminated materials will also be at hand.

- Significant hydrocarbon spill or leak – In the event of a significant hydrocarbon spillage, emergency responses will be escalated accordingly. Escalation can include measures such as installation of temporary sumps, drains or dykes to control the flow or migration of hydrocarbons and contaminated runoff will be contained, managed and pumped to a controlled area in line with Active management including treatment through a suitably equipped treatment tank and Granular Activate Carbon (GAC) vessels. This process will be managed by the ECoW in conjunction with a preidentified consultant (ECoW) specialist register) in regard to effective remediation, treatment and removal of hydrocarbon contaminated water and soils. Excavation and appropriate disposal of contaminated soils will be required in this instance.
- If a significant hydrocarbon spillage does occur, the contractor on behalf of the developer will have an approved and certified clean-up consultancy available on 24-hour notice to contain and clean-up the spill. The faster the containment or clean-up starts, the greater the success rate, the lower the damage caused and the lower the cost for the clean-up.
- Cementitious material – Cement / concrete contamination incidents will be dealt with immediately as they arise. Spill kits will also be established at proposed construction areas, for example a spill kit will be established and mobilised as part of the turbine erection materials and equipment. Suitable receptacles for cementitious materials will also be at hand.

In the event of a significant contamination or polluting incident the relevant authorities will be informed immediately.

9.5.2.24 Managing & Reporting Environmental Incidents

Environmental incidents including accidental spillages on soils (e.g. fuel), breeches of licence limits if applicable (discharge of trade effluent), and significant environmental incidents will be reported to the Local Authority as part of emergency responses to such incidents. Incident notification will be escalated to relevant third parties where relevant e.g. Inland Fisheries Ireland (IFI) if surface water receptors are intercepted.

9.5.2.25 Construction Phase Residual Effects

The residual impact on the surface water receiving environment resulting from the construction phase of the Development is anticipated to be a limited temporary decrease in water quality. A limited temporary decrease in water quality may arise due to a release of suspended solids and sediments to surface waters during excavations at the Site. The potential for release of elevated suspended solids is likely to be exacerbated following heavy rainfall events which occur after sustained dry periods. Any localised reduction in water quality is likely to be mitigated against by the extensive control measures outlined in this chapter and also by natural dilution as distance from the point or diffuse source of contamination increases with distance from the Site.

Mitigation by avoidance and the implementation of physical control measures will ensure that contaminant concentrations, particularly elevated suspended solids entrained in run-off are reduced to below the relevant legislative screening criteria. The overall impact is anticipated to be a **direct, adverse, imperceptible, Imperceptible weighted significance and temporary.**

Mitigation measures outlined in this report lay down the framework to reduce all potential impact of the Development on Hydrological and Hydrogeological receptors. The *Mitigated Potential Effects* lay down the achievable benchmarks provided measures are considered and implemented adequately.

9.5.3 Operational Phase

9.5.3.1 Increase in Hydraulic Loading Proposed Mitigation Measures

The principles of the mitigation measures described under **Section 9.5.1** (check dams, stilling ponds, attenuation lagoons etc.) are based on the control and management of runoff discharge rates, which ensure the regulating the speed of runoff within the drainage network, buffering the discharge from the drainage network where possible, and maintaining the natural hydrological regime. As such, the measures described with a view to controlling the release of suspended solids also mitigate against the potential for rapid runoff and rapid hydrological responses to rainfall potentially leading to flooding and erosion of the drainage network or downstream of the development.

The same measures will be implemented with a view to mitigating against net increase surface water runoff arising from the Development. For example, the following conceptual model will be applied at a proposed turbine hardstand location:

- Collector drains; allowing for 0.5m depth, 1.0m width, presume semi-circular, sectional area; c. 0.4m^2. Presume 100m length of collector drain; up to 40m^3 capacity per 100m, by 50% allowing for gradient equates to 20m^3. Collector drains are not intended to store runoff, however the in line attenuation features, such as check dams and flow regulators will serve to reduce discharge rates dramatically, effectively backing up water and regulating the rate of discharge. The actual attenuation capacity of the drainage network and treatment trains will be calculated during the detailed design phase of the development. The actual attenuation capacity of the drainage network and treatment trains will be calculated during the detailed design phase of the development **(Appendix 9.5 – Tile 7).**
- Check dams at regular intervals throughout the drainage network (existing, new clean collector and new dirty collector drains) will attenuate runoff intercepted by respective drainage channels.
- Dirty water collector drains (associated with construction areas) will direct runoff to established stilling ponds. Stilling ponds will reduce the velocity of runoff, further reducing the hydrological response to rainfall.
- Buffered outfalls to vegetated areas will utilise the infiltration capacity of the ground prior to the rejected rainfall eventually being intercepted by the receiving surface water system.
- Clean water collector drains will intercept clean runoff (upgradient of construction areas) and will direct runoff around construction areas. The runoff will be attenuated by means of check dams and intermittent buffered outfalls.

The Development will lead to an increase in impermeable surface area through the construction of hardstand areas within the Site. This in turn will lead to an increase in hydraulic loading by surface water runoff. Preliminary water balance calculations indicate that the worst-case net increase in surface water runoff volumes will be approximately 13990m^3/hour or 0.102 l/sec (or 0.26%) relative to the area of the Site, therefore this is considered an imperceptible, or not significant impact. The potential combined attenuation capacity of the proposed drainage infrastructure, checked dams, stilling ponds, etc. (**Management Plan 1, Appendix 2.1**) has been designed to attenuate net increase in water runoff during extreme storm events i.e., 1 in 100-year storm event plus a 20% allowance for global warming, as set out in **Appendix 9.1 – Letter Flood Risk Assessment.**

9.5.3.2 Operational Phase Residual Effects

The residual impact on the receiving surface water environment during the operational phase of the Development is anticipated to be neutral i.e., no increase in runoff and no increase in drainage discharge.

Furthermore, the drainage and attenuation network deployed will also need to consider effective passive treatment of runoff (re. suspended solids), considering this the finalised drainage and SuDS design will likely include attenuation capacity in excess of the values listed above. Of note is the absence of any attenuation features as part of baseline conditions.

Depending on the exact area of the Site in question, the finalised drainage design may result in some areas becoming more saturated, particularly at lower elevations, whilst other predominantly upland areas may result in a net drying effect being observed however with mitigation measures constructed wetlands it will be a neutral impact. This will require monitoring and maintenance.

This is considered a **direct, neutral to beneficial,** impact of the Development, which **contrasts to the baseline** conditions.

9.5.4 Development Decommissioning & Restoration

9.5.4.1 Decommissioning of Infrastructure Phase/s

As discussed in **Section 9.4.6**, no new significant effect on the surface water and groundwater receiving environment are anticipated during the Decommissioning phase of the Project. The Decommissioning phase of the Project will result in the removal of Site infrastructure such as wind turbine blades, towers, transformers, etc. The excavation of topsoil and subsoils is expected during the Decommissioning phase, but, however, to a far less extent when compared to that of the construction phase. For instance, it is proposed the turbine foundations will remain in situ and upon turbine dismantling and redressed with topsoil and revegetated with sods.

Similarly, the movement of plant, vehicles and equipment is expected to be required during the Decommissioning phase, but to a far less extend than during the construction phase. As a result, there remains a risk of elevated suspended solids being discharged in surface water run-off to the downstream receiving environmental during the Decommissioning phase. Additionally, the potential risk remains for spills of fuels hazardous chemicals which is a common risk to all developments. The mitigation measures outlined in this chapter will be implemented during the Decommissioning phase, as well as those outlined in the Decommissioning Plan, to reduce the potential for such effects.

In regard to cable ducting, for the Grid Connection route, cable joint bays will be left in-situ and cabling on site will be removed from the cable bays. The ground above original pulling pits/joint bays will be excavated to access the cable ducts using a mechanical excavator and will be fully re-instated once the cables are removed. Excavated material will be temporarily stored adjacent to the site of excavation at a height of less than 1m and outside of any surface water buffer zone, and will be removed from the site appropriately for reuse elsewhere on site, reused on another site or disposed of as a waste (through appropriate classification and assessment).

9.5.4.2 Reinstatement of Redundant Access Track and Hardstand Areas

In order to reduce the potential impact of excavating and removing the entirety of the crane hardstand areas, it is proposed that the majority of the stone structure of the individual crane hardstands will be left in place, with topsoil spread on top of the hardstand to form a vegetated surface layer. The top layer of the crane hardstand areas will have the rock/stone dug out and be left to revegetate naturally. Any reinstatement of topsoil and the restoration of vegetation will be kept consistent and compatible with surrounding vegetation, and shall be agreed with the Environmental Engineer in advance of commencement. Reinstatement of redundant site access tracks and Turbine Hardstand areas during the Decommissioning phase has the potential to result in soil creep, associated erosion and potential entrainment of elevated suspended solids in surface water run-off. This in turn has the potential to impact on the receiving surface water environment.

- A site specific Decommissioning Plan has been developed prior to the commencement of any Decommissioning activities (**Management Plan 6, Appendix 2.1**).

- Mitigation measures described in this chapter to reduce the potential for run-off of elevated suspended solids will be implemented.
- It is recommended that silt/sediment fences should be implemented along the perimeter of all access tracks and hardstand areas prior to decommissioning works and for the during the reinstatement works.
- Additional precautions such as the implementation of check dams, secured straw bales, sandbags, or settlement ponds should be implemented at areas where surface water runoff is likely to be intercepted by both natural and artificial drainage features.
- The mitigation measures for the preparation of the hardstand area surfaces prior to material being deposited discussed in **Chapter 8: Soils and Geology** will be implemented.
- It is recommended that monitoring and maintenance of the reinstated areas should be conducted regularly following the initial stages of establishment to ensure that the potential for excessive surface water runoff eroding deposited material along preferential pathways is minimised.

The Site Access Roads and associated drainage systems will serve ongoing forestry and agriculture activity in the area. All other hard surfaced areas will be allowed to revegetate naturally. Based on the experience of the project team monitoring operational wind farm sites throughout the country, the approach of allowing these areas to revegetate naturally has proven to be very successful.

9.5.4.3 Reinstatement Residual Effects

It is anticipated that the appropriate reinstatement of redundant hardstand areas and localised site access track- will result in a net beneficial impact. This will be achieved through passive continuous improvements at the areas in question. Over time, the reinstated areas will become revegetated and will recover to become similar in appearance to the surroundings of the wider Site. The reinstatement of the Site areas will likely result in enhanced bog water levels at the Site. This will occur through the reintroduction of permeable layers at former hardstand areas which will in turn promote the filtration of potentially contaminated surface water runoff which may originate from reinstated areas. Therefore, the residual impact of reinstatement at site access tracks and former Turbine Hardstand areas is considered to be a **positive**, **localised** and **permanent** impact of the proposed Development. However, it is important to note that reinstatement will be required to be managed similar to the construction phase, including appropriate construction phase mitigation and monitoring.

9.5.4.4 *Decommissioning and Restoration Phase – Physical Infrastructure*

Deconstruction works during the Decommissioning phase of the Project pose similar hazards and risks associated with the construction phase but to a far lesser extent, for example, the potential for fuel spills from vehicles is valid but there will likely be less vehicles required. The principles mitigation measures described in this EIAR chapter will be implemented by means of a Decommissioning Plan.

Restoration of physical infrastructure at the Site following the Decommissioning phase has the potential to cause adverse effects on the receiving hydrological and hydrogeological receiving environment. It is recommended that a benefit analysis should be carried out determine the overall positive outcomes against any potential adverse effects prior to such activities being permitted. The assessment of all restoration activities will require an analysis across multiple other environmental disciplines (i.e., ecology, noise and human beings etc.) with the overall synergistic effects requiring evaluation. It noted that with continued land use practices (agriculture and peat cutting) the environment, in respect to soils and subsoils, surrounding the Site will also become altered over time across the operational lifetime of the proposed Project. It is therefore recommended that the potential for restoration activities following the Decommissioning phase of the Project is evaluated in detail in line with the Decommissioning phase.

9.5.5 Cumulative Effects

With respect to hydrology, the effects of the Project are considered to contribute to and add to the cumulative nature of adverse effects imposed on the surface water network in the catchments associated with the Project (**Figure 9.14**). However, considering the pre-existing "*Good*" and *"Moderate*" WFD status of the surface waters surrounding the proposed Project (**Figure 9.4a and Figure 9.3**), and the generally good-quality baseline water quality results outlined in **Section 9.3.8**, the potential for the Project to have adverse cumulative effects on hydrology is limited to the construction phase. Considering cumulative effects of pressures on the surface water network, if an accidental release of contaminants were to occur, there is a potential to temporarily impact surface waterbodies in the catchment. However, the objectives of the outlined mitigation measures in this chapter and in the Flood Risk Assessment

(FRA), **Appendix 9.1**, are to reduce any potential impact to acceptable levels. Therefore, the Project is not considered likely to significantly contribute to cumulative effects in terms of water quality nor flood risk.

With respect to hydrogeology, and the potential effects of the Development having been assessed as likely being localised due to the overlying tills, slow recharge rates, high run-off rates and poor yielding underlying groundwater aquifer except for local zones, the Development is not considered to potentially significantly contribute to cumulative effects.

Table 9.13: List of Wind Farms within a 20km radius of the Site.

Wind Farm	Status	No. of Turbines	Approximate Distance to the Site Boundary	Direction from the Development
Altagowlan	Operational	9	4.6km	South-East
Black Banks (I & II)	Operational	12	1.4km	South-West
Carrane Hill	Operational	4	4.0km	South-West
Carrickeeny	Operational	4	18.9km	North-West
Corrie Mountain	Operational	8	3.2km	South-East
Croagh*	In-Planning	10	2.4km	West
Derrysallagh (Kilronan II)	Operational	10	6.2km	South-West
Faughary	Operational	3	19.1km	North
Garvagh Glebe	Operational	13	920m	South-West
Geevagh	Operational	6	5.7km	South-West
Kilronan	Operational	10	9.3km	South
Moneenatieve I & II	Operational	5	2.9km	South-East
Seltannavenny	Operational	2	6.7km	South-East
Spion Kop	Operational	2	4.2km	South-East
Tullynahaw	Operational	11	5.7km	South-East
Tullynamoyle I, II & III	Operational	15	7.1km	North-East
Tullynamoyle (V)	Consented under planning application P19/26	4	6.9km	North-East
Tullynamoyle (V)	Consented by An Bord Pleanála under case reference (Pl12.312895)	4	6.6km	North-East

*Refused planning permission by An Bord Pleanála 23/10/23.

9.6 SUMMARY OF SIGNIFICANT EFFECTS

This chapter identified the likely hydrological, and hydrogeological effects of the Project. By summarising relevant guidance and legislation and outlining baseline information, it allowed for the assessment of the potential effects to be identified and their significance rated.

During both the construction and operational phases of the Project, activities will take place at the Site that will have the potential to significantly affect the hydrological regime and surface water quality at the Site or its vicinity. The significant potential effects that could generally arise from the Project during the construction of infrastructure elements including the excavation activities associated with turbine foundations, cable trenches and, and works in close proximity to surface water or drainage network including watercourse crossings and culverts, leading to an increase in suspended sediment concentrations, as well as Operational and Decommissioning phases relate to sediment input from runoff and other pollutants such as hydrocarbons and cementitious substances, with hydrocarbons or chemicals spills to surface waters having the most potential for impact.

The implementation of mitigation through avoidance principles, pollution control measures, surface water drainage measures and other preventative measures have been incorporated into the project design in order to minimise potential significant adverse effects on water quality at the Site. A self-imposed 15m drainage buffer zone and 50m stream buffer zone will be implemented at the Site which will largely result in the avoidance of sensitive hydrological features. Direct discharges to surface waters of dewatered loads will not be permitted under any circumstances. This in turn will reduce the potential for adverse effects on downstream designated Sites. It is not considered likely that the Development will have significant cumulative impact to the conservation status of ecological habitats and terrestrial mammals occurring in the surrounding countryside, over and above any pre-existing effect caused by historic land use practices.

The construction drainage plan / Surface Water Management Plan (SWMP) for the Site will be a key method through which sediment runoff arising from construction activities will be reduced and through which runoff rates will be controlled.

Overarching objectives of the CEMP and SWMP will be to adopt and implement Nature Based Solutions including the provision of extensive Sustainable Drainage System (SuDS) features. This approach will be adopted to the extent that mitigating against likely effects such as net increase in surface water runoff and potential adverse effects to surface water quality, will over shoot net adverse losses and provide beneficial effects compared to baseline conditions.

Implementation of the control measures outlined in this EIAR are considered to result in a robust environmental management plan which will target and mitigate likely sources and pathways of contaminant arising at the site, and to actively manage and monitor systems on site to achieve no impact to the receiving surface water network. Short term minor releases are still possible, however with the monitoring and management, any potential issue arising will addressed immediately and remedied in good time.

Groundwater will not be significantly impacted by the development. The principal residual risk to groundwater posed by the Development is the use, storage and transfer of hydrocarbons (fuel) on site for plant equipment. In the unlikely event a spill occurs, the contaminant will be contained, managed and removed in good time.

Table 9.14: Summary Table of Effects pre and post Mitigation

		Qualifying Criteria Pre-Mitigation									Qualifying Criteria With Mitigation	
Effect / Impact Description	**Phase**	**Type**	**Quality**	**Scale**	**Significance**	**Extent**	**Context**	**Probability**	**Duration / Frequency**	**Mitigation Applied**	**Quality**	**Significance**
Earthworks	Construction	Direct and Indirect *	Adverse	Large	Moderate to Significant	Development Footprint, Localised	Contrast to baseline, and conforms e.g. forestry operations)	Unavoidable	Temporary	Yes; Section 9.5.2.1	Adverse	Neutral to Slight
Clear Fell of Afforested Areas	Construction	Direct and Indirect *	Adverse	Small	Moderate	Development Footprint,	Conforms to baseline	Unavoidable	Permanent but Reversible	Yes; Section 9.5.2.16	Adverse	Neutral to Slight, Potentially Beneficial
Release of Suspended Solids	Construction	Direct and Indirect *	Adverse	Moderate	Moderate Profound	Localised (Potentially Regional)	Conforms to baseline e.g. forestry operations)	Unavoidable	Temporary	Yes; Section 9.5.2.3	Adverse	Neutral to Slight
Vehicular Movements	Construction	Direct and Indirect *	Adverse	Moderate	Moderate to Significant	Localised (Potentially Regional)	Conforms to baseline e.g. forestry operations)	Unavoidable	Temporary	Yes; Section 9.5.2.4	Adverse	Neutral to Slight
Release of Hydrocarbons (SW)	Construction	Direct and Indirect *	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Medium to long term but Reversible	Yes; Section 9.5.2.5	Adverse	Neutral to Slight
Release of Hydrocarbons and Storage (GW)	Construction	Indirect	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Permanent but Reversible	Yes; Section 9.5.2.5	Adverse	Neutral to Slight
Release of Wastewater Sanitation Contaminants (SW)	Construction	Direct and Indirect *	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Temporary to Long Term Reversible	Yes; Section 9.5.2.7	Adverse	Neutral to Slight

		Qualifying Criteria Pre-Mitigation									Qualifying Criteria With Mitigation	
Effect / Impact Description	**Phase**	**Type**	**Quality**	**Scale**	**Significance**	**Extent**	**Context**	**Probability**	**Duration / Frequency**	**Mitigation Applied**	**Quality**	**Significance**
Release of Wastewater Sanitation Contaminants (GW)	Construction	Indirect	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Permanent but Reversible	Yes; Section 9.5.2.7	Adverse	Neutral to Slight
Release of Construction or Cementitious Materials (SW)	Construction	Direct and Indirect *	Adverse	Moderate to Significant	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Temporary to Medium Term	Yes; Section 9.5.2.8	Adverse	Neutral to Slight
Release of Construction or Cementitious Materials (GW)	Construction	Indirect	Adverse	Moderate to Significant	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Permanent but Reversible	Yes; Section 9.5.2.8	Adverse	Neutral to Slight
Hydrologically Connected Designated Sites	Construction	Indirect	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to baseline e.g. cumulative upstream impacts	Likely	Temporary to Long-term	Yes; Covered in all above Sections	Adverse	Neutral to Slight
Local Groundwater Supplies (Wells)	Construction / Operational	Direct and Indirect *	Adverse	Small	Slight	Localised	Conforms to Baseline e.g. other shallow excavations.	Unlikely	Temporary	Yes; Section 9.5.2.14	Neutral	Neutral
Groundwater or Bog Water Associated with Wind Farm	Construction	Direct and Indirect *	Neutral to Adverse	Small to Moderate	Slight to Moderate	Localised	Conforms to Baseline e.g. forestry drains.	Likely	Permanent / Reversible	Yes; Section 9.5.1 and 9.5.2.13	Slight Adverse / Small Beneficial	Slight / Neutral / Beneficial
Groundwater and Surface Water Associated with Wind Farm Cable Works	Construction	Direct and Indirect *	Adverse	Small to Moderate	Slight	Localised	Conforms to Baseline e.g. public roads and services.	Likely	Permanent but Reversible	Yes; Section 9.5.2.15.1	Adverse	Neutral to Slight
Groundwater and Surface Water Associated with Grid Connection Cable Works	Construction	Direct and Indirect *	Adverse	Small	Slight	Localised	Conforms to Baseline e.g. public roads and services.	Likely	Temporary	Yes; Section 9.5.2.15.2	Adverse	Neutral to Slight

		Qualifying Criteria Pre-Mitigation									Qualifying Criteria With Mitigation	
Effect / Impact Description	**Phase**	**Type**	**Quality**	**Scale**	**Significance**	**Extent**	**Context**	**Probability**	**Duration / Frequency**	**Mitigation Applied**	**Quality**	**Significance**
Reinstatement of Redundant Access Track, Hardstand Areas and Borrow Pit	Construction and Decommissioning	Direct and Indirect *	Adverse	Small	Slight	Development Footprint, Localised	Contrast to Baseline.	Likely	Permanent	Yes; Section 9.5.4.2	Adverse	Neutral to Beneficial
Excavation Dewatering & Construction Water	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline.	Likely	Temporary to Permanent	Yes; Section 9.5.2.9	Adverse	Neutral to Slight
Diversion and Enhancement of Drainage	Construction	Direct and Indirect *	Adverse	Small	Moderate	Localised (Potentially Regional)	Conforms to Baseline e.g. forestry drains.	Likely	Permanent	Yes; Sections 9.5.2.10, 9.5.2.11	Adverse	Neutral to Slight
Watercourse Crossings - Mapped Rivers	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to Baseline e.g. existing bridges and roads in area.	Unavoidable	Permanent	Yes; Section 9.5.2.9 -10 and Section 9.5.2.11	Adverse	Slight
Watercourse Crossings - Drainage Features	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to Baseline e.g. agri / peat drains / forestry drains.	Unavoidable	Permanent	Yes; Section 9.5.2.9 and Section 9.5.2.11	Adverse	Slight
Increased Hydraulic Loading & Flood Risk	Operational	Direct and Indirect *	Adverse	Small	Slight	Localised (Potentially Regional)	Conforms to Baseline e.g. existing forestry tracks.	Unavoidable	Permanent	Yes; Section 9.5.3.1	Neutral to Beneficial	Neutral to Beneficial

Note:
*** Includes Indirect / Secondary impacts to receptors downstream of the Project. For example: Contaminants intercepted by surface water features or groundwater bodies can have a potential effect on downstream sensitive receptors or regional groundwater aquifers depending on the environmental circumstances.**

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