9 HYDROLOGY & HYDROGEOLOGY

9.1 INTRODUCTION

This chapter assesses the impacts of the Project (**Chapter 1: Introduction**) on the Hydrology and Hydrogeology environment associated with the Site. The Project refers to all elements of the application for the construction of Inchamore Wind Farm (**Chapter 2: Project Description**). Where negative 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, and
- 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 by the appended documents provided in **Volume IV** of this EIAR.

- **Figure 9.1(a) –** Site Location & Layout Wind Farm
- **Figure 9.1(b) –** Site Location & Layout Grid Connection Route
- **Figure 9.2(a) -** Surface Water Network Wind Farm
- **Figure 9.2(b) -** Surface Water Network Grid Connection Route
- **Figure 9.3(a) -** WFD Status Wind Farm
- **Figure 9.3(b) -** WFD Status Grid Connection Route
- **Figure 9.4(a) -** WFD Risk Wind Farm
- **Figure 9.4(b) -** WFD Risk Grid Connection Route
- **Figure 9.5 -** Rainfall Trends at Site
- **Figure 9.6 -** Surface Water & Designated Area Flow Chart
- **Figure 9.7 (a) -** Surface Water Mapping and Survey Wind Farm
- **Figure 9.7 (b) -** Surface Water Mapping and Survey Grid Connection Route
- **Figure 9.8(a) -** Bedrock Aquifer Wind Farm
- **Figure 9.8(b) -** Bedrock Aquifer Grid Connection Route
- **Figure 9.9 (a) -** Groundwater Vulnerability Wind Farm
- **Figure 9.9 (b) -** Groundwater Vulnerability Grid Connection Route
- **Figure 9.10 (a)** - Groundwater Recharge Wind Farm
- **Figure 9.10 (b) -** Groundwater Recharge Grid Connection Route
- **Figure 9.11(a) -** Designated & Protected Areas Wind Farm
- **Figure 9.11(b) -** Designated & Protected Areas Grid Connection Route

- **Figure 9.12(a) -** Surface Water Network and Water Resources Wind Farm
- **Figure 9.12 (b) –** Surface Water Network and Water Resources Grid Connection Route
- **Figure 9.13 (a) -** Constraints Map Wind Farm
- **Figure 9.13 (b) -** Constraints Map Grid Connection Route

- **Appendix 9.1 –** Inchamore Wind Farm Site Specific Flood Risk Assessment
- **Appendix 9.2 –** Inchamore Wind Farm Site Photographs
- **Appendix 9.3 –** Hydrochemistry Database
- **Appendix 9.4 –** SW Laboratory Certs
- **Appendix 9.5 –** Safety Material Datasheet-Clearbore
- **Appendix 9.6 –** Conceptual and Info 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**.

9.2 PROJECT DESCRIPTION

The Project (**Figure 8.1a-b**) is described in **Chapter 2: Project Description**.

9.2.1 Statement of Authority

Minerex Environmental Ltd. (MEL), an RSK group company was commissioned to carry out this Environmental Impact Assessment Report. 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 members of the RSK EIA team involved in this assessment include the following persons:

- Sven Klinkenbergh – Project Manager and Lead Author – B.Sc. (Environmental Science), P.G.Dip. (Environmental Protection) – Associate, Project Manager and EIA Lead Author with c. 10 years industry experience in the preparation of environmental, geological, hydrological and hydrogeological reports. Sven's involvement in this EIAR has been conducting field surveys and a technical reviewer of both Chapter 8 and Chapter 9
- Project Scientist: Jayne Stephens - B.Sc. (Environmental Science), PhD (Environmental and Infection Microbiology). Jayne is an Environmental consultant with

c. 5 years' experience 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. Jayne's involvement in this EIAR has been data analysis and technical report writing.

- Lissa Colleen McClung - B.Sc. Environmental Studies (Hons.), M.Sc. Environmental Science Hons.). Current Role: Graduate Project Scientist. 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. Colleen's involvement in this EIAR has been data analysis, technical report writing and producing technical appendices and figures.
- Mairéad Duffy- B.Sc. Environmental Management, M.Sc. Climate Change. Current Role: Graduate Project Scientist. Mairéad has experience in technical report writing and field work surveying of hydrological and geological elements of the environment with associated proposed green energy projects around the country. Mairead's involvement in this EIAR has been data analysis and technical report writing.

9.2.2 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 impacts 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 impacts identified.
- Identification and assessment of residual impacts of the Development considering mitigation measures.
- Identification and assessment of cumulative impacts if and where applicable.

9.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

The following sections are general to the EIAR process and where specific items are raised, they are assessed and discussed in detail in following sections of the report.

9.3.1 Assessment Methodology

The following calculations and assessments were undertaken in order to evaluate the potential impacts of the Project on the hydrology and hydrogeology aspects of the environment at the Inchamore 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 Project 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 impacts on the hydrology and hydrogeology aspects of the environment.
- Where impacts 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.

Assessments of routes (Grid Connection Route and Turbine Delivery Route) are assessed in a similar manner but use mainly desktop assessment data to evaluate and qualify potential impact at locations associated with significant infrastructure (cable joint bays and watercourse crossings). These routes generally follow existing infrastructure, namely public roads.

9.3.1.1 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 to minimize potential impacts to acceptable levels where possible, and to evaluate likely or expected residual impacts posed by the Project.

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 Project 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 Project's potential impacts on the environment.

9.3.1.2 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 conceptual 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 where 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.

9.3.1.3 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.

9.3.2 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 adhered 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). 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 2027* (WFD). (*Current RBMP cycle).

The Cork County Development Plan (2022-2028) and Kerry County Development Plan (2022-2028) were 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)
- CIRIA (2015) The SuDS Manual (C753)
- 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 (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (supersedes 1997 and 2002 versions)
- 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
- Scottish nature Heritage (2019) Good practice during wind farm construction 4th Edition)
- Transport Infrastructure Ireland (TII) (2014) "Drainage Design For National Road Schemes - Sustainable Drainage Options".

9.3.3 Desk Top Study

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

- Obtain and compilation of all available and relevant mapped data of the Project provided by the client.
- Study and assessment of the proposed locations of turbines and access roads relative to available data on site topography and slope gradients. At minimum, open source (relatively low accuracy) data will be used where specific data is required, for example; opensource Global Digital Elevation Model (GDEM) data for topo and slope data in the absence of Lidar (relatively high accuracy) or similar.
- 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 (Blue Sky Lidar data (1 m)).

9.3.4 Field Work

Field inspections were carried out by Project Manager Sven Klinkenbergh, at the Site of the Project during c. January and February 2019 as well as September 2020 and November 2022.These works consisted of the following:

- Site walk over including recording and digital photography of significant features. Photographs obtained during Site Surveys are presented in **Appendix 9.2.**
- 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. Four 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 water sampling events.
- Limitations include some access limiting factors such as active commercial forestry and similar vegetation e.g. scrub.

9.3.5 Evaluation of Potential Effects

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

The following table presents rated categories and criteria for rating site attributes:

Table 9.1: 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 presents rated sensitivity categories (SNH, 2013):

Table 9.2: 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**.

[1] Environmental Protection Agency (EPA) (2017) Guidelines on the information to be contained in Environmental Impact Assessment Reports
[2] Environmental Protection Agency (EPA) (2022) Advice Notes for Preparing Environmental Impact Statements Environmental Protection Agency, Ireland
[3] National Roads Authority (NRA) (2008) Guidelines on the information to be contained in Environmental Impact Assessment Reports
[4] Scottish National Heritage (SNH) (2018) Environmental Impact Assessment Handbook V5

Importance	Criteria
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**.

9.3.5.2 *Magnitude*

The magnitude of potential impacts arising as a product of the Project are defined in accordance with the criteria provided by the EPA, as presented in the **Table 9.3**[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 9.3: Describing the Magnitude of Impacts

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 Effects	An effect which, by its character, magnitude, duration or intensity, significantly alters most of a sensitive aspect of the environment.
Profound	An effect which obliterates sensitive characteristics.

In terms of hydrology and hydrogeology, magnitude is qualified in line with relevant guidance, as presented in **Table 9.4** and **Table 9.5**[6]. 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 impacts in terms of weighting impacts relative to site attribute importance, and scale where applicable.

Table 9.4: 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

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

[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
		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 minor impact on integrity of attribute or loss of small 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 >100 mm

Table 9.5: Qualifying the Magnitude of Impact on Hydrogeological Attributes

Magnitude of Impact	Description	Example
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 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 routine 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

9.3.5.3 Significance Criteria

Considering the above definitions and rating structures associated with sensitivity, attribute importance, and magnitude of potential impacts, rating of significant environmental impacts is done in accordance with relevant guidance as presented in **Table 9.6**. 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 9.3: Describing the Magnitude of Impacts**) are linked directly with the Project specific terms for qualifying potential impacts (**Table 9.4: Qualifying the Magnitude of Impact on Hydrological Attributes** and **Table 9.5: Qualifying the Magnitude of Impact on Hydrogeological Attributes**). Therefore, qualifying terms (**Table 9.6**) are used in describing potential impacts of the Project. This is largely driven by the potential for effects to extend down gradient, beyond the Redline Boundary in terms of Hydrology and Hydrogeology.

Table 9.6: Weighted Rating of Significant Environmental Impacts

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

9.3.5.4 Consultations

A Scoping Response was received for the proposed Project from the Development Applications Unit which yielded the following pertaining to a population of freshwater pearl mussel:

> *The combination of clean water diversion, lined multicelled stone-constructed sediment ponds which can be cleaned by suction rather than excavated out, an environmental management plan, alarmed autosamplers, and previous best-practice upland construction experience indicates that a sediment control system could control sediment release such that it will not have an adverse effect on freshwater life downstream.*

Responses to this Scoping Response can be found in **Section 9.6.1.2, Section 9.6.1.2.5,** and **Appendix 9.6 Tile 13.** Further information on sensitive ecological populations is detailed in **Chapter 6 Aquatic Ecology.**

9.4 BASELINE DESCRIPTION

9.4.1 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.

9.4.2 Site Description

The Site is located 5.9 km west of Ballyvourney, Co. Cork and shares the county boundary between Cork and Kerry. It is 54 km west of Cork City, and 23 km north-east of Kenmare, Co. Kerry. The Project is located within the townlands of Inchamore, Mileeny Derryreag and Derreenaling. The Site is characterised by relatively complex (hilly) topography with associated elevations ranging between 460 metres Above Ordnance Datum (m AOD) in the north-western side of the Site to 350 m AOD towards the eastern side of the Site. The Project is 'novel' relative to the Site which is characterised as being rural agricultural land generally, however there are a number of established wind farms in the region including Coomagearlahy Wind Farm, Coolknoohil Kilgarvan Wind Farm, Glanlee Wind Farm and Grousemount Wind Farm c. 2.7 km, 4.4 km 4.9 km, and 7.5 km southwest of the Site, respectively **(Appendix 2.3: Wind Farms within 20 km of Proposed Turbines).**

The Site extends to approximately 170 ha of which 145.4 ha consists of low yielding, commercial forestry. owned by Coillte. Coillte own 76.0 ha of the forestry (53% of forestry on site) while 69.4 ha (47%) of the forestry is owned privately. Other principal land use in the area consists of a mix of agricultural sheep and cattle grazing, farmland, residential properties, agricultural structures and open mountain heath. Topography across the site varies ranging from mostly gently to occasional steep inclinations. Rocky outcrops with steep, shear faces are occasionally distributed across several of the slope faces. Topography is discussed in greater detail in relation to stability and constraints in **Chapter 8: Soils and Geology.**

9.4.3 Rainfall and Evapotranspiration

Rainfall data for the region associated with the Project has been assessed in terms of the following parameters:

- Historical average and max monthly rainfall and effective rainfall. Effective rainfall is calculated as being rainfall minus evapotranspiration equals effective rainfall, or the amount of rainfall which will contribute to surface water runoff discharge volumes and/or groundwater recharge.
- Potential significant storm events including events with a 1 in 100 year return period over 1 hour duration, 25 day duration and 30 day or month duration (inferred using available data).
- Daily 2020 rain (specifically in relation to meteorological conditions at the time of Site Surveys).

Data from the meteorological stations listed in

Table 9.7: Meteorological Stations are used in this assessment[7]. Using data presented in **Table 9.9: Met Éireann Return Period Rainfall Depths (Irish Grid; 113392, 78786)**, storm event of 30 days duration with a 1 in 100 year return period is inferred to be 498.3 mm. For the purpose of this environmental impact assessment, predicted extreme or worst-case values are used, as presented in **Table 9.9: EIA Specific Assessment Data**. Rain fall amounts in the three days preceding baseline sampling events are presented in **Table 9.11: Rainfall Prior to Baseline Sampling Events.**

Table 9.7: Meteorological Stations [8]

Category	Meteorological Station/s & Data Set	Approx. Distance from the Site (km)
Rainfall (Historical Monthly)	M.BALLINGEARY 1948-2020	4
Rainfall (2020/21 Monthly/Daily)	M.BALLINGEARY 1948-2020	4
Evapotranspiration	Cork Airport – 2016-2019 Minimum	50

[7] Met Éireann, Historical Data, Available at; www.met.ie, Accessed; 03rd March 2021
[8] Met Éireann

Table 9.8: Met Éireann Return Period Rainfall Depths (Irish Grid; 113392, 78786)[9]

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 113392, Northing: 78786,

	Interval		Years													
DURATION	6months	1year	2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	3.1	4.0	4.5	5.1	5.6	5.9	6.9	8.0	8.7	9.6	10.4	11.0	11.9	12.6	13.2	N/A
10 mins	4.4	5.6	6.3	7.2	7.7	8.2	9.6	11.1	12.1	13.4	14.5	15.4	16.6	17.6	18.4	N/A
15 mins	5.1	6.6	7.4	8.4	9.1	9.6	11.3	13.1	14.2	15.7	17.1	18.1	19.6	20.7	21.6	N/A
30 mins	7.2	9.2	10.2	11.6	12.5	13.2	15.4	17.8	19.2	21.2	22.9	24.2	26.2	27.6	28.8	N/A
1 hours	10.2	12.8	14.2	16.1	17.3	18.2	21.1	24.1	26.0	28.6	30.8	32.5	35.0	36.9	38.4	N/A
2 hours	14.3	17.9	19.7	22.2	23.8	25.0	28.8	32.8	35.3	38.6	41.5	43.6	46.8	49.2	51.2	N/A
3 hours	17.5	21.7	23.8	26.8	28.7	30.1	34.5	39.2	42.1	46.0	49.3	51.8	55.5	58.3	60.6	N/A
4 hours	20.1	24.9	27.3	30.6	32.8	34.4	39.3	44.5	47.7	52.1	55.8	58.5	62.7	65.7	68.2	N/A
6 hours	24.6	30.3	33.1	37.0	39.5	41.4	47.2	53.2	57.0	62.1	66.3	69.5	74.3	77.9	80.7	N/A
9 hours	30.0	36.8	40.1	44.7	47.6	49.8	56.6	63.7	68.1	74.0	78.9	82.6	88.1	92.2	95.5	N/A
12 hours	34.6	42.2	45.9	51.1	54.4	56.9	64.5	72.4	77.2	83.7	89.2	93.4	99.4	104.0	107.6	N/A
18 hours	42.3	51.3	55.6	61.7	65.6	68.5	77.4	86.6	92.2	99.8	106.2	110.9	117.9	123.2	127.4	N/A
24 hours	48.7	58.9	63.8	70.6	75.0	78.2	88.1	98.3	104.6	113.0	120.1	125.3	133.1	138.9	143.5	159.0
2 days	64.3	76.4	82.2	90.2	95.2	99.0	110.4	122.0	129.1	138.5	146.4	152.2	160.8	167.1	172.2	189.0
3 days	77.6	91.4	97.9	106.9	112.5	116.7	129.3	142.1	149.9	160.1	168.7	175.0	184.3	191.2	196.7	214.8
4 days	89.8	105.0	112.1	121.9	128.1	132.6	146.3	160.1	168.6	179.6	188.8	195.6	205.5	212.8	218.7	237.9
6 days	112.1	129.7	138.0	149.3	156.3	161.5	177.1	192.8	202.2	214.7	224.9	232.5	243.5	251.7	258.2	279.3
8 days	132.7	152.5	161.8	174.4	182.2	188.0	205.2	222.5	232.9	246.5	257.7	265.9	278.0	286.8	293.8	316.8
10 days	152.3	174.1	184.3	198.1	206.6	212.9	231.6	250.3	261.5	276.2	288.3	297.1	310.0	319.5	327.0	351.5
12 days	171.2	194.9	205.8	220.7	229.9	236.6	256.7	276.8	288.8	304.4	317.3	326.7	340.5	350.5	358.5	384.5
16 days	207.5	234.6	247.1	263.9	274.3	281.9	304.5	327.0	340.4	357.8	372.2	382.6	397.8	408.9	417.7	446.3
20 days	242.6	272.7	286.6	305.2	316.7	325.1	350.0	374.6	389.3	408.4	424.0	435.4	451.9	463.9	473.5	504.4
25 days	285.2	318.9	334.3	355.1	367.8	377.1	404.6	431.7	447.9	468.8	485.8	498.3	516.3	529.4	539.8	573.4

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

[9] Met Eireann, Rainfall Return Periods, Available at; https://www.met.ie/climate/services/rainfall-return-periods , Accessed; October 2022

Table 9.9: EIA Specific Assessment Data [10]

Category	Value
Max monthly effective rainfall (mm/month)	680.2
1 in 100 Year Rainfall Event (30 day duration) (mm/month)	498.3
1 in 100 Year Rainfall Event (1 hour duration) (mm/hour)	32.5
Minimum monthly evapotranspiration (mm/month)	9.7

Table 9.10: Rainfall Prior to Baseline Sampling Events [11]

Event No.	Date	Rainfall on days leading up to sampling event (Day 0)				Total Rain in 3 no. days prior to sampling. (Days 1-3)	Event Category	Weather Station
No.	Sampling Date (Day 0)	Day 3 mm/day	Day 2 mm/day	Day 1 mm/day	Day 0 mm/day	mm / 3 days		
1	12/08/2020	0.0	0.0	0.0	14.6*	0.0	Dry	Ballingeary
2	26/08/2020	2.3	53.4	4.0	4.0	59.7	Wet	Ballingeary
3	24/02/2021	0.5	14.1	33.2	4.8	47.8	Wet	Cork Airport
4	16/03/2021	8.1	0.0	0.0	0.0	8.1	Dry	Cork Airport
* Sampling occurred ahead of recorded rainfall for the day. Lead up to sampling event was dry.								

9.4.4 Regional and Local Hydrology

The surface water network draining the Site is mapped and presented in **Figure 9.2a.**

The Project is situated within the Lee, Cork Harbour and Youghal Bay catchment (ID: 19, Area: 2,182 km^2). Surface water runoff associated with the Site drains into the Sullane sub catchment and/or Sullane_010 river sub basins.

All surface waters drainage from the Site eventually combine in Carrigdrohid Reservoir, from which waters eventually flow to Cork Harbour and into the Celtic Sea.

9.4.5 Site Drainage

The Site is characterised by a relatively extensive network of non-mapped natural and artificial drainage channels. Drainage channels identified during desk study assessment

[10] Met Eireann
[11] Met Eireann

and during Site Surveys are presented in **Figure 9.7a and Figure 9.7b**. Photographs of some significant features are presented in **Appendix 9.2**.

Note: Mapping of minor natural or artificial drainage channels has been completed is limited in places due to some site access constraints (afforested areas). Considering the nature of the areas in question, afforested areas, it is presumed that these areas possess extensive forestry drainage channels. Similarly, there are likely to be additional culverts associated with afforested areas or with minor existing access trails and minor drainage channels. Aerial lidar survey data (topographical elevation data, accuracy 1 m) and recent aerial photography was interrogated and some additional drains were identified, however none were material to the impact assessment for the development. It is likely any residual undetected drainage features are minor in scale.

9.4.6 Water Framework Directive (WFD) Water Body Status, Risk & Objectives

Details in relation to the Water Framework Directive (WFD) 2016-2021 status assigned to surface waterbodies associated with the Site are presented in **Figure 9.3a** and **Figure 9.6.**

The WFD status (2016-2021) for the mapped surface water body / river (Sullane_010), directly draining the Site is classified as 'Good'.

Further downstream, the WFD status for rivers fluctuates between 'High' and 'Good' status. However, the status then deteriorates to 'Moderate' in places due to significant pressures in hydro-morphology from channelisation and hard infrastructure such as reservoirs, weirs, embankments and culverts.[12]

Lake water bodies associated with the surface water network possess WFD 2016-2021 status ranging from 'Moderate (e.g., Carrigdrohid Reservoir) to 'Good (e.g., Inniscarra). According to the EPA (2021), based on the 1st and 2nd RBMPs, the WFD statuses associated with the lake water bodies are due to the following actions:

The Carrigdrohid is designated as a heavily modified water bodies (HMWB) in the catchment due to power generation, in addition to 'significant unknown anthropogenic pressures' impacting Carrigdrohid. Pressures upon the Inniscarra are due to power generation and abstraction for drinking water. Both lake waterbodies (Carrigdrohid & Inniscarra) are At Risk of not achieving "Good' status.

[12] Environmental Protection Agency (2021) "3rd Cycle Draft Lee, Cork Harbour and Youghal Bay Catchment Report (HA 19)" Catchment Science & Management Unit. Version no.(1).

The headwaters of the Sullane_010, directly draining the Site, and where proposed locations of WC1, WC2 and WC3 will cross is 'At risk' of deteriorating (WFD), (**Figure 9.4a, Figure 9.6**) from significant pressures in hydro-morphology.

9.4.7 Surface Water Hydrochemistry

Baseline surface water sampling was carried out at four locations that can be seen in **Figure 9.7b** which are representative of drainage and surface water network channels associated with the Site (**Figure 9.2a).** Data on surface water flow at representative baseline sampling locations at the time of sampling is presented in **Appendix 9.5,** and laboratory certificates are presented in **Appendix 9.4**.

Surface water quality observed at all four monitoring locations is of similar standard and is generally of good quality when screened against relevant reference concentrations, however the following is noted:

- Ammoniacal Nitrogen as N was elevated above the relevant reference concentration (0.02 mg/L Ammoniacal Nitrogen as N) at all monitoring locations at given sampling dates (Min Max Range; 0.024 – 0.042 mg/L Ammoniacal Nitrogen as N). Elevations occurred during at least two out of four monitoring events for all monitoring, ranging up to four of four monitoring events at a number of locations.
- Nitrite as NO_2 was elevated above relevant reference concentration (0.05 mg/L Nitrite as NO_2) at SW1 (0.273 mg/L Nitrate as NO_3) during the 24/02/2021 sampling event.
- pH was more acidic than the relevant reference range (pH 6 – 9) at SW1 (pH 5.73) during the 26/08/2020 sampling event.

Elevated concentrations of Nitrogen compounds (Ammoniacal Nitrogen, and Nitrate) as observed at all monitoring locations is indicative of current land practices at the Site, agriculture and forestry (see Photographs **in Appendix 9.2)**.

Low pH in surface water, (see **Appendix 9.3 – Surface Water Hydrochemistry Database),** can be attributed to a range of environmental characteristics and pressures, including the presence of humic and fulvic acids associated with peat (**Chapter 8: Soils and Geology**).

9.4.8 Hydrogeology – Bedrock Aquifer

Consultation with GSI Groundwater maps (2022) indicates that the entire Project is underlain by a Locally Important Aquifer (LI), that is; bedrock which is moderately productive only in local zones (**Figure 9.8a - Bedrock Aquifer)**.

There are no mapped karst features within 10 km of the Wind Farm Site.

9.4.9 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. Regarding sites where low permeability subsoil is present, the following thicknesses of unsaturated zone are specified.[13]

Table 9.11: 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 predominantly mapped as 'Extreme (E)' vulnerability rating which tend to be at lower elevations, with some areas mapped as 'Rock at or Near Surface (X)' vulnerability rating particularly at higher elevations. Both the Turbine Delivery Route and Grid Connection Route traverse land with groundwater vulnerability ratings ranging from 'Moderately Vulnerable' to 'Extreme Vulnerability' (**Figure 9.9a – Groundwater Vulnerability**).

The potential groundwater recharge rate (recharge coefficient) for the local area, as mapped by GSI (2022), ranges significantly depending on the underlying soil / subsoil type and

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

varies significantly relative to the thickness of overburden or aquifer vulnerability, and corresponds to the recharge capacity of the underlying bedrock aquifer. The underlying bedrock aquifer is classified as Locally Important 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. 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[14]. Combining these factors results in the Site being characterised by low recharge rates and high surface water runoff rates.

In peat areas associated with the Site the mapped groundwater recharge coefficient is as low as 20% of effective rainfall. This recharge coefficient is considered very low [15]. 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 of the Site underlain by Locally Important Aquifer (LI) possess a maximum annual recharge capacity of 200 mm effective rain fall. (**Figure 9.10a)**. For additional context, the maximum recharge capacity of 200 mm per annum equates to a recharge coefficient of approximately 15% 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 low to very low recharge rates in overburden (soils/subsoils) and very low recharge capacity in the underlying bedrock aquifer. This implies that, particularly during seasonally wet or extreme meteorological conditions, the majority of water (rain) introduced to the Site will drain off the Site as surface water runoff, and the rejected recharge water volumes will likely discharge to surface waters relatively rapidly and locally. As such, the surface water network associated with the Site is characterised as having a rapid hydrological response to rainfall (i.e., a flashy regime). This is indicative of lands comprising of blanket peat or catchments with elevated peat cover [16] [17].

[14] Labadz J, et al (2010) Peatland Hydrology. Draft Scientific Review, IUCN UK Peatland Programme's Commission of Inquiry on Peatlands. UK.
[15] Williams N. H., et al. (2011) A NATIONAL GROUNDWATER RECHARGE MAP FOR IRELAND. National Hydrology Conference 2011, Ireland.
[16] Misstear B., Brown L. (2008) Water Framework Directive – Recharge and Groundwater Vulnerability. EPA STRIVE Report, EPA, Ireland.
[17] Jennings S. (2008) Further Characterisation Study: An Integrated Approach to Quantifying Groundwater and Surface Water Contributions of Stream Flow, RPS, Ireland

9.4.10 Flood Risk Identification

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

- The Site is not within a probable flood zone, nor has it experienced any historical flooding.
- With reference to **Table 4.4 of Appendix 9.1**, the Project will lead to a net increase in runoff equating to 0.253 m^3/s or 2.06% relative to the Site area. This is considered an imperceptible impact of the Project.
- The associated drainage will be attenuated for greenfield run-off and the Project will not increase the risk of flooding elsewhere in the catchment.

Consultation with OPW Flood Maps (Accessed; October 2022) indicates that:

- No Arterial Drainage Schemes (ADS) have been implemented.
- The Catchment Flood Risk Management Plan (CFRAM) programme did not indicate any flood extents within the proposed Site boundaries, nor its immediate surrounding vicinity.
- There has been only one recorded localised flood event between the Site and the CFRAM mapped probable flood areas. This event 'Flooding at Coolea, Milleeny and Derreenaling' took place on 11/09/2015, however no further information about the event was available.

The closest mapped probable flood areas are associated with:

- The Sullane (030) river approximately four kilometres to the north-east of the Site near Ballymakeery town.

Flood Relief Schemes for Ballymakeery town (flood area identified above) include Measures Applicable in All Areas, which includes:

- Sustainable Drainage Systems (SuDS). Objective: Planning authorities will seek to reduce the extent of hard surfacing and paving and require the use of sustainable drainage techniques to reduce the potential impact of development on flood risk downstream.
- Land Use Management and Natural Flood Risk Management Objective: during the project-level assessments of physical works and more broadly at a catchment-level to identify any measures, such as natural water retention measures (such as restoration of wetlands and woodlands), that can have benefits for Water Framework Directive, flood risk management and biodiversity objectives.

Broad stroke objectives such as the above in addition to those outlined in **Section 9.6.1.2** are relevant to the Project whereby any development within the catchment of a Flood Relief Scheme should aim for a minimal or neutral impact in terms of net change in surface water runoff and in turn impacts downstream. Furthermore, any mitigation which promotes beneficial impacts, i.e., net-decrease in runoff or delaying the hydrological response to rainfall, contributes to the objectives of the Flood Relief Schemes and ultimately the WFD.

In regard to the Grid Connection Route, there are no recorded historic flood events along the proposed Grid Connection Route. However, there is a portion of the route near the proposed HDD crossing of Stream 3 (ITM: 517767, 583303), that crosses both a National Indicative Fluvial Mapping (NIFM) Medium (1% AEP) and Low (0.1% AEP) probability scenario. Both these risks are mapped for the current and future scenarios.

In regard to the Turbine Delivery Route, there have been several 'Single' and 'Reoccurring' Flood Events along the Sullane, in particular near the townlands of Baile Bhuirne, Macroom and closer to Cork Harbour along the River Lee. It is proposed that the TDR will utilise the Macroom to Ballyvourney Dual Carriageway. Along this route, NIFM flood risks have been identified at the following crossing locations:

- ITM: 519851, 578443
- ITM: 527446, 573948
- ITM: 535259 ,572778

Furthermore, where the Sullane meets the River Lee, south of Macroom CFRAM River Flood Extents have been mapped for the surrounding areas of 0.1%, 1% and 10% AEP, where the Turbine Delivery Route follows the N22.

9.4.11 Wells

Consultation with GSI (2022) well database indicates there are no mapped wells within the Redline Boundary. Governing industry guidelines stipulate a buffer zone of 250 m is required of from boreholes used for drinking water abstraction when assessing excavations for Turbine Foundations. The closest mapped wells are more than 1 km from the Redline Boundary (southeast of proposed T5 works), **Figure 9.12a**, suggesting that any potential impact from the Project is low risk for wells in the immediate vicinity.

With reference to **Section 9.4.9**, the groundwater aquifer underlying the Inchamore Wind Farm Site is classified as a Locally Important Aquifer (LI) – Bedrock which is Moderately Productive only in Local Zones.

The Grid Connection Route traverses land underlain by a LI aquifer. Similarly, a small portion of the Turbine Delivery Route, c. 5 km, is underlain by a Poor Aquifer – 'Bedrock which is generally Unproductive except for Local Zones' (PI), the remaining track has been routed over a LI aquifer. While no wells were identified along the Grid Connection Route during the desk top assessment, **Figure 9.12b**, Any identified boreholes along these route during the detailed design stage will highlight the significant potential for the Project to impact groundwater supplies in local zones.

9.4.12 Groundwater Levels, Flow Direction & Groundwater Hydrochemistry

With reference to **Appendix 8.1** and **Appendix F,** groundwater observations during SI rotary core drilling to bedrock depths indicate that the underlying siltstone bedrock is weathered to a minor degree only, with minor volumes of groundwater perched on top of bedrock in the subsoil underlying the Site. This is of importance for a groundwater dependent ecosystem such as the superficial peat observed on Site, that grows in the saturated zone. No significant water strikes were encountered, as would generally be the case in the absence of folding and faults, (maximum drill depth was approximately 10.5 m).

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 moderately productive underlying bedrock aquifer. Groundwater flow likely circulates in the upper overburden saturated zone, recharging and discharging in local zones with a high flowrate; thus, the groundwater is considered to be young. The implications for 'young' groundwater is that it will be more vulnerable in terms of water quality from a pollution incident.

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: Ballinhassig West) and is considered not at risk.

Peat at the Site is generally shallow but with areas or pockets of deeper peat (**EIAR Chapter 8: Soils & Geology, Appendix 8.1 – App A**). Furthermore, extensive drainage and general topography conditions indicate that bog water levels will be variable and are likely impacted to a minor extent by existing drains etc., with the exception of isolated pockets of moderately deeper intact peat areas where bog water levels are likely in line with Active Blanket Bog i.e. near or at the surface.

9.4.13 Designated & Protected Areas

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, as outlined above, associated with the Project are detailed in **Figure 9.6** and presented in **Figure 9.11a** and **9.11b**.

The Site and Turbine Delivery Route are not positioned within or directly adjacent to or immediately upstream of any designated or protected area (Special Protection Area (SPA), Special Area of Conservation (SAC), Natural Heritage Area (NHA)). The nearest downstream designated areas include the following as outlined in **Figure 9.6** and **Figure 9.11b.**

- St. Gobnet's Wood SAC and proposed Natural Heritage Area (pNHA) (EPA Site Code: 000106) which boarders the Sullane_010 approximately 5 km southeast of the Site.
- Prohus Wood Proposed NHA (Site Code: 001248), approximately 18 km downstream of the Site
- Lee Valley Proposed NHA (Site Code: 000094), located approximately 54 km downstream of the Site
- Cork Harbour SPA (EPA Site Code: IE0004030); Douglas River Estuary Proposed NHA (Site Code: 001046); Rockfarm Quarry, Little Island Proposed NHA (Site Code: 001074); Great Island Channel SAC (SiteCode: 001058), approximately 60 km downstream of the Site.

Sections of the Grid Connection Route cross certain watercourses that flow into designated Natural Heritage Areas (NHA) and Special Area of Conservation (SAC) of Killarney National Park, approximately 40 m from proposed works in some areas, **Figure 9.11b**. Particular attention to stockpiling of material will be paid along the proposed Grid Connection Route that runs parallel to the designated area. Horizontal Directional Drilling (HDD) will be utilised, where standard trenching methodologies cannot be applied, to facilitate underground cabling to mitigate the impact to the surrounding ecology through minimising vegetation cutting near the designated areas.

9.4.14 Water Resources

Drinking water rivers designated in accordance with European Communities (Drinking Water) (No. 2) Regulations 2007 (SI no. 278/2007) which are protected for the purposes of drinking water abstraction are presented in **Figure 9.12a** and **Figure 9.12b,** however none are located within the River Subbasin or Sub Catchment associated with the Site.

Surface water bodies designated for drinking water downstream of the Site include:

- Sullane_060. The Sullane_010 flows into the Sullane_020, _030, _040 and _050 until reaching the Sullane_060 approximately 23.5 km southeast of the Site. From here waters flow into the Lee (Cork)_060 which continues east and flows into Carrigdrohid Reservoir and Inniscarra Reservoir which are not designated, however the reservoir discharges to the downstream section of the Lee (Cork) river (090) which is designated for drinking water.

Groundwater encompassing all elements of the Project is (nationally) protected under the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. no. 278/2007). Therefore, although the groundwater aquifer at the site is classed Locally Important, and relatively low on the scale in terms of importance or sensitivity compared to, for example; Regional Important Kart Aquifer, all groundwater is considered an important and sensitive receptor, groundwater is considered a very important and sensitive attribute and receptor.

9.4.15 Receptor Sensitivity

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

- Water Framework Directive (WFD) status (2016-2021) "Good". 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 (i.e., Freshwater Pearl Mussel (FWPM)).
- 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., FWPM, 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.

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). However, the bedrock aquifer underlying the Project is Locally Important (LI), which can be expressed as an aquifer with relatively low to moderate production and connectivity, and therefore the risk of potential adverse impacts on groundwater will be limited to localised zones within the Site. It is noted, with reference to **Section 9.3.14,** no wells have been identified within the 250 m buffer zone of shallow excavations for any element of the Project.

In terms of surface water sensitivity, as stated above, the vast majority of potential contaminants or unmitigated adverse impacts 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 Development.

9.5 ASSESSMENT OF POTENTIAL EFFECTS

In relation to the assessment of effects the following sub-sections consider the potential worst case or unmitigated scenarios which are likely to occur as part of the proposed development, or similar developments in the context of the observed baseline conditions, e.g. effects of construction on peatlands or the receiving surface water network. The potential effects identified will be mitigated to minimise impacts, and reduce the potential adverse unmitigated impacts in line with achievable mitigation objectives.

9.5.1 Significance Rating

The receiving environment associated with the Project is considered as ranging from Low to Very High Sensitivity. With reference to **Section 9.3.5**, receptor sensitivity is qualified as follows:

- Surface Water; Very High
- Groundwater; Bedrock Aquifer; Low
- Bog Water - In areas of cut over peat, forestry or where existing drainage networks exist; Medium
- Bog Water - In areas of intact habitat and/or designated areas e.g., blanket bog / SAC; Very High

These items are discussed further in the following sections.

To account for this, the potential impacts associated with the Project will be limited to Magnitudes associated with respective environmental characteristics, as presented in the **Table 9.14.**

Table 9.12: Magnitude of potential impacts relative to receptor sensitivity

Sensitivity (Importance of Attribute)	Magnitude of Impact			
	Very Small (Imperceptible)	**Small Adverse (Slight)**	**Moderate Adverse (Moderate)**	**Large Adverse (Significant to Profound)**
Very High (Surface Water, Groundwater Regionally Important Aquifers, Bog water in intact or designated peat)	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High (Groundwater but with limited abstraction potential / recorded abstraction points)	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
Medium (Groundwater but with limited abstraction potential / recorded abstraction points) (Bog water in existing impacted areas)	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

In terms of determining and assessing the magnitude of impacts on surface water features, or groundwater features, categories of magnitude relate to the potential effect on the status of the attribute, that is; the attribute driving the classification of sensitivity is the current WFD status (if applicable) and baseline condition of the surface water feature/s, the risk of not reaching WFD objectives (if applicable) and the potential for the surface water system to support, or function as part of designated and protected areas (SAC, drinking water, etc.) downstream of the Site.

9.5.2 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 impacts to baseline conditions through the planting and the installation of drainage networks associated with commercial forestry (**Appendix 9.2 – Plate 5 and Plate 9**), and peat harvesting across portions of the Site (**Appendix 9.2 – Plate 5**),

Planting of commercial forestry and agriculture / land reclamation activities (reconstitution of soils and drainage) have had a significant 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 felling or after heavy rainfall events.

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

9.5.3 Construction Phase Potential Effects

9.5.3.1 Earthworks

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

- Construction of Site Access Roads
- Temporary Construction Compound
- Turbine Foundations and Turbine Hardstands
- Foundations for the Onsite Substation and Control Building
- On-Site Borrow Pit
- Foundations for the proposed Met Mast
- Trenching for underground electrical cabling, including along the Grid Connection Route.
- Temporary and permanent stockpiling of peat, subsoils and bedrock.

All of the above-mentioned excavations which will be required will necessitate the removal of vegetation, the excavation of peat 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 negatively 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:

- Proposed access track crossing the Sullane_010 River at (Watercourse = WC) WC1, WC2 and WC3 locations.
- Verge widening and strengthening along the Turbine Delivery Route Turning point over Flesk (Kerry)_030 headwaters.
- Proposed Grid Connection Routes Horizontal Directional Drilling crossing points of Streams 1, 2 and 3 as well as crossing of existing culverts.
- Turbine Hardstand and infrastructure development, particularly in close proximity to existing drainage with direct connection to surface waterbodies (T2, T3, T4, T5).

The **potential** unmitigated release of elevated suspended solids to surface waters is considered to be a **direct, adverse, large** in scale**, moderate to profound**, **temporary** effect of the Project. This potential impact arising from earthworks is considered **unavoidable** and **conforms to Baseline** (e.g., forestry tracks or operations), and is limited to the footprint of the Project (limits of vehicular movements, discussed later in report). Considering the mobility characteristics of surface waters to downstream receptors, it is not considered reversible and has the potential for indirect impacts to receptors downstream. However, with appropriate mitigation measures 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.

9.5.3.2 Clear Fell of Afforested Area

Felling of forestry at the Site will be necessary for areas of the Project in afforested sections within the Redline Boundary. This is an **unavoidable** consequence of the Project. The Site contains 145.4 ha of commercial forestry. Turbines T2, T3, T4 and T5 are within afforested areas. Subsequently, tree felling will be required as part of the Project. To facilitate the construction of access roads, civil works, site compounds, borrow pits and Turbine Hardstands, 25.68 ha coniferous forestry will need to be clear-felled. The likely felled area of approximately 25.68 ha will represent approximately 15.11% of the proposed Site area (170 ha). In a spatial or land use context this is considered a **slight** to **moderate** impact.

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 Project, 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 9.5.3.4 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 Section 8.4.3.3, Figure 8.7)**
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.
5. 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 Project.

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 Project 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 Project. 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, planning and management this impact can be reversed, and disturbance minimised.

9.5.3.3 Release of Suspended Solids

Excavation and construction activities, associated with the Project, such as stockpiling material and vehicular movements of plant machinery introduce the **potential** 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. Peat, comprising mostly of organic matter, will behave in a similar manner to a fine grained soil whereby much of the material will remain in suspension for a relatively long period of time, but will also dissolve and degrade within the water body, dramatically impacting on water quality.

- Forestry operations will continue at the Site. With reference to **Chapter 8: Soil and Geology**, forestry operations, harvesting and planting, will likely lead to a release of solids and nutrients entrained in surface water runoff.
- Release of suspended solids can be attributed to enhanced nutrient enrichment. This is highly dependent on the type of soil, for example peat released in water will disintegrate and most of the constituents of the peat material (carbon) will eventually dissolve into the water column and / or be consumed by micro-organisms. However, peat and other soils / subsoils will 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 impacts on ecological attributes downstream of the Site.
    - Given the historical land use of the Site, i.e., agricultural forestry, there is likely to be trace amounts of fertiliser in the vicinity of the afforested Site. Teagasc (2017) has stated routine fertiliser application is undertaken following chemical analysis of foliar (tree leaf) samples. If thresholds are not met, fertiliser is applied manually between the months of April and August, avoiding drains and a 20 m buffer zones to waterlogged and aquatic areas. Ground Rock Phosphate (GRP) is used in two forms: Granulated Rock Phosphate (c. 11% P) and Ungranulated Rock

Phosphate (c. 14% P), in application process, given there are no adverse environmental impacts, e.g. deterioration in water quality status.

- 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 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.

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.

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

- Exposed soils / peat generally, including new drainage channels, temporary stockpiles.
- Construction of infrastructure within surface water buffer zones (i.e., site access tracks asses tracks to proposed location of T2 and on-site Sub station, WC1, WC2, WC3), and/or relatively close proximity to surface water receptors, or areas characterised by extensive existing drainage networks which present a direct connection to mapped surface water features, will cross buffers in a perpendicular direction i.e., to minimise any potential effects), and/or instream works associated with proposed watercourse crossing locations.

In addition to potentially direct adverse impacts 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 'Good quality of the baseline surface waters draining from the Site, 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 to be an **unavoidable**, **direct, adverse, moderate to profound significance**, **small to moderate** in scale impact of the Project. This potential impact is considered to contrast to baseline conditions when considering the intensive nature of the construction phase, however forest felling activities 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, this impact can be reduced to within water quality regulatory limits.

It is considered that the release of suspended soils does not have significant potential to adversely impact 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 low and the risk of significant stability issues leading to mass movement or landslides is low, however there is elevated risk of localised stability issues, particularly in areas in close proximity to sensitive receptors i.e., rivers.

The Project 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.

9.5.3.4 Vehicular Movements

During the construction phase of the Project, vehicles will cross over or excavate into areas in order to construct the proposed access tracks, hardstands, and gain access to the Project 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 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. This is considered an **unavoidable, direct and indirect, adverse, moderate to significant**, localised and potentially regional impact on receiving surface waters. However, with the implementation of mitigation measures and appropriate environmental engineering controls, 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 will be implemented and adhered to, localised stability issues are unlikely to give rise to impacts on surface water networks associated with the Project.

[2] With reference to **Appendix 8.1 Peat Stability Risk Assessment and Chapter 8 – Soils and Geology,** the risk of mass movement of peat is considered to be low.

9.5.3.5 Release of Hydrocarbons

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 peat, 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 refuelling – 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 and indirect, small** in scale**, moderate to profound significance, localised (potentially regional), permanent but reversible** effect 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, indirect, adverse, small** in scale**, moderate to profound significance, localised (potentially regional), permanent but reversible** effect of the Project, which is in contrast to baseline conditions. With the implementation of appropriate mitigation measures and environmental engineering, these potential risks will be significantly reduced.

9.5.3.6 Release of Horizontal Directional Drilling Materials

With reference to **Section 9.2.1.1**, there are 4 No. locations along the Grid Connection Route which will require HDD. Depending on the drill material in question, etc. the introduction of such materials can lead to a local change in hydrochemistry and impact on sensitive attributes e.g., ecology. For example, the introduction of bentonite-based clay material can lead to changes in water quality as opposed to a non-toxic single component polymer-based product.

In terms of the HDD process, drilling will involve plant machinery which will be powered by hydrocarbons, therefore risk during the refuelling process as stated previously remains the same. The risk of hydrocarbon spills stems primarily from broken hydraulic hoses used during the drilling/boring process. Small-scale quantities of greases known as 'drilling fluids' are also commonly used during the drilling process to keep components of the drill rig cool and lubricated. These drilling fluids are commonly composed of a mixture of bentonite clay, which can be harmful to the environment[18]. Therefore, there is a risk of a potential oil leak from horizontal directional drilling (HDD) along the grid connection route. It is unspecified at this time which drilling lubricant will be used during UGC route works. From experience in the industry the use of Clearbore is recommended, and this or a similar product will be used when working beneath watercourses. Clearbore is a single component polymer-based product that is designed to instantly break down and become chemically destroyed in the presence of small quantities of calcium hypochlorite. The product is not toxic to aquatic organisms and is biodegradable.

An accidental contaminant spillage (also known as drill return or frack out), would have a **likely, adverse, direct, small** in scale**, slight, localised (potentially regional), long term to permanent** effect which is in contrast to baseline conditions. However, with implementing mitigation and best practice the risk of an accidental spill can be greatly reduced.

[18] Moore Group (2016) "Appropriate Assessment of Cork Lower Harbour Main Drainage Project Estuary Crossing by Horizontal Directional Drilling", Moore Group Environmental Services on behalf of Irish Water, Ref No. 15184.

In terms of groundwater associated with the Site an accidental drilling fluid breakout is considered to be a **likely, direct and indirect, adverse, small** in scale**, moderate to significant, localised (potentially regional), temporary to long term but reversible** effect 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.

Spoil arising from drilling activities will require temporary stockpiling and has the potential to be entrained by surface water runoff (suspended solids). Spoil arising from drilling activities could be mobilised by large volumes of water which would rapidly traverse overland if not managed appropriately and has the potential to mobilise additional solids via eroding soils, or other contaminants, and infiltrate the receiving surface water bodies, or groundwater bodies. Similar to the release of suspended solids, **Section 9.5.3.3,** the introduction of drill arisings to the receiving surface water receptor is considered a **direct, adverse,** potentially **moderate to profound significance** impact of the Development.

9.5.3.7 Release of Wastewater Sanitation Contaminants

The installation of permanent sanitation facilities at the Site will not be required for the operational phase of the Project, s however temporary sanitation facilities for site workers during the construction phase are proposed. Therefore the Project has the potential to result in the accidental leakage of wastewater or chemicals associated with wastewater sanitation onto peat/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 impacts 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 impacts to downstream receptors can be long lasting, or permanent. With appropriate environmental engineering controls and mitigation measures these potential impacts can be significantly reduced.

Mechanism/s:	• Waste water leak – minor in scale. • Chemical leak – minor in scale
Impact	• Release of waste water / chemicals in runoff, intercepted by surface water network.
Receptor/s:	• Surface Water. Surface water quality, ecological sensitivities and WFD status. • Groundwater. Groundwater quality for the purposes of extraction.

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 a **likely, adverse, direct and indirect,** and therefore **localised and potentially regional** effect. While **small** in scale**,** it is considered to be **moderate to significant**, **temporary to long term but reversible** impact of the Project, which is in contrast to baseline. With the implementation of appropriate mitigation measures and environmental engineering, these potential risks can be significantly reduced.

9.5.3.8 Release of Construction or Cementitious Materials

The construction phase of the Project has the potential to result in the accidental spillage or deposition of construction waste into peatland or soils. 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 used in turbine foundations, 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.

Mechanism/s:	• Accidental spillage or unmanaged deposition of construction materials such as wet concrete which is intercepted by drainage or surface water networks associated with the Development. • Dust generation in relation to the production of concrete and management of raw materials. • Transport of material on Site and washout of plant machinery. • Pouring, forming, deposition of concrete during construction. • Generation of waste.
Impact	• Release of cementitious material in runoff, intercepted by surface water network.
Receptor/s:	• Surface Water. Surface water quality, ecological sensitivities and WFD status. • Groundwater. Groundwater quality for the purposes of extraction.

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 Project. 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 **likely, adverse, direct and indirect,** and therefore **localised and potentially regional** effect. While **small to moderate** in scale**,** it is considered to be **a moderate to significant**, **temporary to**

medium term effect of the Project, which is in contrast to baseline. With the implementation of appropriate mitigation measures and environmental engineering, these potential risks can be significantly reduced.

Local Groundwater Supplies (Wells)

The Project has the potential to impact on ground water levels proximal to excavation and dewatering activities. Dewatering of excavations in particular can create a relatively significant cone of depression or lowering of the water table in the surrounding area. The degree to which the water table is lowered is dependent on the baseline static water level, is proportional to the depth of the particular excavations and/or depth at which the pump is placed, and the hydrogeological characteristics of the surrounding geology / aquifer.

The potential productivity and connectivity of groundwater in the underlying bedrock aquifer/s is considered low (Baseline, **Section 9.4**) however the availability of groundwater in a social or agricultural sense is considered important, therefore the importance of groundwater quantities underlying the Site is considered 'Medium to High' sensitivity and importance. Any impact to the availability of groundwater for use (lowering of water level in wells) is considered a **potentially significant adverse** impact of the Project.

Contaminants released due to an environmental incident have the potential to infiltrate soils/subsoils potentially reaching the water table and in turn adversely impacting on groundwater quality. However, it is noted that the Proposed Wind Farm, Grid Connection Route and Turbine Delivery Route do not interfere with any Public Source Protection Areas as mapped by GSI (2022) or Zones of Contribution under the National Federation of Group Water Schemes as outlined and mapped by the EPA and GSI (2022).

Considering the quality of the groundwater underlying the Site (Baseline, **Section 9.4**), and the 'Medium to High' sensitivity and importance associated with groundwaters nationally, any introduction of contaminants is considered an **unlikely, direct and indirect, adverse, slight**, **temporary** effect of the Project which conforms to Baseline (e.g., other shallow excavations). With the implementation of appropriate mitigation measures and environmental engineering controls, these potential risks can be significantly reduced.

The release of suspended soils does not have significant potential to adversely impact on groundwater due to the natural process of filtration associated with percolation of water through soils and bedrock (Potential exception: Karst geology. There is no indication of karst geology underlying the Site (Baseline, **Section 9.4**). Hydrocarbons (e.g., diesel) pose the most significant risk to groundwater quality and can persist for many years.

It is noted:

- Excavations will be of c. 2.8 m to 3.2 m depth for Turbine Foundations (**Chapter 2: Project Description)**. Some deeper excavations will occur, for example, the proposed borrow pit. (See Drawing No. **6226-PL-804**).
- The recommended buffer distance determined by relevant Industry Guidance (**Section 9.3.2)**, for existing wells in relation to Turbine Foundations is 250 m. There are no mapped wells within the Site, or with 1 km of the Development.
- Governing Industry Guidelines (**Section 9.3.2)** stipulate a groundwater buffer zone of 100 m is required of from wells used for drinking water abstraction in relation to the proposed Site Access Roads and cable trenches i.e., shallow excavations.

Given the incomplete nature of the GSI well database and the rural location, it has been assumed for the purpose of conservatism that all dwellings in the vicinity of the Site are utilising a private groundwater well and that groundwater flow direction in the underlying aquifer mimics the local topography. In other words, the groundwater flow paths are expected to be from topographic high points to lower elevated discharge points at streams, drains and rivers. Utilising this conceptual model of groundwater flow, dwellings that are located down gradient of the Site can be identified as potential receptors. The groundwater flow direction in the area of the Site is expected to be predominantly in a north to south direction. There are no dwellings located withing the redline Site boundary, however numerous dwellings are located within 2 km of the Site, **Figure 9.12b**. It is anticipated that any potential groundwater impacts will have attenuated across these distances in the underlying aquifer.

Considering the baseline data and Project characteristics, the risk of lowering groundwater levels to a significant extent is not considered likely. Furthermore, there are no mapped wells (**Figure 9.12a**) within the Redline Boundary, and no mapped wells were identified within a 100 m buffer along the proposed Grid Connection Route or Turbine Delivery Routes.

A combination of low permeability soils (. i.e. peat), the temporary nature of the construction works, and low recharge rates at the Site is expected to result in a likely, **neutral to negative, slight to moderate significance, localised** impact of the Project which is in contrast to the baseline. With appropriate mitigation measures in place, the potential impacts on groundwater wells can be managed and reduced to **Imperceptible to Slight**.

9.5.3.9 Groundwater or Bog Water Associated with Wind Farm

The Project has the potential to impact on bog water levels proximal to excavations and/or drainage channels. Existing drainage at the Site, particularly in forestry and agricultural areas, are intended to drain the respective area, however existing tracks and adjacent drains can also impact on bog water levels. Lowering of the water table in peat lowers the potential for peat growth i.e., sub-optimal conditions. This will lead to the gradual decline in productivity in the acrotelm (living layer of peat), and in time the degradation of the drained peat area, potentially leading to erosion.

The scale of the impact is dependent on the depth of the excavation in question and subsequent lowering of the water table at the location. This can vary depending on the underlying characteristics of the Project. In peat the impact can be minimal in scale initially but over time and as the acrotelm layer degrades and recedes the impact can continue to progress slowly/chronically, potentially leading to profound impacts in worst case scenarios. However, it is noted that the Site is characterised by shallow peat or peaty soil generally with isolated areas of moderately deep saturated peat (**Chapter 8: Soils and Geology**). Therefore, the scale of such impact is likely limited to the extent of those isolated pockets, near the proposed location of T1, if impacted. Furthermore, the Site is generally characterised as having extensive existing drainage features, and therefore impacts arising from drainage can be in line with baseline conditions.

With regards to bog water levels at the Site, drainage is considered a **likely, adverse, direct and indirect, small to moderate** scale**, moderate to significant, localised, permanent but reversible** effect which conforms to baseline conditions (forestry drains).

With appropriate environmental engineering controls and measures (i.e. Mitigation measures), these potential risks can be significantly reduced. Additionally, in areas impacted by draining activities, if considered adequately, mitigation measures have the potential to have a **positive beneficial** impact on bog water levels, particularly in places already impacted by drainage.

Furthermore, groundwater levels are unlikely to be impacted to a significant extent due to:

- Baseline conditions (**Section 9.4**) i.e., upland area, locally important aquifer with low productivity and low groundwater recharge (indicative of low groundwater levels). Site investigation data indicates (**Appendix 8.1 and Appendix D**), that in most instances trial pits (in line with construction depths) were dry. Shallow groundwater encountered (**Appendix F**) is associated with areas of deeper peat (bog water) and perched groundwater (perched on bedrock or bedrock troughs).

- Characteristics of the Project i.e., excavations will generally be shallow and any potential dewatering will likely be for short duration. Deeper excavations will potentially encounter groundwater. However due to the Baseline character, volumes will likely be low and dewatering of such locations will not impact groundwater levels to a significant extent.

9.5.3.10 Groundwater and Surface Water Associated with Grid Connection Cable Works

The GSI well database has not indicated any wells mapped along or within the vicinity of the proposed Grid Connection route. Given the incomplete nature of the GSI well database and the rural location, there is a potential for more private wells in use along the proposed Grid Connection route, however it is noted the route traverses mainly forestry lands in the absence of any identified dwellings. Shallow trenching (c.1,220 mm deep) which will be backfilled is expected to be required for the proposed Grid Connection, with a depth of c. 1,500 mm at Horizontal Drilling locations.

Due to the vast majority of the gird connection requiring shallow trenching and the temporary nature of the construction works, it is expected to result in a **likely, direct and indirect, adverse, small** in scale, **slight and temporary** effect which conforms to Baseline (e.g. public roads and services). With appropriate environmental engineering controls and measures (i.e. Mitigation measures), these potential risks can be significantly reduced.

9.5.3.11 Excavation Dewatering & Construction Water

Construction waters arising from open excavations, or construction waters intercepted from construction areas are likely to be heavily laden with suspended solids. The dewatering of excavations during construction phase of the Project 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.

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.

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, direct and indirect, localised (potentially regional), temporary to permanent** effect of the Project which is in contrast to the baseline conditions. While **small to moderate** in scale it is considered to be **moderate to profound in significance**. With appropriate environmental engineering controls and measures (i.e. Mitigation measures), these potential risks can be significantly reduced.

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

Considering the nature of the site, 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.**

9.5.3.12 Constructed Drainage, Diversion or Enhancement of Drainage

Drainage features constructed at a Site have the potential to significantly adversely impact on the baseline hydrological regime, particularly in areas of intact peatland habitat, but equally in peatland areas impacted by artificial drainage and forestry operations, there is the potential for the Project 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.

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 Project footprint has the potential to lead to adverse impacts 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 Project will likely result in diversion, alteration and/or enhancement of the existing drainage networks at the Site during the construction phase relative to baseline conditions. The existing drainage network at the Site is mapped and presented in **Figure 9.7a.** Diversion of artificial drainage channels will be required at locations where the Project layout intercepts existing artificial drainage networks. This includes minor modifications where existing drainage will be aligned with proposed culverts etc. and/or where proposed drainage interacts or connects with existing drainage networks. Drainage modification / diversions is required at, but not limited to;

- Access track between T2 and T3 where cut and fill extents overlaps an existing drainage feature.
- Substation, where the footprint of the hardstand is over an existing drainage feature.
- Other non-mapped drainage within forestry areas i.e. commercial forestry locations will inherently possess extensive drainage channels.

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 an **unavoidable, direct and indirect, adverse, localised (potentially regional**) and **permanent** effect of the Project which conforms to baseline conditions. While small in scale the effect is considered to be of **moderate to profound significance.** 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. With appropriate environmental engineering controls and measures (i.e. Mitigation measures), these potential risks can be significantly reduced.

The potential impacts of excavations are addressed in **Section 9.5.3.1** and in **Chapter 8: Soils and Geology, Section 8.4.3.3.1**. Management of storm and construction water runoff to prevent loading of the receiving network with contaminants in detailed in the later sections, that is; these potential impacts can be mitigated.

9.5.3.13 Watercourse Crossings

9.5.3.13.1 Surface Water Crossings - Bridges & Culverts over Mapped Rivers and Non-Mapped Drains

In terms of mapped streams and rivers there are a number of existing bridges at the site are associated with the development footprint (e.g. along Turbine Delivery Routes). The development will also require a number of new bridges, including on the Wind Farm Site.

In terms of non-mapped surface water features and drains there are a number of existing culverts at the site are associated with the Project footprint. The Project will also require a number of new drainage culverts under the proposed access track, particularly in areas of extensive existing drainage (Figure 9.5a). Although more minor in scale, and less significant in terms of ecological importance and sensitivity, such culverts must be considered similarly to watercourse crossings in terms of potential impacts associated with poor design and construction. Note; existing culverts presented in Figure 9.5a were observed during site surveys and/or from desk top assessment of aerial imagery and site drainage mapping, including recent Lidar and Aerial Survey data (BlueSky) available for the site. There is potential for buried stone culverts/ land drains to be present on Site which are not mapped here and which could be discovered during excavations.

Through the design and construction and operation of watercourse crossings, examples of associated activities or impact mechanisms include:

- Significant changes to the hydrological regime at the Site.
- Construction activities (Earthworks, addressed under Release of Suspended Solids)
- Construction activities (Earthworks) within existing drainage channels and/or streams and rivers.
- Connecting new and existing drainage channels.
- Poor design and/or installation of watercourse crossings.
- Poor design and/or installation of culverts.
- Upgrading of existing bridges where necessary.
- Upgrading of existing culverts where necessary.
- Poor design and/or installation of drainage infrastructure including culverts attenuation features.

Potential impacts arising from such activities include:

- Release of suspended solids or other contaminants, intercepted by surface water network.
- Significant surge release of suspended solids, intercepted by surface water network.
- Altering hydrological regime at a particular location. Potentially leading to erosion / deposition not in line with baseline conditions.
- Restricting water flow.

Receptors include; Surface Water, and in terms of; Surface water quantity and flood risk, Surface water quality, ecological sensitivities and WFD status.

Mechanism/s:

- Significant changes to the hydrological regime at the Site.
- Construction activities (Earthworks, addressed under Release of Suspended Solids)
- Construction activities (Earthworks) within existing drainage channels.
- Connecting new and existing drainage channels.
- Poor design and/or installation of drainage network
- Poor design and/or installation of drainage infrastructure including culverts.
- Upgrading of existing culverts where necessary.
- Poor design and/or installation of drainage infrastructure including culverts attenuation features.

Impact

- Drying - Lowering of bog / groundwater table proximal to respective drainage features.
- Wetting – Excess discharge in a particular area (local flooding)
- Increasing hydrological response to rainfall.
- Release of suspended solids, intercepted by surface water network.
- Significant surge release of suspended solids, intercepted by surface water network.

Receptor/s:

- Surface Water. Surface water quantity and flood risk. Surface water quality, ecological sensitivities and WFD status.
- Groundwater. Groundwater / bog water quantity for water dependent terrestrial habitats.

Watercourse crossings and associated portions of access track are naturally in very close proximity to or directly within sensitive receptor buffer zones i.e. surface waters or drainage features discharging to surface water features. As sited in **Chapter 8 Land, Soils and Geology** it is very important to consider the potential for ground stability issues arising. Due to the close proximity to the receptor, minor, or localised stability issues arising can potentially have profound impacts on surface water features.

Potential effects with regards to upgrading and installing watercourse crossings at the Site are considered to be **unavoidable, adverse, direct and indirect, small to moderate** in scale**, moderate to profound significance, localised (potentially regional** when considering the extensive downstream surface water network), and **permanent** which conforms to baseline conditions (e.g. existing bridges and roads in the area. However, with implementing mitigation and best practice the risk of an accidental spill can be greatly reduced.

9.5.3.13.2 Wind Farm

The potential impacts that could arise from the Project during the construction, operational and decommissioning phases relate to the potential for increased suspended sediment concentrations associated with site preparation activities and excavations for the infrastructure elements including the turbine foundations, cable trenches and watercourse crossings (77,262 m^3). There will be no change to the potential impacts or predicted effects irrespective of which turbine is selected within the Turbine Range because of the design phase mitigation measures which will be implemented prior to construction. All works will be outside of the 65 m buffer from watercourses and 20 m buffer from drains, where possible. Where this is not possible, additional mitigation measures such as increased use of Sustainable Drainage Systems (SuDS), will be implemented. Additionally, all temporary stockpiles will be at no less than 25 m from watercourses. This will be implemented regardless of the volume of excavated materials created as a result of the Turbine Range.

The Development has been assessed at EIA stage in terms of the intersection of the Development footprint and existing surface water and drainage features at the Site. With particular reference to tributary locations identified **(Figure 9.7a)**, these locations relate to where the Development footprint intersects with EPA mapped rivers, and it must be noted that the actual drainage design will include some degree of drainage diversion and relocation and / or removal of some the listed *culvert* locations, however all will be considered in terms of maintaining the hydrological regime at the Site.

Regarding WFD or EPA mapped rivers, watercourse crossing locations identified are listed here:

There are three new watercourse crossings over mapped rivers included as part of the proposed Development (**Figure 9.7a**).

- WC1 and WC2 are located in close proximity to each other on two headwater tributaries of the Sullane_010 on the approach to proposed location of T2 hardstand area. Both the river sections at these locations span approximately 1.0 m in width and are observed to discharge water throughout the year, potentially with the exception of prolonged dry periods during summer months where there is the potential for the river to be at very low levels or dry. The banks of the rivers are low and the adjacent lands are characterised as agricultural (pasture) / mountain heath / blanket bog. Site photos of monitoring locations SW1 presented in **Appendix 9.2,** which is a short distance downstream from the WC1 and WC2 gives context to the significance of the feature**.** It is noted that the surface water features in this particular area of the site have likely been impacted and altered by historic agricultural activities at the site. A Clear Span Bridge is proposed at this location with the following indicative dimensions: 10 m width, 3.5 m water depth (flood level), 0.3 m freeboard, and standard length, that is; in line with width of Site Access Road.

- WC3 is located on the headwaters of the Sullane_010 and along the proposed Site Access Tracks between the proposed location of the On-Site Substation (west) and proposed locations of T4 and T5 (east). The river section at this location spans approximately 1.0 to 2.0 m in width and is observed to discharge water throughout the year, potentially with the exception of prolonged dry periods during summer months where there is the potential for the river to be at very low levels or dry. The banks of the rivers are variable with some overhanging peat or boulders etc. and the adjacent lands are characterised as agricultural (pasture) / mountain heath / blanket bog and forestry. Site photos of monitoring locations SW2 presented in **Appendix 9.2,** which is a short distance downstream from the WC3 gives context to the significance of the feature**.** It is noted that the surface water features including the riparian zone in this particular area of the site have likely been impacted and altered by historic agricultural and forestry activities at the site. A Clear Span Bridge is proposed at this location with the following indicative dimensions: 10 m width, 3.5 m water depth (flood level), 0.3 m freeboard, and standard length, that is; in line with width of Site Access Road.

Identified surface water crossings are listed in **Table 9.12.**

Table 9.12: Surface Water Crossings – Mapped Rivers (WFD / EPA)

Surface Water Crossings - Mapped Rivers (WFD/EPA)					
Category	**ID**	**Description**	**Easting ITM**	**Northing ITM**	**Comment**
River Crossing	WC1	New; Clear-Span Bridge	512924.6	578627.8	Watercourse Crossing under the proposed Site Access Tracks on approach to T2 **Clear Span Bridge**
River Crossing	WC2	New; Clear-Span Bridge	512943.8	578678.8	Watercourse Crossing under the proposed Site Access Tracks on approach to T2 **Clear Span Bridge**

Surface Water Crossings - Mapped Rivers (WFD/EPA)					
Category	**ID**	**Description**	**Easting ITM**	**Northing ITM**	**Comment**
River Crossing	WC3	New; Clear-Span Bridge	513495.5	578692.9	Watercourse Crossing under the proposed Site Access Tracks between the proposed location of the On-Site Substation (west) and proposed locations of T4 and T5 (east) **Clear Span Bridge**
Sub-Total	New	3			

A number of existing minor drains along the existing and proposed Site Access Road network within the Site (**Figure 9.7a**) will require upgrading to accommodate the increased width of the road. These minor surface drains can be dry and receive flows only following heavy rainfall events throughout the year, however, due to their connectivity to mapped surface water network within the catchment, appropriate measures outlined in the Mitigation Section, **Section 9.6**, of this report will be required during construction to avoid siltation or other pollutants entering the drainage network. **Table 9.13** lists culvert locations of crossings over non-mapped drains**.**

Table 9.13: Surface Water Crossings – Non-Mapped Drains

Surface Water Crossings - Drainage and/or Non-mapped Surface Water Features					
Category	**ID**	**Description**	**Easting ITM**	**Northing ITM**	**Comment**
Culvert	CULV-01	New	514047.1	578568.2	
Culvert	CULV-02	New	513347.1	578655.6	
Culvert	CULV-03	New	513300.4	578636.6	
Culvert	CULV-04	New	512732.5	578983.4	
Sub-Total	New	4			Number will potentially change pending detailed design.
Sub-Total	Existing				
Total	All				

9.5.3.13.3 Grid Connection Route

With reference to **Figure 9.2b** and **Section 9.5.3.3**, works along the Grid Connection Route related to culverts in the northeast portion of the route are hydrologically linked to the surface waterbody Garrane [Lee] (EPA Code: 19G03). Grid Connection Route works encompassing the HDD locations for Stream 1, Stream 2, Stream 3 and the N22 HDD are hydrologically linked to the Flesk [Kerry] River (EPA Code: 22F02). A worst-case scenario could possibly occur whereby the proposed works of HDD could result in a **direct, negative, potentially significan**t, impact of the Project. This impact could result from any number of indirect anthropogenic sources, most commonly would be from: inadvertent drill returns containing bentonite clay, as mentioned above or by spillages of oil, fuel, or drilling fluid disposal. Such spillages could potentially affect either surface water or groundwater depending on the nature of the contamination issue, and to varying degrees depending on the hydrological and hydrogeological characteristics of the Site area.

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

9.5.3.13.4 Turbine Delivery Route

The Turbine Delivery Route will require road junction widening and one turning point off the N22 (**EIAR Chapter 2**). The estimated excavation amounts for the Turbine Delivery Route equates to approximately 1,870 m^2 (refer to **Table 2.1, Management Plan 4 Appendix 2.1** of the CEMP). Works relating to the Turbine Delivery Route will be hydrologically linked to the Sullane_010 River (EPA Code:19S02).

This portion of the Project and associated construction impacts are similar to those described for the construction of the wind farm infrastructure. Construction of any new watercourse crossing or modification of any existing watercourse crossing will have inherent risk given the level of disruption (e.g. excavations, heavy plant machinery) involved with construction activities, and the proximity to the primary sensitive receptor, that is; the watercourse itself.

Potential impacts on hydrology and water quality associated with the construction or upgrading of water course crossings include:

- Alteration of flow regime potentially leading to erosion and/or flooding.

- Potential loss of natural feature e.g., closed culverts implies the replacement of river/stream bed with the invert of the culvert structure, and the loss of riparian / vegetated banks.
- Potential loss of ecological function or service e.g., relatively long span structures have the potential to block light and lower soil moisture, in turn leading to loss in vegetation and bank stability through erosion.
- Harmful discharges during construction and operation, in particular the release of suspended solids.
- Other impacts associated with ecological sensitivities.

Unmitigated, the alteration of watercourse crossings poses a high level of risk and adverse but imperceptible to slight impact adverse, potentially permanent impacts on the quality and flow characteristics of the receiving surface water feature.

The main contributing factors for achieving worst-case scenario/s associated with installation of new watercourse crossings include:

- The potential for poor planning and construction methodology,
- Potential for poor design of new watercourse crossings,

Poor design and construction can potentially result in significant changes in flow, erosion and deposition patterns and rates associated with the surface water feature, which can potentially lead to flow being restricted leading to increased risk of flooding locally.

9.5.4 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.

9.5.4.1 Increased Hydraulic Loading & Flood Risk

The Project has the potential to result in increased rates of runoff during the operational phase relative to baseline conditions. This is a function of the progressive excavation and removal of vegetation cover and replacement with hardstanding surfaces (effectively or assumed impermeable) and installation of constructed drainage along the Project footprint 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.

Mechanism/s:

- Significant changes to the hydrological regime at the Site.
- Replacement of vegetated land with respective recharge capacity with impermeable (assumed) hardstand surfaces. Introduction of constructed drainage intercepting greenfield runoff. Construction activities (Earthworks) within existing drainage channels and/or streams and rivers.
- Connecting new and existing drainage channels.

Impact

- Increase in runoff at the Site.
- Increase in hydrological response to rainfall at the Site and in downstream surface water bodies.

Receptor/s:

- Surface Waters. Site hydrological response to rainfall and potential downstream flood risk areas.

Preliminary water balance calculations indicate that the Project will lead to a net increase of surface water runoff of approximately 0.253 m^3/sec (or 2.06 % relative to the area of the Site) during a 1 in 100 year storm. This calculation, as shown in **Table 4.4** of **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. This is considered to be an **unavoidable, direct and indirect adverse, slight, permanent** impact of the Project which conforms to Baseline (e.g., existing forestry tracks). The increase in hardstand area associated with the Project will likely impact on groundwater and hydrogeological flow regimes at a localised scale but not at a regional scale.

With appropriate environmental engineering controls and mitigation measures, i.e. attenuation features, these potential impacts 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 Project can reduce discharge rates at the Site below estimated greenfield or baseline runoff rates, it will have a beneficial impact by reducing the Site hydrological response to rainfall and mitigate against potential flood events downstream.

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 public and local road networks as well as privately owned forestry tracks.

Land take is required for the Turbine Delivery Route, off the N22 in the form of widening of existing portions of roads which typically involves digging out road verges to c. 0.4 m and replacing with compact stone for facilitate a turning point along the route for large plant machinery and vehicles. c. 1,870 m^2 of road is to be upgraded). Works involving existing portions of roads which traverse greenfield / green verge areas are considered to be small scale of disturbances (shallow excavation, superficial paving) the impact is considered **slight**. Similarly, there is unlikely to be an increase in the rate of runoff from the construction of both these routes due to utilization of pre-existing road infrastructure.

9.5.5 Decommissioning Phase

Decommissioning of the Project 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:

- 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 left in place after Decommissioning:

- The reinforced concrete Turbine Foundations
- The Crane Hardstand Areas adjacent to the turbines
- All Site Access Roads
- Substation
- Grid Connection

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 will render the drainage system less effective over time. The Site will therefore revert over time to a more natural drainage regime. All anticipated impacts are similar in nature to those already highlighted during the construction phase of the Project, 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.

The works to be completed during the Decommissioning phase are expected to be an **imperceptible to slight, neutral, permanent impact** on the hydrological and hydrogeological setting surrounding the Site.

9.6 MITIGATION MEASURES AND RESIDUAL EFFECTS

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

9.6.1 Design Phase

9.6.1.1 Mitigation by Avoidance

The fundamental mitigation measure implemented during each stage of the Project was the avoidance of sensitive hydrological or hydrogeological receptors wherever possible, this key principle is referred to as "mitigation by avoidance". This principle was 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 Figure 9.13b**.

The identified constraints have been extensively discussed in consultation between RSK Ireland Ltd. and the design team. 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 as detailed in this EIAR.

9.6.1.2 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 impacts to water quality in the receiving surface water network. Details on how such measures will be applied (objectives, design considerations, layout) are 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.

9.6.1.2.1 Nature Based Solutions

Nature Based Solutions (NBS) will be adopted at the Wind Farm site where possible. 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 impacts i.e., a net reduction in runoff rates at the Site, beneficial impacts 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.

In peatland areas, 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 on peatland. Generally, and as is the case on the subject site, peatlands have been subject to peat cutting and forestry operations which include extensive drainage networks and draining of peatland bogs. Lowering bog water levels leads to increases erosion, release of carbon to atmosphere and the receiving surface water network and reduces the productivity and general health of the bog, potentially leading to chronic degradation and decline. The objective of nature based solutions in peatlands will be to reverse this impact 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 Project as detailed in the following sections of this report. Best practice and relevant guidance in the design and construction of drainage features will be followed. This includes, but is not limited to;

- CIRIA (2015) The SuDS Manual (C753)
- Scottish Natural Heritage (2019) Good practice during wind farm construction 4th Edition)

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 *, and to promote and maintain high bog water levels and healthy peatland conditions.

* Relevant guidance on the Wise Use of Mires and Peatlands (Joosten H, Clarke D, 2022) outlines principals for decision making through considering the cultural, or other values held by stakeholders associated with the subject peatland. It is noted that active peat cutting, and commercial forestry operations require networks of drainage channels, with the objective of reducing and maintaining relatively low bog water levels. This is in contrast to promoting and maintaining higher bog water levels for healthy peatland function. 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.

9.6.1.2.2 Constructed Drainage

The drainage design for the Project (Surface Water Management Plan, **Appendix 2.1**), has been planned so that drains are positioned adjacent to the footprint of the Project, therefore the proposed drainage infrastructure can be considered part of the 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 Project. However, it is important to consider the gradual degradation over time.

The design principles of the proposed drainage network will facilitate:

- The collection of surface water runoff from the footprint of the Project 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.

- 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 involves achieving the objectives of the Surface Water Management Plan (SWMP) (**Appendix 2.1**) i.e., mitigating against potential adverse impacts to the hydrological response to rainfall at the Site, as well as monitoring water quality in the receiving surface water network during construction phase.

9.6.1.2.3 Attenuation Features

Mitigation measures to address surface water runoff and drainage will be implemented, including in line attenuation features such as check dams and stilling ponds and buffered outfalls. Both check dams and stilling ponds provide mitigation against potential impacts 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 into consideration for a 1 in 100-year rainfall event, including an additional 20% to account for climate change, **Appendix 9.1.**

9.6.1.2.4 Checked Dams

Check dams will be constructed along the length of constructed drainage at regular intervals in line with relevant guidance (**Section 9.3)** along with engineered calculations presented in **Table 5.1** of Management Plan 3, **Appendix 2.1**. Check dams (**Appendix 9.6– Tiles 3-6**), will be permanent (for the life of the project / drainage network), made of suitable locally sourced coarse aggregate (similar geology), and will 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.

Check Dams will be distributed widely, that is; exhausting all opportunities for placement of check dams in the drainage network across the development footprint. The distribution will be in line with relevant guidance (including CIRIA SuDS Manual), but aim to attenuate as much runoff in the drainage network itself as practically feasible. This is in line with Nature Based Solutions and striving for net beneficial impacts. Checks dams in the drainage network will attenuate runoff and reduce the hydrological response to rainfall at the site, mitigating against downstream flood risk, and will promote a more diffuse discharge of storm runoff into adjacent peatland by infiltration and recharge. The features once established could also provide some biodiversity gains.

9.6.1.2.5 Stilling Ponds

Stilling ponds with buffered outfalls will be constructed at drainage outfalls associated with the constructed drainage network. 28 No. buffered outfalls will be established at intervals along the clean runoff drainage network. Multiple outfalls (i.e., the proposed three consecutive cluster ponds shown on **Plate 5.4b** Management Plan 3 **Appendix 2.1**), 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 will 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 (to a degree of <25 mg/L), to not impact any sensitive receptors. At low velocity the runoff has increased opportunity to percolate through the coarse aggregate and into the surrounding peat area. Through both forms of discharge (buffered outfall and percolation through aggregate) the stilling ponds will contribute to bog water levels at their locations and are designed to provide attenuation to greenfield run-off rates. The 28 No. designed stilling ponds that will be constructed on site will have a combined area of 2,368 m^2. Please **see Management Plan 3: Surface Water Management Plan** of the CEMP (**Appendix 2.1**) for further details. Refer to detail drawings (**Drawing No. 6226-PL-303).**

9.6.1.2.6 Promotion of Peatland Habitats

Excavated peat will be deposited in order to restore infilled excavation areas associated with the Site e.g., adjacent to hardstand areas and borrow pits. The deposition of peat, particularly in cutover peat areas, once successfully restored / revegetated will promote the recovery and development of peatland habitats. This will also lead to improvements to the hydrological regime as a function of the Project through promoting the recovery and development of peat habitats, particularly in previously impacted areas due existing land use practices of constructed forestry drainage. For example; re-establishing degraded peatland, and promoting bog water levels and healthy ecosystems will improve environmental services provided by the site including improving isokinetic runoff storage (vegetation reducing runoff rates and promoting infiltration and recharge).

The Project layout and existing drainage network, and their interaction, are assessed in detail and a detailed constructed drainage and attenuation network layout has been provided which will be implemented in full and presents the requirement, locations and conceptual function and objective of the drainage network and treatment trains tailored to the Project footprint (**Section 5** of Management Plan, **Appendix 2.1**).

9.6.1.3 Constraints & Buffer Zones

The descriptive mitigation measures outlined in this report will be applied to the Project design and construction methodologies with a view to avoiding and/or minimising any potential adverse impacts to water quality in the receiving surface water network. Details and a description of how such measures will be applied (objectives, design considerations, layout, mitigation measures) are contained within this Chapter and in the Surface Water Management Plan (**Appendix 2.1**).

As part of mitigation by avoidance principles applied during the design phase of the Project, self-imposed groundwater, surface water, and drainage buffer zones were established where applicable. Buffer zones intended to inform the design process by minimising or avoiding the risk to surface water or other receptors and by restricting construction disturbance to outside these zones in so far as possible. Buffer zones will in turn provide enhanced potential for nature based mitigation including, for example; allowing filtering capacity of runoff within surface water riparian zone. However, it is important to note that buffer zones will not be relied upon to mitigate acute issues such as construction water laden with solids arising at the site.

The available guidance (**Section 9.3)** stipulates that surface water buffer zones should be prescribed to mapped surface waterbodies or aquatic zones i.e., defined as a permanent or seasonal river, stream or lake shown on an Ordnance Survey 6-inch map, however guidance also states any drainage features leading from the Site and flowing into the receiving surface water network which may short circuit buffer zones must also be considered. 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 9.3).**

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 5 m to 50 m depending on site specific and activity specific characteristics. For the purposes of this assessment the following conservative approach has been applied:

- 50 m Surface Water Buffer Zone - Mapped surface water features i.e., mapped streams, rivers, lakes. Source for mapped surface water features; EPA.
- 15 m 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, and field observations. Significant drainage features have been identified and mapped in so far as practical. Some drainage features will likely not be recorded due to issues relating to access and complexity e.g., within afforested areas. 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 Project i.e., mitigating for the potential for drainage connection to receiving surface water network.

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

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., 15 m (exclusion zone karst swallow holes) to entire catchments (source protection in regionally important karstified aquifer) depending on site specific characteristics. For the purpose of this assessment the following conservative approach has been applied:

- 100 m Groundwater Buffer Zone – Groundwater abstraction points in relation to proposed access tracks and cable trenches i.e., shallow excavation. Source for mapped abstraction points: GSI. Not applicable, none within 100 m of the Site, Turbine Delivery Route or Grid Connection Route.
- 250 m Groundwater Buffer Zone – Groundwater abstraction points in relation to proposed borrow pits and foundations. Source for mapped abstraction points: GSI. Not applicable, none within 250 m of the Site.

Some portions of the Project infrastructure footprint falls within buffer zones due to the unique and limiting circumstances associated with the Site and the Project, such as constraints related to other environmental disciplines including; surface water receptors, 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 and associated widening where required, watercourse crossings, etc. naturally fall within buffer zones associated with mapped streams / rivers. The proposed Site Access Roads and fill material intersect the Sullane_010 river surface waterbody and associated buffer zone at each water course crossing (WC1, WC2, WC3) which will result in implementation of clear span bridges during construction works.

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. Some of the proposed Turbine Hardstands (T3, T4, T5), and Site Access Roads fall within the 15 m buffer zones associated with existing natural and constructed drainage features at numerous locations highlighted in pink in **Figure 9.13a**. These features pose an elevated risk in terms of connectivity to surface water receptors; streams and rivers.

No groundwater buffer zones are required for the Project, refer to the baseline section of this report. With reference to **Appendix 8.1 and Appendix H (a - c),** 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 8.6a**) is used to indicate constraints in relation to hydrogeology and stability (**Appendix 8.1 and supporting Appendices A-I**), which is overlaid with hydrological buffer zones as presented in **Figure 9.8 a-k**. Areas which are particularly sensitive include:

- The approach to proposed location to T2, in an area of moderately high landslide susceptibility (GSI) and will require the crossing of two WFD mapped river headwaters.

Furthermore, this area is surrounded by drainage channels with evidence of iron pan in the vicinity.

- The portion of the site south of T3 and proposed location of T5. These areas are characterised similar to the above scenario. Land surrounding T3 also contain areas of elevated localised stability risk due to steep localised inclines.

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 Project footprint, that is; avoiding steep inclines, areas of elevated stability risk, areas with degraded and exposed soils/peat etc, and targeting areas which will receive the runoff to vegetated, low risk areas where vegetation present will provide isokinetic storage, filtering and generally buffering runoff before being intercepted again by the side existing drainage and surface water network.

Some of the Project footprint will fall within buffer zones due to the unique and limiting circumstances associated with the Project, including; the proposed infrastructure itself whereby the Grid Connection Route traverses a relatively large distance and is limited to public and local road networks and privately owned forestry access tracks. Portions of the Grid Connection Route pass through numerous surface water buffers. Of note are the three 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 Project 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. Method statements and the proposed design of the watercourse crossings (as detailed in **Appendix 2.1 Construction Environmental Management Plan**; **Management Plan 2 Water Quality Management Plan**) will 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.

9.6.2 Construction Phase

9.6.2.1 Earthworks Proposed Mitigation Measures

9.6.2.1.1 General / Wind Farm

Management and mitigation for earth works is covered in further detail in **Chapter 8: Soils and Geology**. Mitigation measures to reduce the potential for adverse impacts arising from earth works and management of spoil include the following which will be implemented in full:

- Management of excavated material –with a view to establishing material balance (reuse of excavation arisings) 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. A Peat and Spoil Management Plan has been prepared and forms **Management Plan 4** of the Construction & Environmental Management Plan (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 Project Excavated materials will be stored temporarily adjacent to the excavation sites within the Project footprint while avoiding areas identified as Geo Hazards in **Chapter 8: Soils and Geology, Appendix H,** as well as prescribed surface water buffers (50 m for mapped river 15 m for drainage features, **Figure 9.13a**.
- 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 – Environmental 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 level is exceeded (e.g., sustained rainfall (any foreseen rainfall event longer than 4-hour duration) and/or any yellow or greater rainfall warning (>25 mm/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, assessment of construction areas and infrastructure by Ecological Clerk of Works, and confirmation no additional escalation of response is required. All construction works will cease during storm events such as yellow warning (Met Éireann) rainfall events. 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, repair works to drainage features if necessary.

- Exposed soils/peat (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), in a effort to minimise sediment laden runoff.
- All drainage infrastructure (as per drainage design, **Sections 4 and 5 of Management Plan 3, Appendix 2.1**) required for the management of surface water runoff or draining peat ahead of excavation works will be established before excavation works commence. Similarly, mitigation measures related to surface water quality and the release of suspended solids (**Section 9.6.2.8**) will be implemented before excavation works commence.

9.6.2.1.1 Grid Connection Route

The Grid Connection Route will require excavation of cable trenches in existing roadways as well as forestry tracks and private lands. With reference to general excavation practices discussed above, excavation of cable trenches in close proximity to (0 m at crossings) 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 impacts 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 will be minimised. Vacuum excavation techniques or similar will be used for excavations within Surface Water Buffer zones and other sensitive areas (such as constraints, **Section 9.6.1.3**) (**Figure 9.13a)**. 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 Project.

- All spoil from trenches in public roadways will be removed from works areas as it is excavated and transported to a licenced facility this is due to the presence of bituminous material and potential hydrocarbon contaminants which will not have the opportunity to be entrained in runoff from stockpiling, but rather removed (i.e., mitigation by avoidance).
- Temporary stockpile locations will be situated outside of Surface Water Buffer Zones (as seen in **Figure 9.13a)**. Temporary Spoil stockpiles will have side slopes battered back to a safe angle of repose, e.g., 1:1. Silt fencing will 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 9.6 – Tile 7, 8, 9**). Management of construction waters is discussed in following sections.
- 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 >25 mm/hr), 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.

9.6.2.2 Excavation Dewatering Proposed Mitigation Measures

Mitigation measures to reduce the potential for adverse impacts arising from earth works / management of spoil and associated entrainment of solids in runoff and construction water will include the following:

- **Appendix 9.6 – Tiles no. 7, 8 and 9** present layout and specification for Active Management treatment trains (containment, management and treatment of construction water) and emergency response and intervention (recycling or diversion of poor-quality runoff to the Active Management portion of the treatment train). Continuous real time monitoring is also detailed.

- Management of excavations, that is areas of soil / subsoils to be excavated will be drained ahead of excavation works by sumps, in a stepped / phased approach whenever necessary, with the aim of temporarily lowering groundwater levels to allow excavation to be carried out in dry and stable conditions. For example, saturated areas of peat will require dewatering prior to excavation, thus reducing the volumes of water encountered during excavation works.
- Engineered drainage and attenuation features (discussed in following sections) will be established concurrent with excavation works.
- Dewatering flow rate or pumping rate will be controlled by an inline gate valve or similar infrastructure (**Appendix 9.6- Tile 8, Tile 11**). This will facilitate reduction of loading on the receiving drainage and attenuation network, thus enhancing the attenuation and settlement of suspended solids. All pumped water will be discharged to constructed drainage and in line treatment train or to a vegetated surface through a silt bag (**Appendix 9.6 – Tile 12**) outside of surface water buffer zones **(Management Plan 3, Appendix 2.1** and **Appendix 9.6 – Tiles 7, 9 and 12).** Dewatering is a dynamic process and will require continuous monitoring and modification depending on conditions encountered (**Appendix 9.6 – Tile 8, refer to Section 9.5.5.5**).
- In some areas of the Project constraints related to incline and/or stability, or construction activities within the prescribed buffer zones, will likely limit the potential for installation of engineered attenuation features. In such instances water arising from dewatering activities will be directed or pumped to a settlement tank (**Appendix 9.6 – Tile 8**) before being discharged to the receiving drainage network, or pumped to an area of the site where the installation of attenuation features is suitable. Areas with such constraints are presented in **Figure 9.13a**.
- No extracted or pumped water will be discharged directly to the drainage or surface water network associated with the Site (This is in accordance with the Local Government (Water Pollution) Act, 1977 as amended).
- All pumps, tanks, settlement ponds, dewatering bags and check dams used in the dewatering process will be regularly inspected and maintained as necessary to ensure surface water run-off is appropriately treated.

9.6.2.3 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 9.6 Tiles 7,8 and 9)**.

Contaminated water arising from construction works, namely; excavations, drilling 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 9.6 – 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 be on standby and ready to use in line with the drainage network 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, particularly at HDD locations works will be within buffer zones. In these instances, waters will 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 a site red line boundary is not a licenced activity however this methodology is possible only under relatively low flow conditions (e.g., <2 litres per second (L/s) 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/s) a discharge licence will be acquired, and trade effluent will be discharge directly to the surface water network. The latter will include all works associated with HDD.

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 prescribed surface water buffer zone where possible. The developer will identify suitable locations for the establishment of temporary infrastructure considering other variable such as traffic and access management. Similarly, the preferred 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., >25 mg/L) additional measures will be implemented including Active Water Management to ensure the source of the spike in contaminants is identified, isolated and managed with a view to re-establishing favourable conditions in runoff and within receiving surface water bodies, 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. Collected and treated construction water will be discharged by gravity / pump to a vegetated area of ground within the Site. Silt fences 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 designated 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 minutes 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).

Active Construction Water Management will be utilised for all works within surface water buffer zones, and for all over pumping.

9.6.2.4 Excavation Dewatering Proposed Mitigation Measures- Passive Construction Water Management

Passive management systems (**Appendix 9.6 – Tile 7,** refer also to diagrams in **Management Plan 3, Appendix 2.1**) include some of the features described in Active Management treatment trains. The following measures will be implemented:

- 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., drilling / 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. 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 redline 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 or development, in many cases the diverted water will likely require active management to ensure sensitive receptors are protected. Diverted storm water, if clean will discharge to the receiving vegetated areas or existing drains, but any construction waters impacted by contaminants on the site will be managed, and potentially active management / treatment will be implemented.

9.6.2.5 Grid Connection Route – Excavation of Cable Trenches, Watercourse Crossings and Horizontal Directional Drilling

Excavation and installation of cable ducts within existing bridges (alteration) will require consent from the OPW and various mitigation measures. Mitigation measures outlined in this Report have been developed to minimise the environmental impacts of the grid connection route on the receptors of conservation importance that have been recorded in the area. Mitigation measures mentioned in this Report are included in the CEMP, **Management Plan 2- Water Quality Management Plan, Appendix 2.1**.

Detailed site risk assessments will be carried out with a view to identifying and qualifying risk associated with all watercourse crossings associated and in close proximity (within buffer zones) to the grid route connection corridor. In relation to directional drilling, and the general risk to groundwater during grid connection route construction, risk assessment and prescription of mitigation measures will be designed in accordance with relevant guidance and reference documents, **Section 9.3**.

Risk assessments involved identifying pathways and receptors for each potential source of contamination. This included each directional drilling location and is particularly important in relation to groundwater source protection zones and surface water bodies protected for the purposes of drinking water. Prescription mitigation measures are driven by the identification and qualified risk associated with each particular location and are as follow:

General Overview of Works Mitigation Measures

- The timing of grid connection cable laying will be carried out during metrologically dry seasons/periods.
- An Environmental Clerk of Works (EnvCoW) will be onsite in order to lessen environmental disruption and ensure site integrity is maintained. The Environmental Clerk of Works (EnvCoW) 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 Environmental Clerk of Works (EnvCoW) and the site will be fully restored post grid route connection (GRC) works.
- All chemical fluids used in the boring process are to be inert to the environment (environmentally safe) and follow the relevant legislation. The Contractor will retain a chemical register and have Safety Data Sheet (SDS) documents available onsite during the operation. The Contractor will also be responsible for a Fluid Management procedure which will include:
    - Drilling Fluid program and Safety Data Sheets
    - Management of spoil including volume on site, specialised site storage
    - Management of drilling fluid displacement (expected volumes and proposed storage)
- Considering the high volumes, high flow rates and high contaminant content (drilling spoil) of water arising for drilling activities, water will be managed and treated by means of a settlement tank and/or associated infrastructure (**Appendix 9.6 – Tile 8**). If a separation (recycling) system is to be used it will be adequately sized and bunded to handle the through-put of the drilling fluid so continuous drilling and reaming operation can be maintained. A separation system will be complete with screens and hydro - cyclones to separate the solids from liquid. Drilling fluids and drill spoils will be disposed off-site at an approved licensed location or discharged to the local surround area with approved licencing permits.

Good Practice of Plant Machinery

- All equipment used during HDD will be in good working order, checked regularly and maintained when necessary. Fluid return lines used in HDD process will be tested for leaks prior to use to check their reliability. Plant machinery not in use will have drip trays below engines as well as at refuelling points, if necessary.
- All practices involving bentonite will be monitored closely, that is: pumping pressure, drilling mud formulation i.e., drilling fluid volume and the volume of mud returns.
- 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.

Contingency Plan

- In the event that a drilling fluid spill or 'breakout' occurs, the Contractor will cease drilling immediately, notify the Environmental Clerk of Works (EnvCoW) and Emergency Service Management Personnel.
- 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.
- The Contractor will draft and apply a Contingency Plan highlighting with the principal HDD risks. At minimum, the Contractor will have equipment and materials on standby to mitigate against the following risks associated with HDD[19]:
    - Hydro-lock (loss of fluid flow)
    - A hydro-fracture incident (loss of fluid pressure)
    - Fluid spill over
    - Hydrocarbon/fuel spill
    - Drill pipe rupture
    - Borehole path failure
    - Major workplace safety events in remote areas

- The HDD operators will need to be equipped with straw bales, stakes to secure bails, oil booms, silt fences, sandbags, shovels, pumps, and any other materials or equipment necessary to contain and clean up and properly dispose of unintentional releases.

[19] MDM (2018) "Rockabill System Specifications for Cable Installation", McMahon Design & Management Ltd. Consulting Engineers and Project Managers, Job no. 1319

9.6.2.6 Groundwater Contamination Proposed Mitigation Measures

As identified and discussed, the risk posed to groundwater quality by the Project is low, however mitigation measures to further reduce the risk will be implemented.

The main threat to groundwater quality is the introduction of hydrocarbons. In order to mitigate groundwater contamination by hydrocarbons in particular, the following will be implemented:

- Minimum fuel storage will occur on site and re-fuelling of vehicles will occur off-site at a controlled fuelling station whenever possible.
- Where fuelling must occur on site due to logistical reasons, then a discrete "fuel station" will be used.
- For large machinery such as cranes, drip tray will be used and spill kits will be on hand.

The following mitigation measures will be implemented in relation to non-hydrocarbon potential contamination:

- Wastewater from the sanitation facility will be mitigated by use of temporary, self-contained compound. This facility will not interact with the existing hydrological environment in any way and wastewater will be removed off-site weekly, by a licensed wastewater disposal company and disposed at an appropriate licenced facility.
- Inorganic nutrients such as nitrogen and phosphorus compounds (if present in excavated sediment and as discussed in discussed in **Section 9.5.3.2** with commercial forestry) will be controlled by the attenuation of the suspended solids to which they adsorb to and by retention of discharge waters within stilling ponds to allow peak runoff to recede prior to discharge (refer to the next section, **9.6.2.12** for monitoring details). It is noted that the baseline surface water chemistry indicates elevated Ammoniacal Nitrogen and Phosphate.
- Bacteriological contamination arising from availability of nutrients (e.g., livestock etc.) will be mitigated by appropriate self-contained sanitation facilities (above) and livestock grazing control on the site overall, but particularly on areas zoned for excavation and development.
- There is low risk of mobilising trace metals that may naturally be present, refer to **EIAR Chapter 8: Soils and Geology, Appendix C** for recoded locations of iron pan. The potential impact may arise from introduced water percolation with excavated bedrock substrate[20]. Concentrations of trace metals are usually low in the natural environment; however, water quality will be checked for metals concentration before, during and after the construction phase as part of monitoring at river monitoring locations.

[20] Teagasc (n.d.) "Research Soils Special: Irish Soil Information System" *Agriculture and Food Development Authority*

9.7 RELEASE OF SUSPENDED SOLIDS PROPOSED MITIGATION MEASURES

Graphics associated with mitigating runoff quality are presented in **Appendix 9.6 – Tiles 7 - 9.**

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 Project 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 9.6.2.2**).

Diffuse surface water runoff will be managed as follows:

- With reference to **Management Plan 3, Appendix 2.1**, collector drains and/or soil berms 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, buffered discharge points or other surface water runoff control infrastructure as appropriate. This is particularly important for effective surface water management associated with proposed infrastructure within the varied surface water buffer zones. The drainage system will be permanent (see also **Appendix 9.6** for conceptual graphics).
- Silt fences will be established along the perimeter of source areas e.g., stockpiles, within the drainage network, and in existing natural drains and degraded peat areas which are likely to receive surface water runoff (**Appendix 9.6 – Tile 14).** Section 5.5 of the Surface Water Management Plan (**Management Plan 3, Appendix 2.1**) describes this in more detail. 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. Double silt fences / screens will be deployed at outfalls within surface water buffer areas (**Appendix 9.6 – Tiles 7 – 9**). 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 followed by buffered outfalls 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 9.6 – Tile no. 8, 9 and 11).** 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 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 0.3 m/s at which velocity, silt particle settlement occurs. Stilling ponds will be permanent (life of development at minimum). The locations of stilling pond have been chosen as a part of the drainage design, refer to **Series 100 Site Layout Plans 6225-PL-100-108 planning drawings.** Flow control devices such as weirs and baffles will facilitate achieving better attenuation, particularly when considering fluctuating runoff rates (**Appendix 9.6 – Tile 11**).
- In line Check Dams will be constructed across drains (**Appendix 9.6 - Tiles 3 – 6, Section 5.6 of Management Plan 3, Appendix 2.1)**. 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 9.6 – Tile 13**) 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 and is therefore prescribed, 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. 20 m intervals within the length of drainage channels. This is dependent on the slope angle and height of check dams constructed, refer to **Appendix 9.6 – 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 1.2 m (**Appendix 9.6 – 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 9.6 – Tile no. 3 to 6**, refer also to **Section 5 of Management Plan 3, Appendix 2.1**.

- Surface water runoff will be discharged to land via buffered drainage outfalls (refer to **Appendix 9.6 Tiles 7, 8 and 12**, see also **Figure 4.2** and **Drawing Nos. 6226-PL-301** and **6226-PL-100 to 108** in **Management Plan 3**, **Appendix 2.1**). 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 have been 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.
- As per the drainage design (**Figure 2.6**), buffered drainage outfalls will be located outside of surface water buffer zones. 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 9.6 – Tiles 12 and 13**). These structures will be akin to rip raps (coastal erosion defences/ outfall erosion defences). Silt fences (**Figure 2.6** and **Sections 4 and 5 of Management Plan 3, Appendix 2.1**) 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 Environmental Clerk of Works (EnvCoW)) 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 (negative charge) are also effective flocculants, and are not toxic i.e., environmentally friendly [21]. 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 9.6 - Tile 13**), and silt fences (discussed under diffuse runoff) will 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 during excavation works) or to facilitate temporary works (e.g. corrective actions, discussed in later sections). 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 Environmental Clerk of Works (EnvCoW) to ensure the bypassing does not occur. Coarse stone / boulders will 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 (>25 mg/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

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

courses and mitigates potential impacts 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 impacts on water quality and will ensure that the sensitive receptors in the catchment of the Project do not suffer any deterioration in water quality, either during construction, operation, or decommissioning. With reference to **EIAR Chapter 6: Aquatic Biology**, the populations of Freshwater Pearl Mussel in the lower catchments of the wind farm (Sullane) and along the grid connection route will not be negatively affected by the proposed development. Therefore, the risk to sensitive receptors is low.

Particularly sensitive areas are identified and presented in **Figure 9.13a** to inform the drainage design. Refer also to specific constraints relating to drainage, outfalls and stability in **EIAR Chapter 8 Land, Soils and Geology** and **Figure 8.7a**. Sensitive areas include identified site constraints / buffer zones, but also particular areas with elevated soil or slope stability risk results. Drainage design will not include outfalls discharging to those particular sensitive areas without proper consideration and tailored mitigation in buffer zones and will be avoided outright in areas of elevated risk.

The drainage design is presented on **JOD Drawings 6226-PL-100 to 6226-PL-108** and calculations are included in **Management Plan 3 – Surface Water Management Plan** appended to the CEMP, **Appendix 2.1**. The design indicates in detail the locations of treatment train features, and the specification required at each location.

9.8 RELEASE OF HYDROCARBONS PROPOSED MITIGATION MEASURES

The following mitigation measures to reduce potential impacts 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 impacts 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 (**Figure 2.16**). 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 50 m 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 Project. 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, Onsite Substation, spoils storage areas and Met 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 Project 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 have been established and specified in Management Plans 1 and 3 of the CEMP, **Appendix 2.1**.

9.8.1.1 Release of Horizontal Directional Drilling Material Proposed Mitigation Measures

In consultation with Drilling Supplies Europe[22], following the polymer break down, cuttings will settle out of the drill fluid which will form approximately 20% of the volume, the liquid phase will form about 80% of the volume. It is noted that settlement will be done overnight in a pit or holding tank, to leave a fluid phase of less than 400 ppm suspended solids.[21] As has been seen in the past, the remaining water phase will be decanted and disposed of to a wastewater treatment facility or in the sewerage infrastructure, with appropriate discharging licenses from relevant authorities; and the sludge/solids will be disposed of as semi-dry waste to landfill at a reduced cost.[21]

Quantities of drillings cuttings have not been specified to date; however, it is noted that in each entry and exit pit associated with HDD, a 1 m x 1 m x 2 m steel box will be installed to contain any drilling fluid returns from the borehole. The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit. It has been determined that drilling rig and fluid handling units will be located on one side of each bridge and will be stored on double bunded 0.5 mm PVC bunds which will contain any fluid spills and storm water run-off. Upon completion of the HDD process, the steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.

Drilling mud containing spoil recovered from the bored path can be retrieved at the launch and reception sites of the bore. This bentonite contaminated spoil will be treated in one of two ways. It can either be transferred off-site to an approved and authorized EPA license

[22] Drilling Supplies Europe (2022) "ClearBore" *Drilling Supplies Europe.* Available at: <https://www.drillingsupplieseurope.com/drilling-fluids/clearbore/>

facility (in accordance with the Waste Management Act 1996 as amended) to be properly disposed of; or the spoil can be pumped to a mechanical separation container (**Appendix 9.6 – Tile 14**). This involves drill mud being stored within a holding tank until separation of particulates can be achieve only then can the fluid be discharged to the surrounding area.

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 at sufficient rates. To address this, flocculant will be used to promote the settlement of finer solids prior to discharging to surface water networks. Flocculant 'gel blocks' are passive systems, self-dosing and self-limiting, however they still require management as per the manufactures instructions. Flocculants are made from ionic polymers. Cation polymers (positive charge) are effective flocculants; however, their positive charge makes them toxic to aquatic organisms. Anionic polymers (negative charge) are also effective flocculants, and are not toxic i.e., environmentally friendly.[23] Therefore, if flocculants are deployed the material used must be made from anionic polymers.

9.8.1.2 Release Wastewater Sanitation Contaminants Proposed Mitigation Measures

A temporary compound area will be constructed on-site to contain temporary facilities for the construction phase including 'port-a-cabin' structures. The temporary compound will be constructed on a base of geo-textile matting laid at ground level. This will be stabilized with the laying of hardcore material on top. During the construction phase, foul effluent will be periodically removed for offsite disposal.

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 for treatment. There will be no onsite treatment of wastewater. A wastewater or sewerage leakage is not anticipated in a properly managed Site.

[23] USEPA (2013) "Stormwater Best Management Practice: Polymer Flocculation" *United States Environmental Protection Agency: Office of Water*, 4203M.

9.8.1.3 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 will be implemented:

- The acquisition, transport and use of any cement or concrete on site will be planned fully in advance of commencing works by the Contractor's Environmental Manager and supervised at all times by the Developer appointed Environmental Clerk of Works (EnvCoW). 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 Project where precast concrete will be used have been identified and are indicated in the CEMP, **Appendix 2.1.** Elements of the Project where the use of precast concrete will be used include structural elements of watercourse crossings (single span / 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 be implemented.
    - 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 such material will be relatively clean upon arrival on site, that is; vehicles will be washed/rinsed removing cementitious material leaving the source location of the material. There will be no excess cementitious material on the vehicle which could be deposited on trackways or anywhere else on site. To this end, vehicles will undergo a visual inspection prior to being permitted to drive onto the proposed site or progress beyond the Contractor's yard. Vehicles will also be in good working order.
        - 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. **(Appendix 9.6 – Tile 21)**

- 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 (>3 mm/hour, 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 required 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 at a suitable licensed facility. Concrete washing will be contained and managed similarly.
- 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 Site 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.

9.9 CLEAR FELL OF FORESTRY

No new impacts or remediation measures are associated with forestry activities. 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 regarding the management of forestry operations which will be implemented include:

- Phased felling approach
- Minimising erosion by use existing tracks and use of brash for off track areas.

- Felling and extraction, if economical, of timber will, as far as possible, be undertaken at the same time as currently licensed extraction activities in order to minimise extra traffic and noise disturbance.
- Felling and extraction of timber will, as far as possible, be undertaken in dry weather conditions.
- All Forest Service guidelines will be adhered to during all harvesting activities.
- All relevant forestry guidance and policies as follows:
  - Forestry Service (2015) Forestry Standards and Procedures Manual
  - Forestry Service (2002) Forest Protection Guidelines
  - Forestry Service (2018) Forests & Water - Achieving Objectives under Ireland's River Basin Management Plan 2018-2021
  - Forestry Service (2000) Forests & Water Quality Guidelines
  - Forestry Service (2000) Forest Harvesting and Environmental Guidelines
  - Forestry Service (2018) Forestry and Freshwater Pearl Mussel Requirements - Site Assessment and Mitigation Measures DRAFT
  - Forestry Service (2000) Forest Biodiversity Guidelines
  - Forestry Service (2000) Forestry and The Landscape Guidelines
  - Forestry Service (2000) Forestry and Archaeology Guidelines
- It should be noted that the clear-felling of trees in the State requires a felling licence.
- 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 remining trees, which can be a major attributor to windblow.
- Felling and extraction of timber will be undertaken in dry weather conditions.
- Harvesting operations will be scheduled according to the nature of the soil seasonally, depending on ground conditions. Mechanised harvesting operations will be suspended 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. The following measures to avoid impacts will be implemented:
  - 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 and riparian zones maintained.

9.9.1.1 Watercourse Crossings Proposed Mitigation Measures

The Project includes the construction of three (3 No.) clear-span bridge watercourse crossings (**Figure 9.7**). The Grid Connection Route will encounter 113 No. Culvert crossings, 3 no. watercourse crossings and 6 no. service crossings (**Appendix 2.4**). These crossings require detailed planning and consideration to ensure potential impacts 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 will 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 – IWF 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. 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 9.3).**

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. Preliminary design details are included in **Drawings ref. 6226-PL-WC 1-3.**

All crossings will have clear span structures.

Single span structures are structures which span the width of the channel with no associated instream support and do not affect the bed of the river or water body. This ensures that the bank and instream habitats are maintained and the riverbed is not impacted.

The decision to use single span structures is in accordance with Engineering in the water environment: Good Practice Guide – River Crossings (SEPA, 2010) and Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes (NRA, 2008) for river waterbodies in upland or transitional river segments.

With reference to **EIAR Chapter 6 – Aquatic Ecology**, none of the proposed watercourse crossing locations 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 impacts 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 impacts downstream (e.g. scouring etc) or upstream (e.g. passage of fish) will be avoided, in line with 'good practice' defined by 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, all crossings will be Clear Span Bridges.

This is 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 (<2 m width) in stream supports will not be required for the construction of single span structures.
- The design facilitates adequate hydraulic capacity (**Management Plan 3 of Appendix 2.1**). 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.
- In line with the above design consideration, allowance will be made for the transport of sediment through the crossing, not just hydraulic capacity.
- The design facilitates adequate freeboard to OPW requirements. The design facilitates passage of woody debris. Freeboard to facilitate navigation and recreation is not applicable in relation to the development and associated surface water features.
- For single span structures, abutments will be set back from the river channel (**Appendix 9.6 – Tile 15**) and banks to allow the continuation of the riparian corridor underneath the structure. This helps to minimise or prevent the need for bed and bank reinforcement, reduces the risk of creating a barrier to fish passage and allows mammal passage under the structure. The distance between the bridge abutments will be as wide as possible and will maintain the bank habitat, maximising the riparian corridor and allowing the river some space to move. Foundations (of abutments) will be deep enough to minimise or prevent the need for bed or bank reinforcement or bridge weirs or aprons. This will maintain the natural bed material and bed levels, protecting habitat and allowing fish passage. Foundations will be buried deep enough to allow for scour during high flows. Construction will be supervised by a suitably qualified engineer who will confirm that the depth is as per the design.
- The design minimises the potential for localised bank and bed erosion, refer to **Planning Drawing No. 6226-PL-WC-01, 6226-PL-WC-02, 6226-PL-WC-03**.

9.9.1.1.1 Culverts & Instream Works

Infrastructure such as culverts and non-mapped drainage features will require instream works. Where culverts are required and the subsequent in-stream works are necessary, the following will be implemented:

- Relevant guidance referenced is presented in **Section 9.3**. Method statements will be included in the CEMP, **Appendix 2.1.**
- 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 9.6 – 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 9.6 – 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 impacts are minimised, particularly in relation to ecological sensitivities.
- In order to ensure isolation and over pumping is carried out effectively, the methodology will 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. With reference to **Section 6.4.2 of Chapter 6: Aquatic Biology**, clear span design of the bridges/crossings will not affect instream aquatic habitat or interfere with the passage of fish or aquatic fauna.
- 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 9.6 – 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, or preestablished stilling pond to remove suspended solids before being discharged (**Appendix 9.6 Tiles 8 and 9**). The quality of the water being discharged will be monitored. If discharge water quality is poor (e.g., >25 mg/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 9.6 – Tile 12**). Silt fences (**Appendix 9.6 – Tile 14**), 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). For further details refer to **Appendix 9.6 – Tiles 6 to 9**.

- 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.
- Operation of machinery in-stream will be kept to an absolute minimum and avoided where possible. Where in stream works are required, the area will be isolated by means of over pumping or drainage diversion (**Appendix 9.6 Tile 1**), discussed further below.
- Works in relation to watercourse crossings 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 9.6.2.1**).
- 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 9.5.3.2**, 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 9.6 – Tile 8**).

9.9.1.1.2 Diversion of Drainage

Diversion of artificial drainage channels will be required at locations where the development layout intercepts existing artificial drainage networks (**Figure 9.7a**).

Diversion of drainage will be done under similar conditions to that described above for instream works. Many of the existing constructed drainage channels are observed to be dry during sustained dry 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.

Erosion control will be incorporated into the design (**Appendix 9.6– 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 (**Appendix 9.6– Tile 14)** 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 (**Management Plan 3, Appendix 2.1).** The use of silt screens as a form of mitigation during watercourse crossing works is considered a precautionary measure. Refer to **Appendix 9.6 – Tile 2** for further information on the recommended ordering of control measures.

9.9.1.2 Groundwater Contamination Proposed Mitigation Measures

A combination of the underlying bedrock geology, the associated aquifer potential, low permeability soils/peat and low recharge rates has resulted in the risk posed to groundwater quality by the Project being considered as 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 Project. In order to mitigate against potential groundwater contamination by hydrocarbons, the following measures will be implemented:

- In the first instance, no fuel storage will occur at the Site whenever feasible and refuelling of plant and equipment will occur off Site at a controlled fuelling station.
- In instances where on Site refuelling is unavoidable, then the bunded on Site designated refuelling area will be used. The designated refuelling area must be bunded to 110% volume capacity of fuels stored at the Site. **(Appendix 9.6 – Tile 19)**

- 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.

The following mitigation measures will be implemented 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.

9.9.1.3 Site and Water Quality Monitoring

9.9.1.3.1 Defining Monitoring Roles and Responsibilities

An Environmental Clerk of Works (EnvCoW) will be appointed during the construction and operational phases of the Project, to ensure sensitive areas outlined in this EIAR are prioritised and to ensure mitigation measures are followed to protect these sensitive areas. It is often compulsory as part of the planning conditions to have an EnvCoW present during works. Local Authorities will often define what role the EnvCoW has, for example; an advisory capacity, an audit capacity, for ecological work or an all-encompassing environmental role. For the Project, the EnvCoW will incorporate, where relevant, mitigation and monitoring responsibilities set out here width. The EnvCoW ensures compliance with the method statements and management plans, in turn in line with environmental and mitigation objectives outlined in this report, and will relay advice, information and instruction to the appointed contractors during the construction and operational phases of the Project.

9.9.1.3.2 Wind Farm Site

Monitoring of peat, subsoils, bedrock and material management during the construction phase of the Project 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, 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 Environmental Clerk of Works (EnvCoW) will be assigned by the Developer to carry out monitoring at the Site during the construction and operational phases of the Project. The role of the EnvCoW will be to actively and continuously monitor site conditions and advise on environmental issues and monitoring compliance. The EnvCoW will have the authority to temporarily stop works in a particular area of the Site to ensure corrective measures are implemented and adverse environmental impacts are minimised if not avoided. The following wind farm Site monitoring measures will be undertaken by the EnvCoW, to mitigate against potential impacts on the surface water and groundwater receiving environment:

- During the construction phase, daily inspection of silt traps, buffered outfalls and drainage channels, in conjunction with daily measurement of total suspended solids, electrical conductivity, and pH at selected water monitoring locations on the Site (locations close to active working zones). Monitoring of same features, parameters and locations 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, <25 mg/l Total Suspended Solids (TSS). This threshold can be described as one of the environmental and mitigation objectives set for the Development.

- Continuous Monitoring will be carried out as part of Active Management of construction water management and treatment (**Appendix 9.6**). These monitoring systems will travel with 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., 25 mg/l TSS)
- Continuous Monitoring at designated downstream Baseline SW Locations (**Figure 9.7b**) will be carried out using telemetry during the construction phase. Exceedance of thresholds at these locations will trigger emergency response and escalation of measures including immediate full Site inspection to ascertain the potential unknown source (bearing in mind that the quality of managed runoff will be known by means of live telemetry and handheld meters). Monitoring at Baseline SW Locations will continue into the operational phase until such time that it is confirmed that the construction phase is complete, that there are no further construction activities required on site, and when stable conditions are observed i.e. stable conditions in line with baseline conditions observed for 2 months following the completion of the construction phase.
- 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. 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 areas or works 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 systems 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 Project, 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, watercourse crossings will be monitored frequently (daily during construction and intermittently during operational phase i.e., weekly / monthly inspections) and reduced gradually in line with observed stability and confidence in data obtained over time. Monitoring will include structural integrity and the impact on respective watercourses (i.e., erosion, siltation).
- A detailed inspection and continuous monitoring regime is 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. This also includes Site water runoff quality instructions at all designated downstream SW locations. Continuous Monitoring Locations or Telemetric Monitoring Stations (TMS) will use probes to monitor the following parameters:
    - Electrical Conductivity
    - Turbidity (Data obtained can be equated to estimated Total Suspended Solids (TSS) through calibration)
    - pH
    - Temperature
    - Capacity for additional probes.
    - TMSs will be self-powered and will be comprised of the following components at a minimum:
    - Remote Telemetry Unit (RTU) – Modem / data hub and transmission.
    - Solar panel
    - Sensor – pH
    - Sensor – Turbidity
    - Sensor – Electrical Conductivity
    - Sensor Cleaning Device (SCD)(Turbidity probe)
    - Power Management Unit (PMU)
    - Power Bank (PB)
    - Website – presenting data trends over time.
    - Metal stand / frame and protective fencing.

  - The TMS will have capacity for additional parameters.
- Telemetric continuous monitoring sampling frequency is generally set at one data point per 15 minutes, however considering the intensive nature of the proposed works, particularly drilling activities, if possible it is recommended that sampling frequency is set at 5 minutes or less with a view to escalating responses to potential discharge quality issues in good time. Data is transmitted to a project website which will display data trends over time. Access to the website can be gained and shared via a website link by the designated EnvCoW.
- Telemetric Monitoring Systems will be used a key part of Active Management of runoff and construction water at the Site, as presented in **Appendix 9.6 – Tiles no. 7 to 9.**
- 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 by vacuum) on an ongoing basis, particularly during the construction phase of the Project. 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 incoming flow and vacuum extracting settled solids or sludge. Where the drainage feature poses relatively significant flow rates, isolating and over pumping is the best course of action. As part of the CEMP, **Appendix 2.1** 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 (**Appendix 2.1**).

Monitoring the potential hydrological impact of the Project, particularly during the operational phase will be inherently linked to the ecological health of the blanket peat (as a functioning ecosystem) and therefore both hydrology and ecology will be considered, and monitored in tandem. For example, impacts 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 sections of this report, 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 turn raising bog water levels resulting in wetting of peatlands at the Site.

9.9.1.3.3 Grid Connection Route and Turbine Delivery Route

Monitoring will be carried out at each significant construction location (HDD, any excavation >2.0 m) and at significant environmental receptors including the following Environmental Monitoring Locations:

- Upstream and downstream of surface water crossings on mapped rivers.
- Operational wells within groundwater buffer zones associated with significant construction locations (namely SW Crossings).
- Groundwater abstraction points within buffer zones (mapped wells, source protection areas, and/or associated Regionally Important Karst Aquifer).

Monitoring proposed will be specified relative to the particular activity and associated risk at respective locations.

9.9.1.3.4 Monitoring Under License

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.

9.9.1.3.5 Tailoring Monitoring Requirements

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 Project 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 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, 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, **Appendix 2.1**).

9.9.1.4 Emergency Response

Monitoring of the development during the construction and operational phase will potentially indicate weaknesses of the drainage and attenuation design, and/or the potential for excessive loading at particular locations etc. In such instances corrective actions will be taken to mitigate against any potential adverse impacts. Depending on the severity of the issue there is the potential that immediate action will be required, for example the introduction of straw bales to reduce flow / enhance attenuation at a particular location, erect silt fences etc., however such measures will be temporary. Any issue observed will require assessment by a specialist consultant and alternative mitigation design (in line with measures described in this EIAR) will be implemented to ensure the efficacy of the system during both the construction and operational phases of the Development. Scenarios where corrective action will be required, and proposed corrective mitigation measures include:

- 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 that will be implemented; 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 that will be implemented; 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 that will be implemented; 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 9.6 – Tile no. 7 to 9**).
- Potential issue; Management of unexpected runoff patterns leading to excessive drying or wetting in a particular area, potentially leading to enhanced erosion and / or adversely impacting on the ecological health of peat ecosystems. 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 impacts to ecological sensitivities will become apparent relatively slowly in comparison. It is noted that much of the Site is impacted as part of baseline, (**Section 9.4.6**) in this regard e.g., extensive existing artificial drainage networks.

Prior to commencement of construction, the Environmental Clerk of Works 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 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, **Appendix 2.1**, Management Plan 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 will 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 Environmental Clerk of Works (EnvCoW) in conjunction with a preidentified consultant (Environmental Clerk of Works (EnvCoW) 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.

With reference to **Appendix 8.1**, localised stability issues are to be anticipated. In close proximity to surface water receptors this represents an acute risk to river water with potentially catastrophic impacts to downstream ecological attributes if not managed and isolated sufficiently.

9.9.1.5 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 (e.g., landslide) 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.

9.9.1.6 Construction Phase Residual Impacts

The residual impact on the surface water receiving environment resulting from the construction phase of the Project 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 will 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 **direct, negative, imperceptible**, and **temporary**.

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

9.9.2 Operational Phase

9.9.2.1 Increase in Hydraulic Loading Proposed Mitigation Measures

The principles of the mitigation measures described under **Section 9.6.1.2** (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 Wind Farm 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 0.5 m depth, 1.0 m width, presume semi-circular, sectional area; c. 0.4 m^2. Presume 100 m length of collector drain; up to 40 m^3 capacity per 100 m, by 50% allowing for gradient equates to 20 m^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.
- 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 (**Appendix 9.6 – Tile 7**).

The Project 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 0.253 m^3/second (or 2.06%) relative to the area of the Site. The potential combined attenuation capacity of the proposed drainage infrastructure, checked dams, stilling ponds, etc. (**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**.

9.9.3 Development Decommissioning and Restoration Phase/s

9.9.3.1 Decommissioning of Infrastructure

As discussed in Section 9.5.7, 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, as outlined in **Management Plan 6 -Decommissioning Plan, Appendix 2.1**, details the removal of Site infrastructure such as wind turbine and concrete plinths, removal of permanent met mast and the removal of all associated underground electrical and communications cabling.

The excavation of peat 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, redressed with peat. 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 (**Appendix 2.1**), to reduce the potential for such impacts.

In regard to cable ducting, for the Grid Connection route, it is envisaged 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 1 m 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).

9.9.3.2 *Reinstatement of 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 hard- stands will be left in place, with topsoil and or peat being 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 will be agreed with the Environmental Engineer in advance of commencement. Reinstatement of 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 Pan has also been developed prior to the commencement of any Decommissioning activities.
- Mitigation measures described in this chapter to reduce the potential for run-off of elevated suspended solids will be implemented.
- It is proposed that silt/sediment fences will 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.
- Any drains or outfalls which have the potential to draw water from reinstatement areas, or promote preferential surface water runoff flow paths through reinstatement areas will be removed, blocked or decommissioned as deemed required by the Environmental Engineer.
- 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 proposed that monitoring and maintenance of the reinstated areas will 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.

It is proposed that the Site Access Tracks and associated drainage systems will serve ongoing forestry and agriculture activity in the area.

9.9.3.3 Reinstatement Residual Impacts

It is anticipated that the appropriate reinstatement of redundant hardstand areas 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 peatland/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 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.

9.9.3.4 Development Decommissioning and Restoration Phase – Physical Infrastructure

No significant excavations will occur during the decommissioning phase, therefore, no new impacts are anticipated during the decommissioning phase of the Project on the hydrological and hydrogeological environment therefore no additional mitigation measures are required.

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 principle mitigation measures described in this EIAR chapter will be implemented by means of the Decommissioning Plan **Appendix 2.1.**

9.9.4 Cumulative Effects

9.9.4.1 Water Quality

The phasing/commencement of any other permitted developments in the locality (**Appendix 2.2: Wind Farms within 20 km of the Development** and **Appendix 2.4: List of Projects for Cumulative Assessment)** could potentially result in the scenario where a number of other construction sites are in operation at the same time as the Project.

Considering cumulative effects of a range of pressures on the surface water network on a national scale, if an accidental release of contaminants were to occur, there is a potential to temporarily effect 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 effect to acceptable levels, and to strive for net gains where possible. 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 Project having been assessed as likely being to be minor and temporary, for example; in the event of a minor spill of fuel / hydrocarbons, the spill will be contained and remediated efficiently. Therefore, the development is not likely to contribute significantly to cumulative effects on groundwater quality, but the residual risk even if small in scale is important to consider in the context of the elevated sensitivity and importance of the receptor i.e. groundwater designated as drinking water on a national scale.

With the adequate application and execution of mitigation measures and achievement of mitigation objectives, the Project is not considered to contribute to cumulative surface water or groundwater effects potentially significantly.

In the event of accidental or temporary contamination incidents, water quality in downstream receptors can potentially be adversely impacted, particularly during the construction phase. Such incidents will detected quickly through ongoing monitoring and trigger an emergency response on site and escalation of Active Management on site (**Appendix 9.6 Tiles 7 – 9).** Assuming other, similar developments, construction activities and potential adverse impacts in the area, there is the potential for such incidents to have a cumulative impact on water quality to some degree if such incidents occur on multiple sites in a short period of time and within the same hydrological catchments. However, it must be noted that similar sporadic natured impacts are part of baseline conditions at the site, including, land reclamation, excavation of drainage, commercial forestry, agricultural practices.

Allowing for worst case whereby a contamination incident occurs, the incident will likely be minor and temporary and therefore will unlikely contribute significantly to cumulative effects in the associated surface water network. The risk of a major landslide or mass movement to occur as a function of the Project is generally low (**Appendix 8.1**).

9.9.4.2 Hydraulic Loading

Due to a net increase in impermeable surface at the Site as part of the Project a reduction in recharge to groundwater, and rapid transmission of runoff to surface water systems has the potential to significantly contribute to the cumulative / catchment of adverse impacts imposed on the surface water network in the catchments associated with the Project and the hydrological response to rainfall, (refer to Appendix 2.3 for permitted and operational wind farms within 20 km of the proposed Site). However, considering the pre-existing "Good" WFD status of the surface waters surrounding the Project, and the generally high-quality baseline water quality results outlined in **Section 9.4.8**, the potential for the Project to have adverse cumulative impacts on hydrology is limited to the construction phase. Considering cumulative impacts 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 Project having been assessed as being localised due to the overlying peat, slow recharge rates, high run-off rates and poor yielding underlying groundwater aquifer except for local zones, the Project is not considered to potentially significantly contribute to cumulative effects.

9.10 SUMMARY OF SIGNIFICANT EFFECTS

This chapter comprehensively assesses all scenarios within the Turbine Range which is described in **Section 9.2.1,** and a summary of unmitigated and mitigated impacts are presented in **Table 9.13: Summary of Potential Impacts on receiving environment from the Project in the absence of and with mitigation measures.**

There will be no change to the potential impacts or predicted effects irrespective of which turbine is selected within the Turbine Range because of the design phase mitigation measures which will be implemented prior to construction. All works will be outside of the 65 m buffer from watercourses and 20 m buffer from drains, where possible. Where this is not possible, additional mitigation measures such as increased use of Sustainable Drainage Systems (SuDS), will be implemented. Additionally, all temporary stockpiles will be at no less than 25 m from watercourses. This will be implemented regardless of the volume of excavated materials created as a result of the Turbine Range.

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 impacts that could generally arise 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, 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. There will be no change to the potential impacts or predicted effects irrespective of which turbine is selected within the Turbine Range.

This chapter identified the likely hydrological, and hydrogeological impacts 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.

Elements of the design, construction, and operation of the Project that may potentially impact on the hydrogeological and water environment receptors have been identified and their pathways for impacts have been assessed. It has been determined that without mitigation, the Project would likely cause adverse impacts ranging from moderate to profound significance due to the sensitivity of the SAC hydrologically linked to elements of the Project, including the Grid Connection Route.

However, 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 impacts on water quality at the Site. A self-imposed 50 m stream buffer zone will be implemented at the Site which will 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 impacts on downstream designated Sites. Layout design amendments along with the application of the specified mitigation during each phase of the Project have reduced the potential significance to all receptors related to the Project to **'neutral' or 'positive'**. The Project will not impact upon any surface water or groundwater body as it will not cause a deterioration of the status of the body and/or it will not jeopardise the attainment of a WFD 'Good' status. The Project will not cause it to deteriorate and will not in any way prevent it meeting the biological and chemical characteristics for WFD 'Good' status.

The drainage plan (Surface Water Management Plan) 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 impacts such as net increase in surface water runoff and potential adverse impacts to surface water quality, will overshoot net adverse losses and provide beneficial impacts 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 be addressed immediately and remedied in good time.

The Project as a whole, including the Turbine Delivery Route and Grid Connection Route are not likely to significantly impact groundwater quantities, quality or availability. The principal residual risk to groundwater posed by the Project 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.

Preliminary assessments conclude that the likelihood of exacerbating flood risk or behaviours at the site is very low, and the potential to exacerbate impacts on local receptors including dwellings is very low.

Table 9.13: Summary of Potential Impacts on receiving environment from the Project in the absence of and with mitigation measures.

		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 Profound	Development Footprint	Conforms to baseline e.g. Agri/forestry tracks or operations)	Unavoidable	Temporary	Yes	Adverse	Neutral to Slight
Release of Suspended Solids	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to baseline e.g. forestry tracks or operations)	Unavoidable	Temporary	Yes	Adverse	Neutral to Slight
Vehicular Movements	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to baseline e.g. forestry tracks or operations)	Unavoidable	Temporary	Yes	Adverse	Neutral to Slight
Release of Hydrocarbons (SW)	Construction	Direct and Indirect *	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Permanent but Reversible	Yes	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	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 Horizontal Directional Drilling Materials	Construction	Direct	Adverse	Small	Slight	Localised (Potentially Regional)	Contrast to Baseline	Likely	Long Term to Permanent	Yes	Adverse	Neutral to Slight
Release of Drill Arisings	Construction	Direct and Indirect *	Adverse	Small	Moderate to Significant	Localised (Potentially Regional)	Contrast to Baseline	Likely	Temporary to Long Term Reversible	Yes	Adverse	Neutral to Slight
Release of Wastewater Sanitation Contaminants	Construction	Direct and Indirect *	Adverse	Small	Moderate to Significant	Localised (Potentially Regional)	Contrast to Baseline	Likely	Temporary to Long Term Reversible	Yes	Adverse	Neutral to Slight
Release of Construction or Cementitious Materials	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Significant	Localised (Potentially Regional)	Contrast to Baseline	Likely	Temporary to Medium Term	Yes	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	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	Neutral	Neutral

		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**
Groundwater or Bog Water Associated with Wind Farm	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Significant	Localised	Conforms to Baseline e.g. agri / peat drains / forestry drains. .	Likely	Permanent / Reversible	Yes	Slight Adverse / Small Beneficial	Slight / Neutral / Beneficial
Groundwater and Surface Water Associated with Grid Connection Cable Works	Construction	Direct and Indirect *	Adverse	Small	Slight	Localised (Potentially Regional)	Conforms to Baseline e.g. public roads and services	Likely	Temporary	Yes	Adverse	Neutral to Slight
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	Adverse	Neutral to Slight
Diversion and Enhancement of Drainage	Construction	Direct and Indirect *	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Conforms to Baseline e.g. Agri / peat drains / forestry drains. .	Unavoidable	Permanent	Yes	Adverse	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	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	Adverse	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**
Watercourse Crossings - Grid Connection Route (HDD)	Construction	Direct and Indirect *	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Unavoidable	Permanent	Yes	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	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.**

9.11 REFERENCES

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