MWP

Chapter 9 Hydrogeology and Water Quality

Brittas Wind Farm Project

Brittas Wind Farm Ltd

November 2024

MWP

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Appendices

Appendix 9A – Flood Risk Assessment

Appendix 9B – Water Framework Assessment

Project No.	Doc. No.	Rev.	Date	Prepared By	Checked By	Approved By	Status
23318	6001	A	15/11/2024	KC	MT/EH	MT	ISSUE

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9. Hydrology, Hydrogeology and Water Quality

9.1 Introduction

This chapter describes the existing hydrological and hydrogeological characteristics in the EIAR study area and considers the potential effects on the existing water environment associated with the proposed project. A full description of the proposed project, development lands and all associated project elements is provided in Chapter 02 Description of the Proposed Project of this EIAR.

An impact assessment was carried out to determine whether the project is likely to have a significant adverse effect on the hydrology and hydrogeological aspects of the environment and to propose mitigation measures to reduce any potential negative effect of the proposed wind farm.

9.1.1 Competency of Assessor

The assessment was completed by Kate Cain and reviewed by Maura Talbot of MWP. Kate Cain has a BSc Honours in Geography and Environmental Management. She is an environmental consultant at MWP and has over 15 years of experience. Kate has authored EIA Screening reports, Environmental Impact Assessment Reports (EIAR), Detailed Site Assessments, Environmental Reports and Construction and Environmental Management Plans (CEMPs) for a wide range of projects. She has a strong background in hydrology and has undertaken water chapters and Water Framework Directive assessments for a wide range of projects.

This assessment has been reviewed by Maura Talbot who is a Chartered Environmental Practitioner with a Master in geography and over twenty years' experience in Environmental Consulting and research focussing primarily on Environmental Impact Assessment (EIA). She has prepared and reviewed a number of chapters for EIARs over her career for a broad range of projects.

9.1.2 Scope of Assessment

The scope of the chapter and assessment includes the following:

1. Establish the baseline conditions on site and agricultural practices that would remain operational without the proposed project;
2. Identify the likely significant adverse effects on hydrology and hydrogeological aspects of the proposed project during construction, operation, and decommissioning;
3. Identify and develop mitigation measures to avoid, reduce or eliminate likely significant adverse effects; and
4. Identify any significant residual impacts, effects and possible cumulative effects after mitigation measures are implemented.

9.2 Methodology

A comprehensive assessment of the potential effect of the proposed project on the hydrological and hydrogeological regime has been undertaken through a combination of a desktop study of resources, followed by a site walkover and field survey work.

9.2.1 Study Area

The proposed Wind Farm Site is located 3km north of Thurles town. The proposed windfarm and substation are located within or on the boundaries of the townlands of Brittas, Rossestown, Clobanna, Killeenleigh, Brownstown, Clonamuckoge Beg, and Kilkillamara.

The proposed grid route to Thurles 110kV substation is located within or along the boundaries of the townlands of Coolgarrane, Globanna, Athnid More, Rossestown, Cassestown, Farranreigh, Laghtagalla. Furze and Loughlahan.

The SID planning application development site boundary includes a total land area of approximately 331.98 ha and illustrated in Figure 9-1. The study area for this chapter therefore includes the associated hydrological (catchment and sub catchment areas) and geohydrological (aquifers) relating to the proposed project.

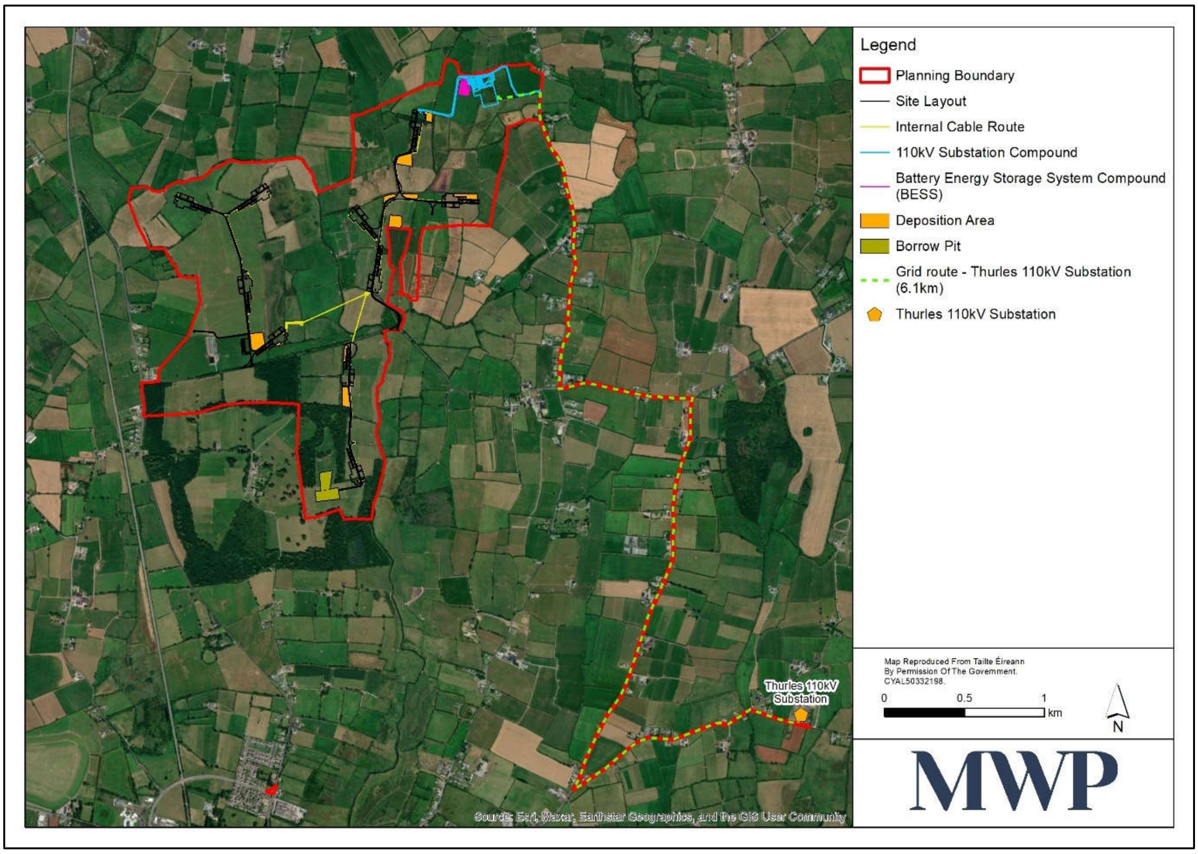


Figure 9-1: EIA Project Area and Redline Site Boundary

9.2.2 Desktop Study

A desktop study, involving a review of all available information, datasets and documentation sources pertaining to the proposed project site's natural environment was completed. The study involved the following:

- Examination of maps and aerial photography to identify any hydrological features, site topography and slope (accessed in May 2024);
- Review of local and regional development plans and planning policy in order to identify future development and identify any planning allocations within the study area;

- Review of Tipperary County Council's Planning Register to identify relevant development proposals currently under consideration by the Council;
- Tipperary County Development Plan, 2022-2028;
- Environmental Protection Agency (EPA) – website mapping and database information (accessed May 2024);
- National Parks and Wildlife Services (NPWS) – Protected Site Register (accessed May 2024);
- Office of Public Works (OPW) flood mapping data (www.floodmaps.ie) (accessed May 2024);
- Examination of the Geological Survey of Ireland (GSI) online datasets pertaining to hydro-geology features such as aquifers, wells, groundwater bodies and groundwater protection schemes (accessed May 2024);
- Examination of the Environmental Protection Agency – "HydroTool" Map Viewer (www.epa.ie) (accessed May 2024);
- Examination of CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie) (accessed May 2024); and
- Examination of information on private wells or water supply available from the GSI online datasets and the EPA Water Abstraction Register (accessed May 2024).

9.2.3 Field Work/Site Walkover

A site walkover was carried out by MWP within the site boundary and the study area (upstream and downstream of the site) to determine the existing site conditions. The survey was used to inform the assessment of potential effects on the local water environment and involved the following:

- A walkover survey of the site to identify hydrological features on site, wet ground, drainage patterns and distribution for flood risk assessment, exposures, and drains; and
- Confirmation of the site catchments and drainage regime, and any hydrological buffers to be implemented.

A Site Investigation (SI) was undertaken to provide geotechnical information for input into the design of the wind farm. The following SI report has been generated:

- Northwest Geotech, February 2024: *Ground Investigation Report Brittas Windfarm, Thurles, Co. Tipperary* (dated 26th February 2024).

9.2.4 Assessment Criteria

The method of impact assessment and prediction follows the EPA (2022) *Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR).*

9.2.4.1 Overview of the Impact Assessment process

The conventional source-pathway-target model (illustrated in Figure 9-1was applied to assess potential effects of the proposed project on hydrological and hydrogeological receptors.

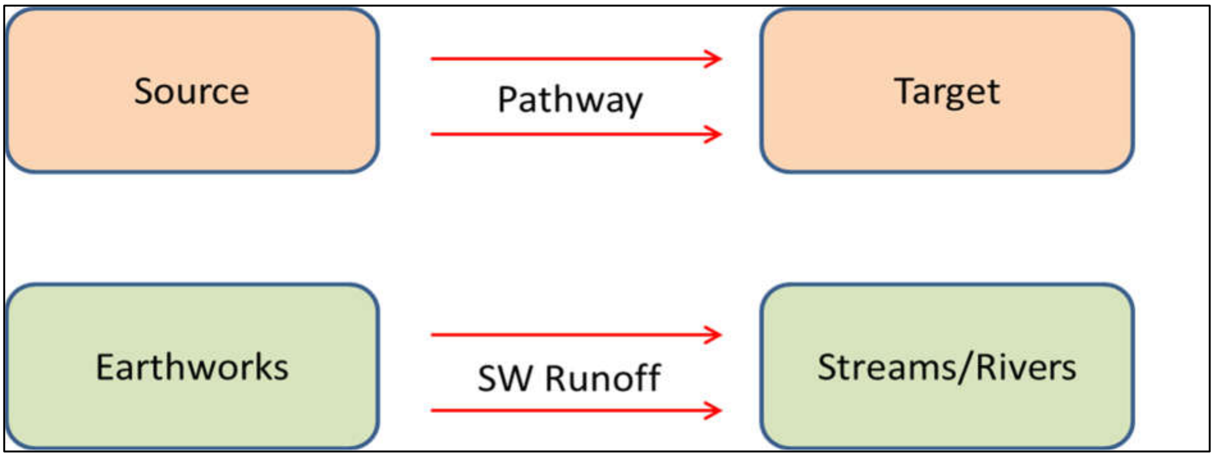


Figure 9-2: Source Pathway Target Model

Where potential effects are identified, the classification of these in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (EPA, 2022).

The application of the Impact Assessment methodology identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect effect (detailed in Chapter 01 Introduction of the EIAR).

In order to provide an understanding of the stepwise impact assessment process applied, Table 9-1 presents a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model, and the EPA effect descriptors are combined.

Using this defined approach, the impact assessment process is then applied to all wind farm construction, operation, and decommissioning activities which have the potential to generate negative effects on the hydrological and hydrogeological (including water quality) environments.

Table 9-1: Summary of Impact Assessment Process

Step	Impact Assessment	Description
Step 1	Identification and Description of Potential Impact Source	This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which a potential impact is generated.
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, e.g., human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place. Refer to (detailed in **Chapter 01 Introduction** of the **EIAR**)

Step	Impact Assessment	Description
Step 5	Proposed Mitigation Measures:	Control measures will be put in place to prevent or reduce all identified significant negative effects. In relation to this type of development, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by engineering design.
Step 6	Post Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment. Refer to (detailed in **Chapter 01 Introduction** of the **EIAR**)

9.2.4.2 Relevant Legislation

In addition to legislation detailed in Chapter 01 Introduction of the EIAR, this chapter has also complied with the following legislation specifically relating to water:

<u>The Water Framework Directive (WFD) (2000/60/EC)</u>

The Water Framework Directive (WFD) (2000/60/EC) (WFD) (as amended) establishes an integrated and coordinated framework for the sustainable management of water. Under the WFD[1], the island of Ireland has been divided into a number of River Basin Districts (RBD) in order to facilitate the effective implementation of the WFD objectives. The proposed project is within the Suir Catchment (ID:16).

The strategies and objectives of the WFD in Ireland have influenced a range of national legislation and regulations, since its inception in the year 2000. The WFD (1st Cycle) was transposed into national legislation in 2003, with the aim to:

- Prevent deterioration of status for surface and groundwaters and the protection, enhancement and restoration of all water bodies;
- Achieve good ecological status and good chemical status for surface waters and good chemical and good quantitative status for groundwaters;
- Progressively reduce pollution of priority substances and phase-out of priority hazardous substances in surface waters and prevention and limitation of input of pollutants in groundwater;
- Reverse any significant, upward trend of pollutants in groundwaters; and
- Achieve standards and objectives set for protected areas in Community legislation.

The objective for each surface water and groundwater body is to prevent deterioration, maintain high and good status waters, restore waters to at least good status where necessary, and ensure that the requirements of associated protected areas are met. The draft River Basin Management Plan for Ireland 2022 - 2027 (RBMP), the third-cycle of river basin management planning under the WFD, provides for the targeted implementation of the two principle objectives of the WFD, namely;

1. To prevent the deterioration of water bodies and to protect, enhance and restore them with the aim of achieving at least good status; and
2. To achieve compliance with the requirements for designated protected areas.

Five key 'evidence-based' priorities form the pillar of this iteration of the RBMP and are outlined as follows:

1. Ensure full compliance with relevant EU legislation;

[1] Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.

2. Prevent deterioration;
3. Meet the objectives for designated protected areas;
4. Protect high-status waters; and
5. Implement targeted actions and pilot schemes in focused sub-catchments aimed at:
    a) Targeting water bodies close to meeting their objective; and
    b) Addressing more complex issues that will build knowledge for the third cycle.

The assessment will determine the effect in accordance with the following regulations which give effect to the WFD:

- S.I No. 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended);
- S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Water Regulations) 2009 (as amended);
- S.I. No. 293 of 1988: Quality of Salmonid Water Regulations;
- European Communities Environmental Objectives (Freshwater Pearl Mussel Regulations) 2009 to 2018 (as amended); and
- Urban Waste Water Treatment Regulations (SI No. 254 of 2001 as amended) (UWW Regulations).

These Regulations have been devised to implement the requirements of the WFD and establish Environmental Quality Standards for the purpose of assessing the status of surface waters and groundwaters. The Surface Waters Regulations apply to all surface waters including lakes, rivers, canals, transitional waters, and coastal waters and supersede all previous water quality regulations.

<u>Water Framework Directive - Protected Areas:</u>

The WFD requires a register of protected areas. These are protected for their use (such as fisheries or drinking water) or because they have important habitat and/or species that directly depend on water. The register includes areas identified by the WFD itself or other European Directives. These may include:

- Areas used for water abstraction - European Union (Water Policy) (Abstractions Registration) Regulations 2018 (S.I. No. 261 of 2018);
- Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality (repealing Directive 76/160/EEC);
- Nutrient Sensitive Areas (Nitrates Directive 91/676/EEC;
- Wastewater Treatment Directive 91/271/EEC);
- Areas of protected species or habitats where water quality is an important factor in their protection (Natura 2000 sites under Conservation of wild birds 2009/147/EC and Habitats Directive 92/43/EEC); and
- Surface waters (The European Communities Environmental Objectives (Surface Waters) Regulations [S.I. No 272 of 2009], and amendment regulations 2012 [S.I. 327 of 2012]), 2015 (S.I. 386/2015), 2019 (S.I. 77/2019), 2021 (S.I.659/2021), 2022 (S.I.288/2022), and 2023 (S.I. 410/2023).

Potential impacts of the proposed project on Special Areas of Conservation (SAC) and Special Protection Areas (SPA) are addressed in Chapter 06 Biodiversity, Chapter 07 Ornithology of this EIAR and in the Natura Impact Statement (NIS) submitted with the planning application.

9.2.4.3 Relevant Guidance and Policy

The following guidelines and policies have been complied with to the extent that they are applicable for the preparation and assessment of effects from the proposed project on hydrology and geohydrology, including:

- The Planning System and Flood Risk Management, Guidelines for Planning Authorities (Department of the Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW);
- Review of legislation including the Water Framework Directive (WFD) and all previous water quality legislation along with the River Basin Management Plan (RBMP) for Ireland 2022 - 2027;
- Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors' (CIRIA 532, 2001);
- Environmental Protection Agency (2022): *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*;
- *Transport Infrastructure Ireland (previously National Road Authority) - Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (TII, 2009);*
- *Wind Farm Development Guidelines for Planning Authorities* (2006) and the draft revised guidelines (2019);
- *Irish Wind Energy Industry Best Practice Guidelines* (IWEA, 2012);
- Tipperary County Development Plan 2022-2028;
- *The Code of Best Forest Practice and the Forestry and Water Quality guidelines*[2];
- Coillte (2009): *Forest Operations & Water Protection Guidelines*;
- *Control of water pollution from linear construction projects. Technical guidance (C648) 234pp. CIRIA, UK (Murnane et al. 2006);*
- *Guidelines for the Crossing of Watercourses during the Construction of National Road Scheme*s (NRA, 2008);
- *Good Practice During Wind Farm Construction*. Scottish Renewables 2019;
- The *SuDS Manual (C753) - Construction Industry Research and Information Association* (CIRIA), 2015;
- Developments on Peat Land - *Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste'*. Scottish Renewables (2012);
- Guidelines on *Protection of Fisheries during Construction Works in and Adjacent to Waters* (IFI, 2016);
- CIRIA B14 *Design of Flood Storage Reservoirs* (Hall et al. 1993); and
- River Crossings and Migratory Fish: Design Guidance (Scottish Executive, 2012).

9.2.4.4 Surface Water Quality

The Quality Rating (Q) System is the standard biotic index which is used by the EPA. This system was developed to determine the status of organic pollution in Irish rivers by assessing the occurrence of macro-invertebrate taxa

[2] The Code of Best Forest Practice is a listing of all forestry operations and the manner in which they should be carried out to ensure the implementation of sustainable forest management in Ireland, as agreed at the Third Ministerial Conference on the Protection of Forests in Europe, Lisbon, 1998.

of varying sensitivity to pollution[3]. Biological Water Quality data was examined as part of this assessment (see Section 9.3.4.3). The Q-index is a quality measurement ranging from Q1 to Q5 with Q1 being of the poorest quality and Q5 being pristine/unpolluted. The Quality Rating System has been shown to be a robust and sensitive measure of riverine water quality and has been linked with both chemical status and land-use pressures in catchments. The system facilitates rapid and effective assessment of the water quality of rivers and streams. There are nine Q-value scores, ranging from 1 to 5 (including intermediate scores such as Q4–5). High ecological quality is indicated by Q5 or Q4–5, while Q1 indicates bad quality. Biological Water Quality data was examined as part of this assessment (See Section 9.3.4.3).

9.2.4.5 Groundwater Vulnerability

Groundwater vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. Groundwater vulnerability maps are based on the type and thicknesses of subsoils (sands, gravels, glacial tills (or boulder clays), peat, lake and alluvial silts and clays), and the presence of karst features. Groundwater is most at risk where the subsoils are absent or thin and, in areas of karstic limestone, where surface streams sink underground at swallow holes. All land area is assigned one of the following groundwater vulnerability categories, as presented in the GSI vulnerability mapping guidelines and outlined in Table 9-2 and Figure 9-20.

Table 9-2: Summary of Impact Assessment Process (Source GSI)

Vulnerability Mapping Guidelines					
Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High Permeability (sand/gravel)	Moderate Permeability (e.g. Sandy subsoil)	Low Permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	
Extreme (E)	0-3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	30m radius
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 – 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A
Notes: N/A = not applicable Precise permeability values cannot be given at present Release point of contaminants is assumed to be 1-2 m below ground surface.					

9.2.4.6 Sensitivity Impact Assessment and Significance

An impact rating has been developed with reference to '*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*' (NRA, 2005). This document deals with major infrastructure developments and the assessment guidance is therefore deemed appropriate to the current project.

The sensitivity of the receiving hydrological and hydrogeological environment was identified for the proposed project. The sensitivity of an environmental receptor is based on its ability to absorb an impact without perceptible change. Then, the magnitude of the potential hydrological impact was determined. The sensitivity rating, together with the magnitude of the potential impact, provides an overall rating of the significance of the effect prior to application of mitigation measures. The assessment of the magnitude of an effect incorporates the timing, scale,

[3] http://www.epa.ie/QValue/webusers/
https://gis.epa.ie/EPAMaps/

size and duration of the potential impact. The magnitude criteria for hydrological effects are defined as set out in Table 9-3.

Table 9-3: Assessment of Magnitude of Hydrological and Hydrogeological Impact (Adapted from NRA, 2005)

Magnitude	Criterion	Description and Example
Major	Loss of attribute	Long term changes to the geology, hydrology, water quality and hydrogeology, e.g., loss of EU-designated salmonid fishery: change in water quality status of river reach, loss of flood storage/increased flood risk, pollution of potable source of abstraction.
Moderate	Impact on integrity of attribute or loss of part of attribute	Short to medium term changes to the geology, hydrology, water quality and hydrogeology: loss in productivity of a fishery, contribution of significant sediment and nutrient quantities in the receiving water, but insufficient to change its water quality status.
Minor	Minor impact on attribute	Detectable but non-material and transitory changes to the geology, hydrology, water quality and hydrogeology - measurable change in attribute, but of limited size and/or proportion.
Negligible	Impact on attribute but of insufficient magnitude to affect the use/integrity	No perceptible changes to the geology, hydrology, water quality and hydrogeology: discharges to watercourse but no loss in quality, fishery productivity or biodiversity, no increase in flood risk.

Potential effects are assessed as being of major, moderate, minor or negligible significance as shown in Table 9-4.

Table 9-4: Significance of Criteria

Magnitude	Sensitivity					
	Very High	High	Medium	Low	Very Low	Negligible
Major (High)	Very Significant /Profound	Significant	Significant	Moderate	Slight	Slight
Moderate (Medium)	Significant	Significant	Moderate	Slight	Not Significant	Not significant
Minor (Low)	Moderate	Moderate	Slight	Slight	Not Significant	Imperceptible
Negligible	Slight	Not significant	Not significant	Not Significant	Imperceptible	Imperceptible

9.2.5 Statement of Limitations and Difficulties Encountered

No difficulties were encountered in the preparation of this assessment.

9.3 Existing Receiving Environment

9.3.1 Site Location and Project Context

9.3.1.1 Proposed Project Site

The proposed project area is located 3km north of Thurles Town in County Tipperary. The proposed windfarm and substation are located within or on the boundaries of the townlands of Brittas, Rossestown, Clobanna, Killeenleigh, Brownstown, and Kilkillahara (see Figure 2-3 in Chapter 02 Project Description). The proposed grid route to Thurles 110kV substation is located within or along the boundaries of the townlands of Killeenleigh, Coolgarrane, Clobanna, Athnid More, Rossestown, Cassestown, Farranreigh, Laghtagalla. Furze, Loughlahan and Ballygammane.

The proposed project area is approximately 331.98 hectares and is presently a greenfield site. Figure 9-3 for the site location and wind farm layout.

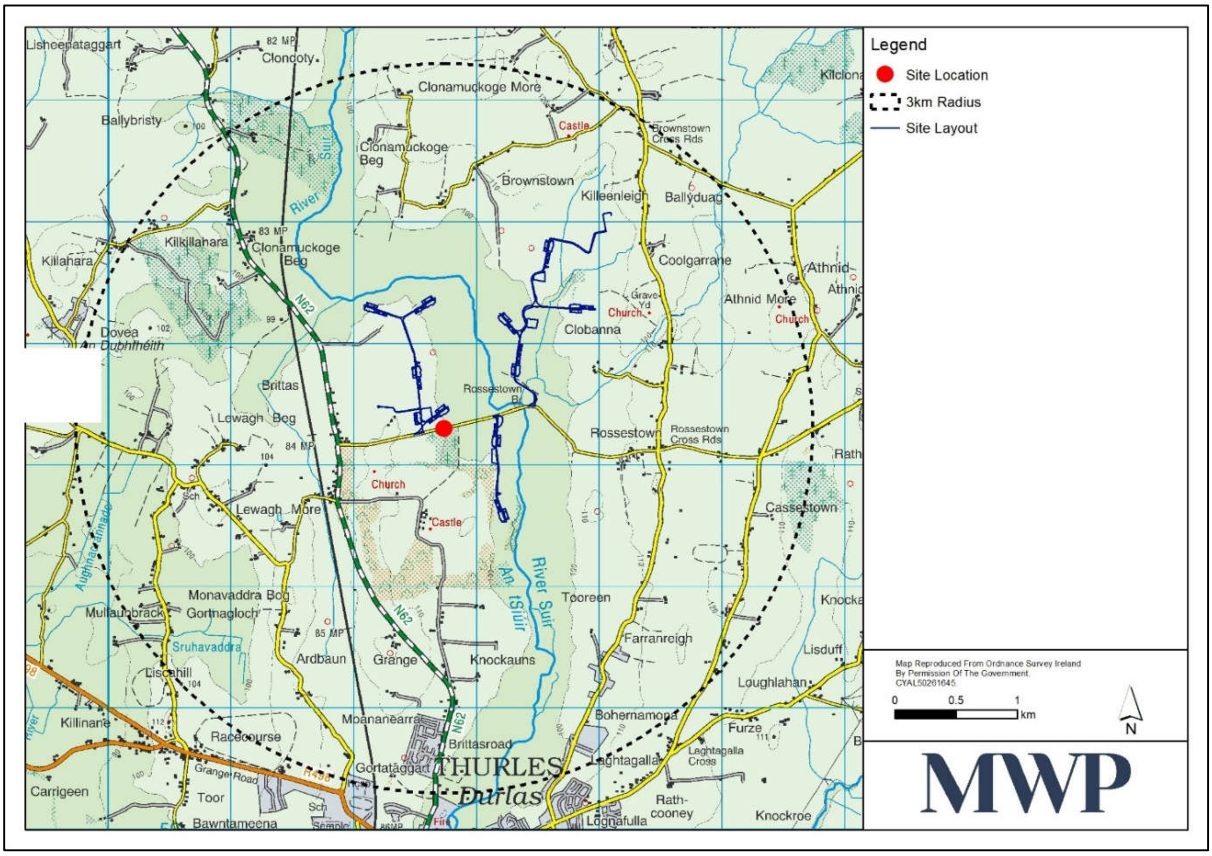


Figure 9-3: Site Location

The affected lands are made up of agricultural fields bounded by hedgerows and treelines. An area of broadleaf forestry is located at the southwest of the site. The River Suir transects the site from north to south. The N62 is located west of the site, running north to south, connecting Templemore to Thurles. The N62 provides a link to the M6, M7 and M8 motorways. The L8017 local road traverses the centre of site from east to west, crossing the River Suir at a bridge point.

Primary access to the proposed project site will be provided from the local public Rossestown road (L-8017). There will be four site entrances. Three of these are located along the Rossestown road (Figure 9-3) and will provide site access during the construction, operational and decommissioning phases. The most westerly of these three site entrances provides access to turbines 1, 2, 6 and 8 as well as the Lidar and the main construction site compound to the north of the L8012 public road.

The middle entrance provides access to the south to Turbines 9 and 10 and the borrow pit. The third eastern entrance provides access to turbines 3, 4, 5 and 7 as well as another construction compound and the substation and BESS. The fourth entrance (Figure 9-5) is to the substation only and will only be used for operation and maintenance access during the operational phase. This entrance is located along the section of the Rossestown road (L-4120) that goes northward on the eastern side of the River Suir.

Seven water crossings will be required at the Wind Farm site for the internal access roads and underground cables. Section 9.4.2.4 details the methods for these crossing and their location within the proposed project site.

Figure 9-4: Three construction Site Access Points (marked in yellow)

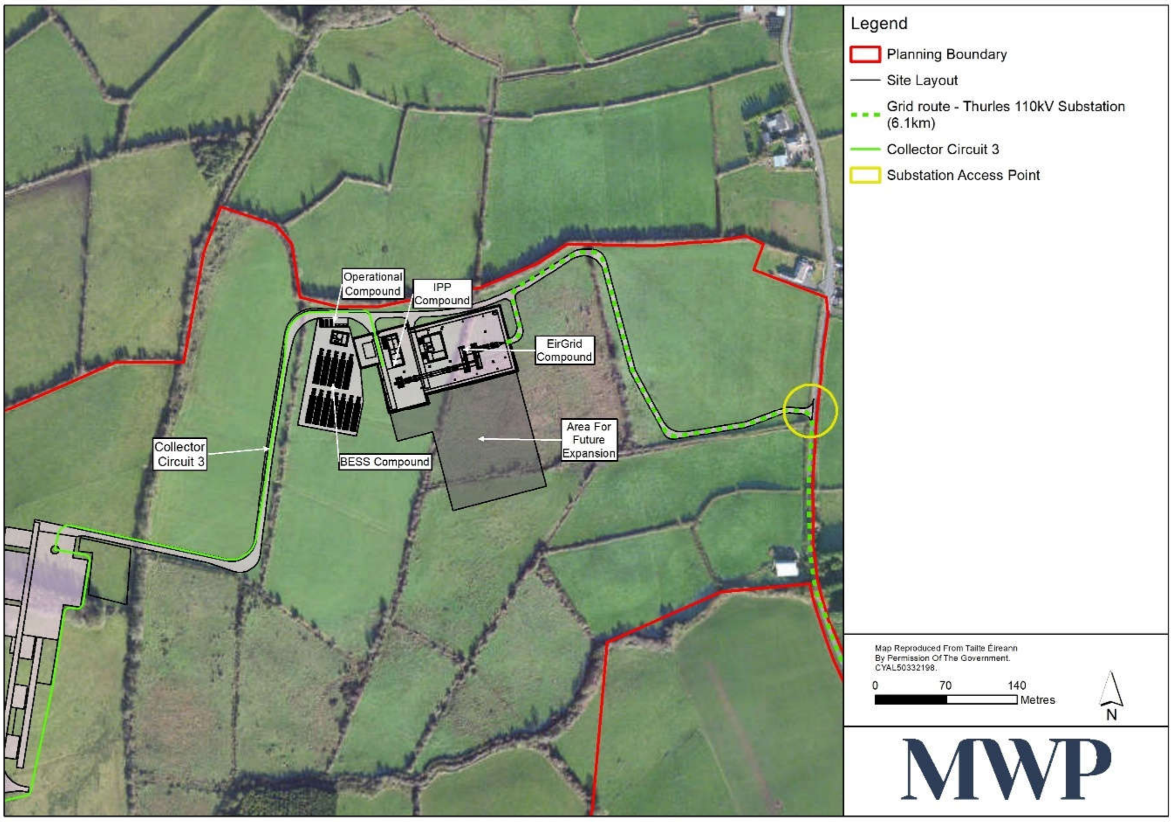


Figure 9-5: Access point for substation during the operational phase (marked in yellow)

9.3.1.2 Grid Route and Substation

The grid connection route and associated connection point for connecting the proposed Brittas Wind Farm to the National Grid has been assessed in the EIAR as shown in Figure 9-6. This will connect to the nearby existing Thurles 110kV substation located approximately 6.1km south-east of the proposed wind farm site.

The proposed grid connection route (Figure 9-6) begins at the Brittas WF boundary and heads southeast towards its destination at existing Thurles 110kv substation. It is roughly 7km in length within the public road. There is one water crossing in close proximity to Thurles 110kv substation and another over the Rossestown stream on the L-4120 road close to the proposed wind farm substation.

Figure 9-6: Grid Connection Route to Thurles Substation

9.3.2 Overview of the Proposed project

The development for which planning permission is sought in the planning application (the proposed project) is detailed in Chapter 02 Description of the Proposed project of this EIAR. Refer to Figure 2.4 in Chapter 02 Description of the Proposed project for the infrastructure layout of the proposed project.

9.3.3 Water Balance

The long-term average annual rainfall (AAR) and evaporation data was sourced from Met Eireann (www.met.ie). The closest station to the proposed project is at Kilkenny which is located approximately 50km to the east of the project. The 30-year average rainfall (1981-2010) recorded at Kilkenny is presented in Table 9-5.

Table 9-5: Average Long Term Rainfall Data

Month	Station: Kilkenny Operation from 1978-2007 (mm)
January	78
February	66
March	68
April	56
May	60
June	61
July	55

Month	Station: Kilkenny Operation from 1978-2007 (mm)
August	78
September	69
October	95
November	80
December	90
Total	857

The closest synoptic weather station where the average potential evapotranspiration (PE) is recorded by Met Eireann is located at Gurteen, Co Tipperary, approximately 40km southeast of the proposed project site. The average PE for between 2021 and 2023 at this station is 541mm/year (accessed from https://data.gov.ie/dataset/monthly-weather-gurteen). Note that the average used was for the past three years only as the long-term average is not available for this station. This value is used as a best estimate of the proposed project site PE. Actual Evaporation (AE) at the proposed project site is estimated as 514 mm/year (which is 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the study area is calculated as follows:

Effective rainfall (ER) = AAR – AE

= 857mm/year –514mm/year

ER = 343 mm/year

Recharge coefficient estimates from the GSI (www.gsi.ie) indicate a range of between 22.5(moderate permeability subsoil and overlain by poorly drained gley soil) – 60% (moderate permeability subsoil overlain by well-drained soil), an estimate of 41% recharge is taken for the proposed project site as an overall average.

Therefore, annual recharge and runoff rates for the study area are estimated to be 140.63mm/yr (0.41% X 343).

9.3.4 Local Hydrology

9.3.4.1 Surface Water Features

The proposed project site is located within Hydrometric Area No. 16, also known as the Suir catchment, within the sub catchments 16_22 (Suir_SC_010) and 16_21 (Suir_SC_040) (**Figure 9-7**). The project area falls within the following river sub basins:

- Suir_050; and
- Suir_060.

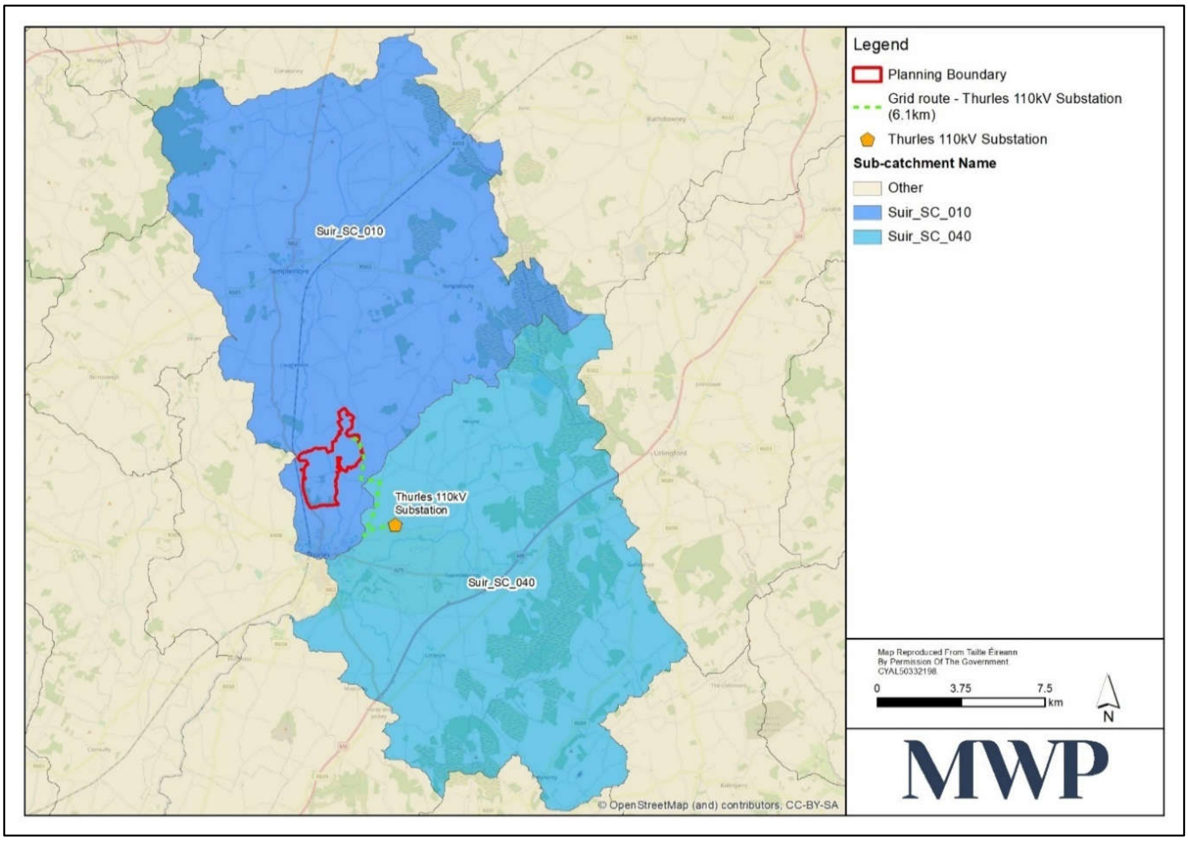


Figure 9-7: Sub-catchment locations

The River Suir (IE_SE_16S020500 and IE_SE_16S020600) flows in an easterly direction north of Turbine 1 and 2. The river then bends and flows in a southerly direction between Turbines 3, 6, 7 and 8. It continues in a southerly direction and flows to the east of Turbine 9 and 10.

The Rossestown Bridge Stream (IE_SE_16S020500) flows to the east of Turbine 4. The Athnid More Stream (IE_SE_16S020500) then confluences this stream to the north of Turbine 5 which flows in a southerly direction to the East of Turbine 3 and 7 before the confluence with the River Suir passing Turbine 9 and 10. The grid connection route crosses this stream over a single span arch stone bridge.

The Rossestown Stream (IE_SE_16R010300) flows to the east of the proposed project site and confluences with the Rossestown Bridge Stream. Refer to Figure 9-7 9-8 for the location of these streams in relation to the proposed project infrastructure.

The Farranreigh 16 Stream (IE_SE_16D020400) is located to the east of Thurles and is crossed by the grid connection over a single span arch bridge before connecting into the Thurles substation.

The River Suir is designated as a Natura 2000 site downstream of the proposed project site after Thurles. This protected area is named the Lower River Suir SAC (Site code 002137). Refer to Chapter 06 Biodiversity of this EIAR and the Natura Impact Statement (NIS) submitted with the planning application package for further details on these sites.

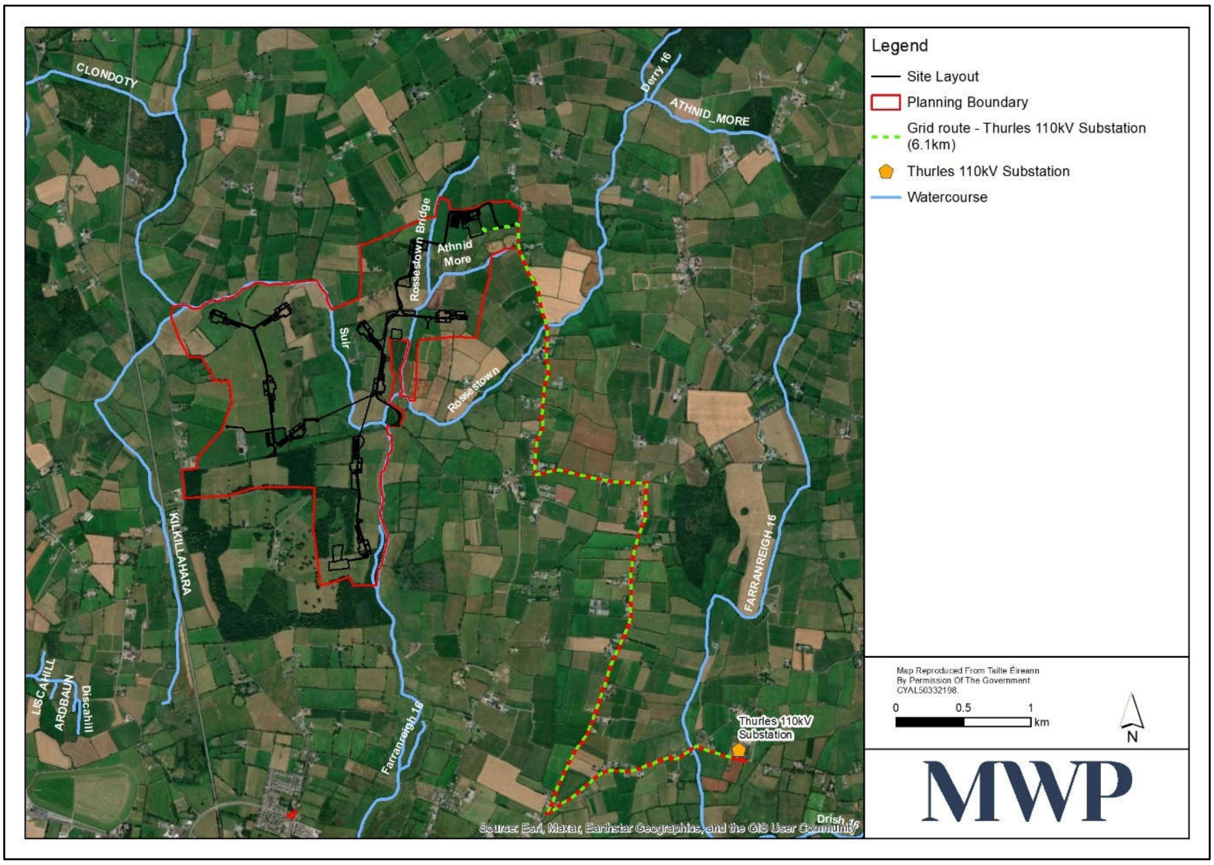


Figure 9-8: Surface Water Features

9.3.4.2 Drainage

The study area's overall topography is largely flat, with elevations ranging from 100m to 120m AoD. The centre and southern parts of the study area are low-lying regions incised by the Suir River, which flows into the site from the northwest. The ground levels drop by 5-10 m AoD along the river and slope up towards the embankment. The northern and eastern regions of site also consist of rivulets flowing into the study area from the northeast direction.

As the proposed project site is a greenfields site, there are no existing drainage systems onsite except for small-scale historic agricultural land drains (indicated on 6-inch historic mapping) that outfall into the streams that flow through the site.

9.3.4.3 Biological Water Quality

The EPA has the following monitoring stations on the Suir River that flows through the proposed project site:

- Penane Bridge (code: RS16S020300) – located approximately 7km upstream;
- Rossestown Bridge (code: RS16S020500) – located within the proposed project site (approximately 370m north east of Turbine 9); and
- Thurles Bridge (RS16S020600) – located approximately 3.8km downstream in the town of Thurles.

The Br u/s Suir R confluence station (code: RS16R010300) is situated on the Rossestown River to the east of the proposed project. Refer to **Figure 9-9** for the location of these monitoring stations.

The latest water quality data for each of these stations is shown in **Table 9-6.** From the data, it is evident that the Suir River (although 'Not at Risk' where it flows through the proposed project site) is 'At Risk' of not achieving the WFD objectives. Refer to **Figure 9-10** for the river waterbody risk.

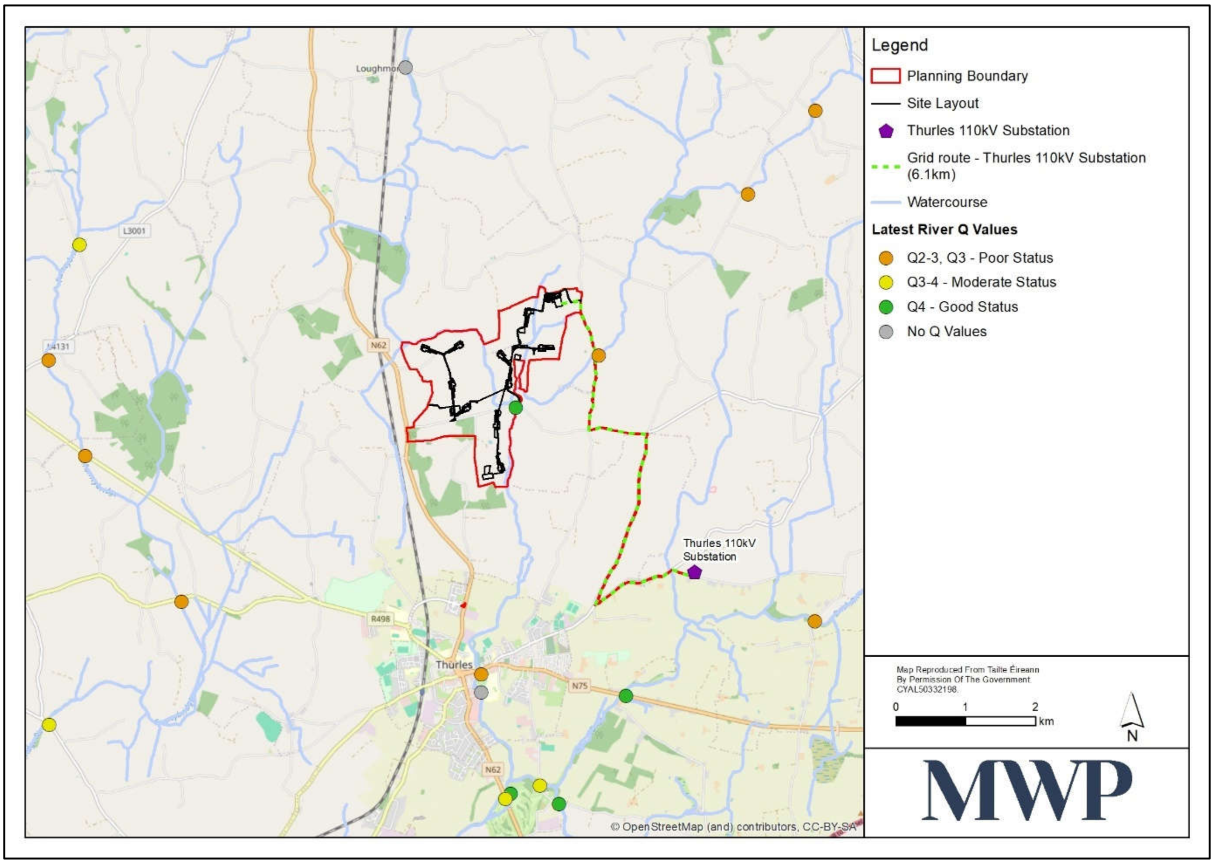


Figure 9-9: Latest River Q Value Map (Source EPA)

Table 9-6: River Water Quality at Relevant EPA Stations in proximity to the Proposed Project

River	Station Name/Location	Station ID	Q-rating	Corresponding WFD status*	Latest Rating (Year)	River Waterbodies Risk
River Suir (upstream)	Penane Bridge	RS16S020300	Q3-4	Moderate	2020	Review*
River Suir (at proposed project site)	Rossestown Bridge	RS16S020500	Q4	Good	2020	Not at Risk
River Suir (downstream)	Thurles Bridge	RS16S020600	Q3	Poor	2020	At Risk
Rossestown Stream	Br u/s Suir R confluence	RS16R010300	Q4	Poor	2020	At Risk
**Water bodies for Review are not considered to be At Risk but require further evidence that the objectives are being met, typically with ongoing monitoring and/or possibly modelling.*						

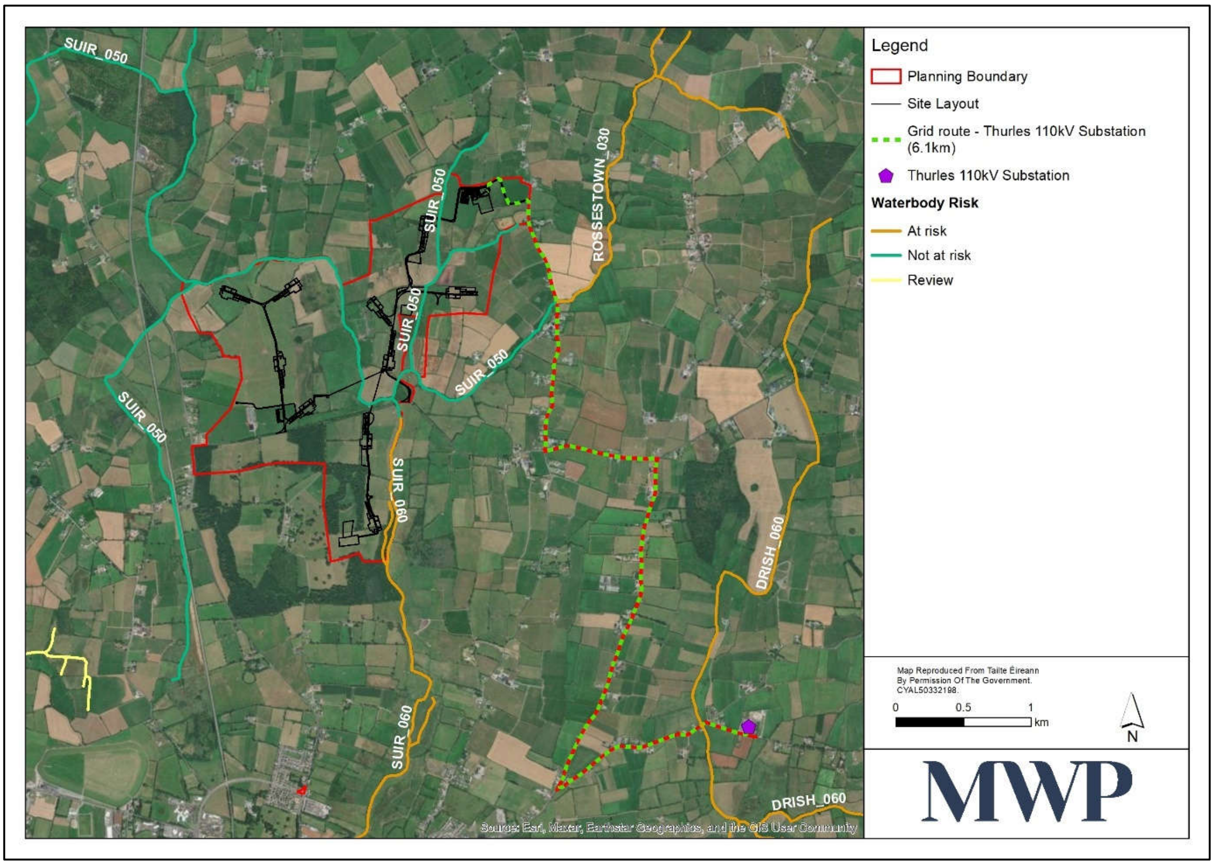


Figure 9-10: River Waterbody Risk (Source EPA)

9.3.4.4 Flood Risk Identification

A detailed Flood Risk Assessment (FRA) (submitted with the planning application)was undertaken by MWP. The full assessment is attached as Appendix 9A in Volume III of this EIAR.

The Stage 1 and 2 flood risk assessments indicated that there is potential for flooding at the proposed project site. The potential source of flooding was identified as fluvial flooding from the River Suir, and the Rossestown Stream and its tributaries. The assessment also found that the River Suir CFRAMS published flood extents indicate that this site may be vulnerable to flooding.

A Stage 3 detailed flood risk assessment was then carried out to provide a quantitative appraisal of potential flood risk to the site. The assessment required the construction of a hydraulic model of the River Suir and tributaries of the River Suir and the completion of a hydrological assessment of the catchments.

There are flow records available for the River Suir and Rossestown Stream. The Flood Studies Update (FSU) was selected as the most appropriate flood estimation method to calculate the flood flows for catchments with an area >5km². The IH124 flood estimation method was adopted for catchments that have an area <5km².

In order to predict the flood extents and flood levels at the site, a combined 1D-2D hydraulic model was created using HEC-RAS river modelling software. The model was used to create a flood zone map of the existing site which indicates the extent of Flood Zones A and B. Areas of the site outside of these Flood Zones are in Flood Zone C.

The hydraulic model was used to establish the design flood levels at the site for the 1% AEP and 0.1% AEP flows and these were used to produce a flood zone map for the site and surrounding floodplains. The Flood Zone Map, which indicates the extent of Flood Zones A and B is shown on Figure 9-11 to Figure 9-15. The turbine locations are in all three flood zones as defined in the Flood Risk Management Guidelines. As can be seen in Figure 9-11 the proposed sub-station is located within Flood Zone C. The majority of the turbines are located outside of Flood Zone A and Flood Zone B, therefore placing the turbines in Flood Zone C.

The hardstand associated with Turbine 4 is shown to be within Flood Zone A. However, the depth of flooding at the hardstand for Turbine 4 is negligible. The zoning of each of the turbines is summarised in Table 9-7

Table 9-7: Flood Zoning

Turbine	Flood Zone
Turbine 1	B
Turbine 2	B
Turbine 3	B
Turbine 4	A
Turbine 5	C
Turbine 6	C
Turbine 7	B
Turbine 8	C
Turbine 9	C
Turbine 10	C

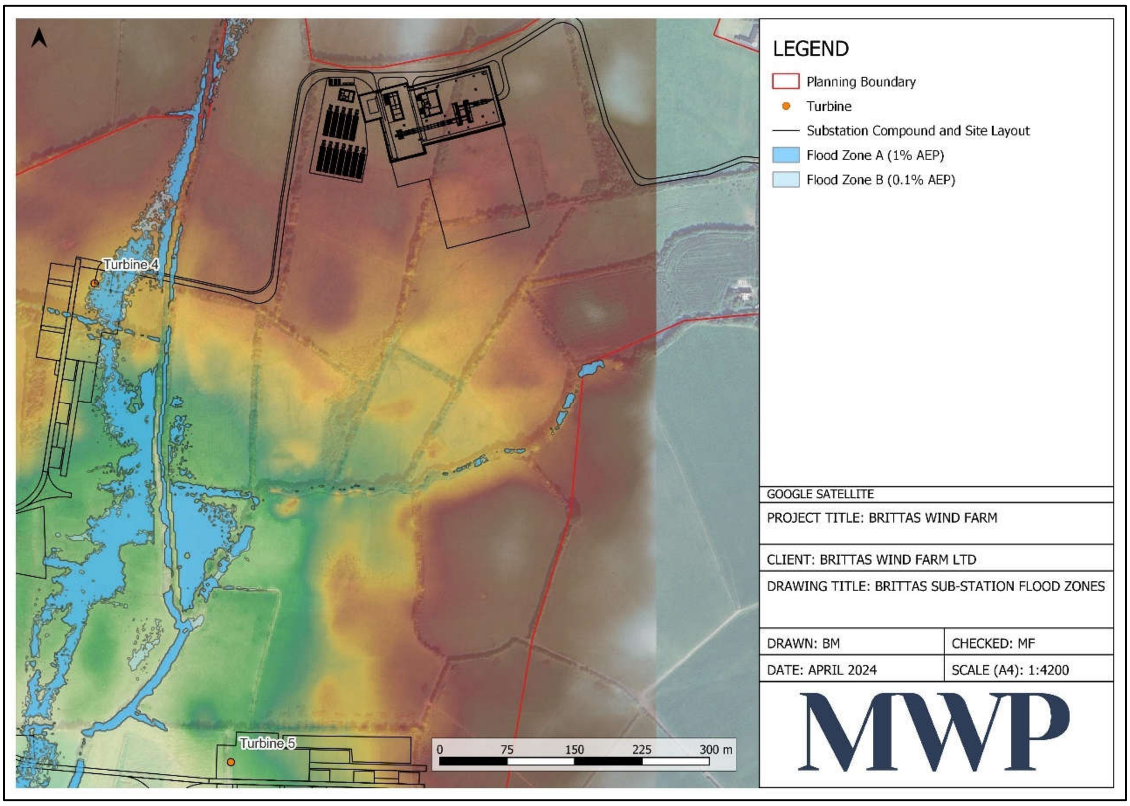


Figure 9-11: Brittas Sub-station Flood Zones – Existing Scenario

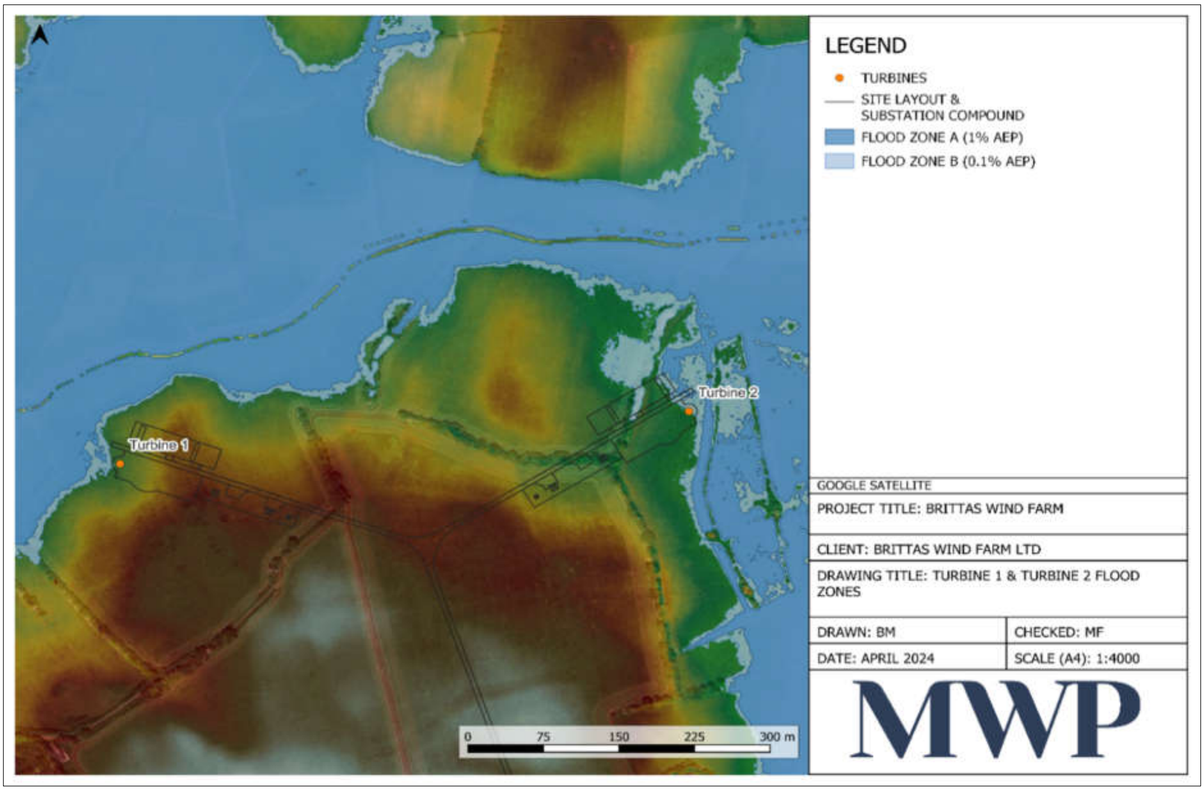


Figure 9-12: Turbine 1 and 2 Flood Zones – Existing Scenario

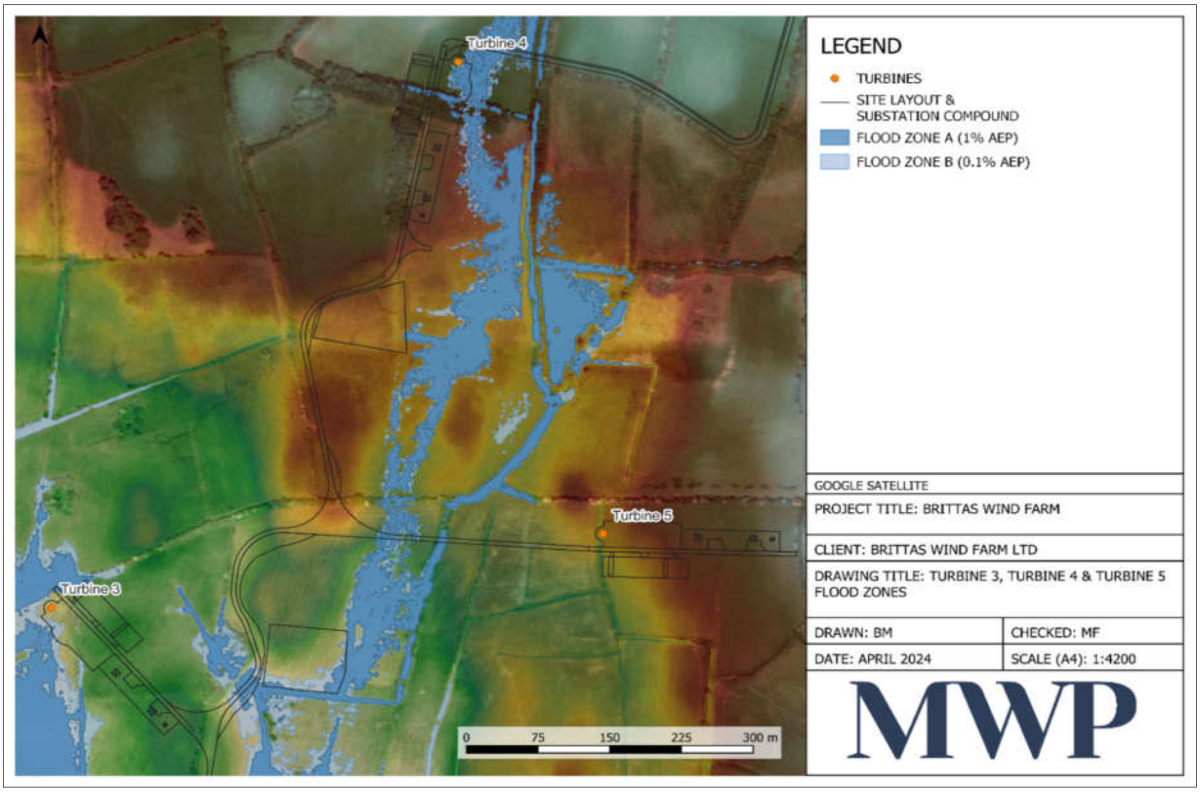


Figure 9-13: Turbine 3, 4 and 5 Flood Zones – Existing Scenario

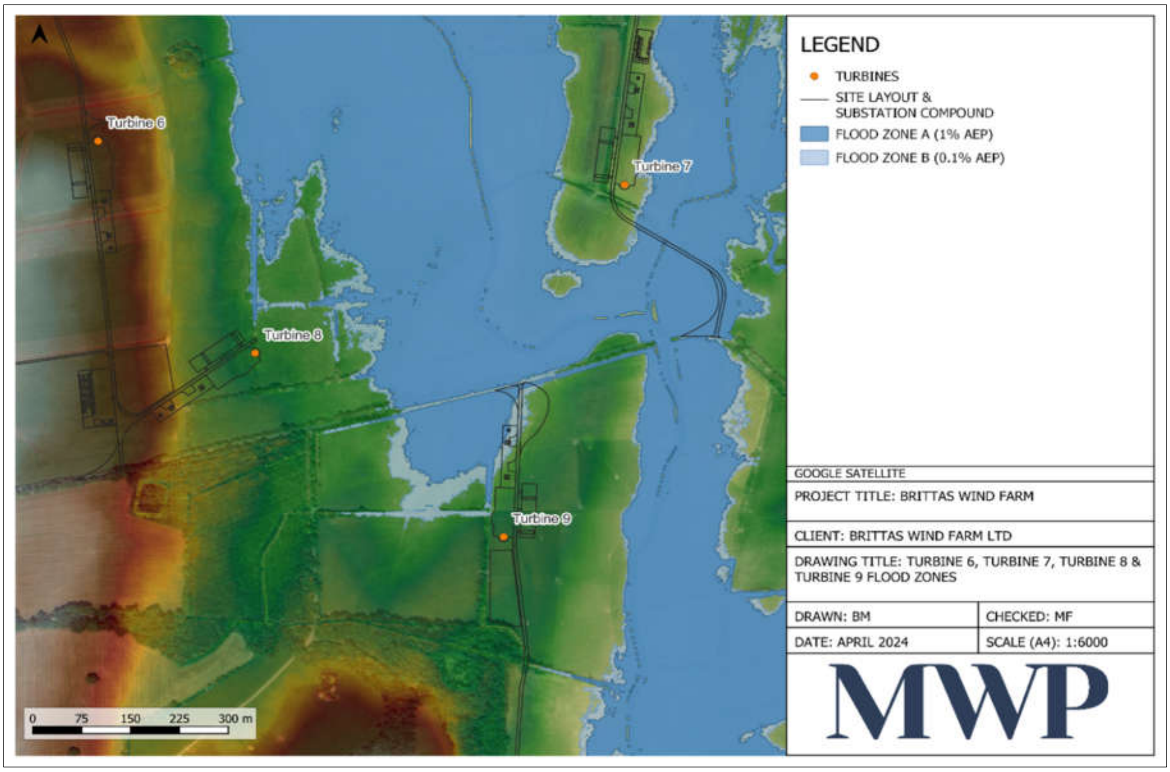


Figure 9-14: Turbine 6, 7, 8, and 9 Flood Zones – Existing Scenario

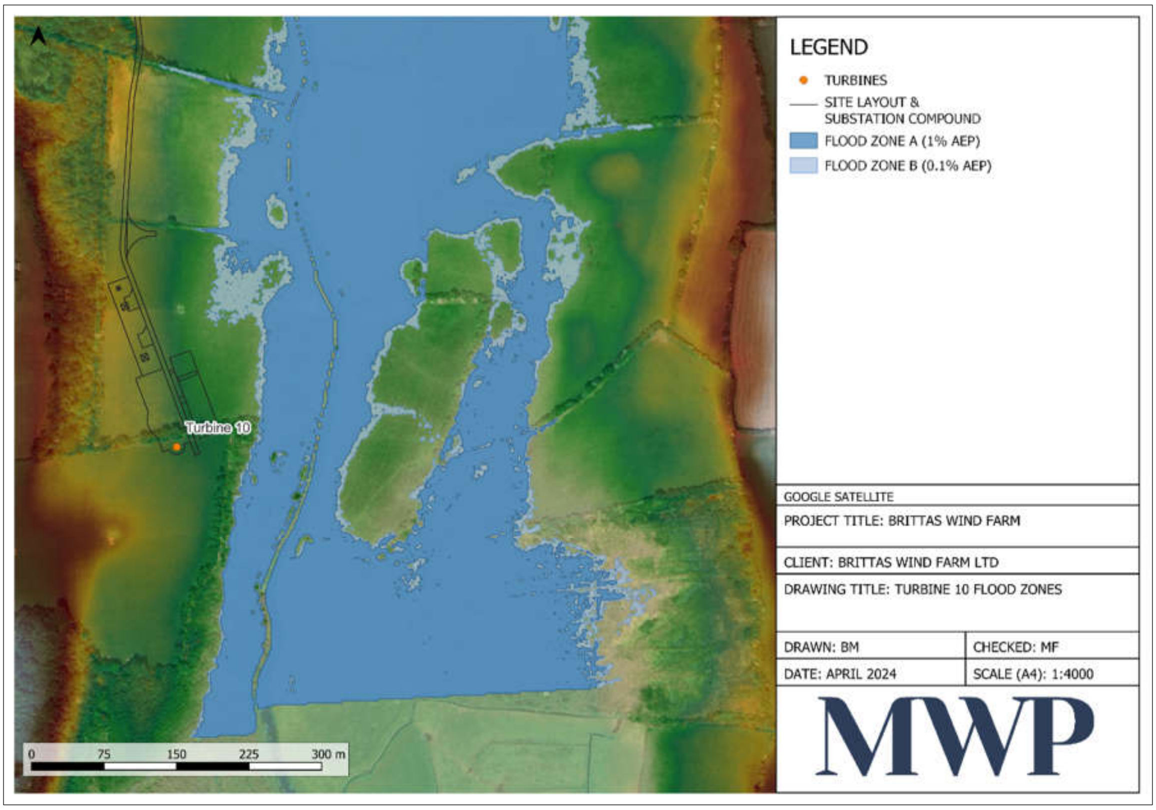


Figure 9-15: Turbine 10 Flood Zones – Existing Scenario

9.3.5 Local Hydrogeology

9.3.5.1 Groundwater Body

Groundwater bodies are subdivisions of large geographical areas of aquifers so that they can be effectively managed in order to protect the groundwater and linked surface waters. The proposed project site and grid connection route are situated within the groundwater bodies (GWB) detailed in Table 9-8 as provided by the EPA mapping tool. The location of these GWBs in relation to the proposed project are illustrated in Figure 9-16.

Table 9-8: Groundwater Bodies Related to the Proposed project

GWB Name	European Code	Description	Project related Infrastructure
Templemore	IE_SE_G_131	Poorly productive bedrock	Turbines and related infrastructure Portion of the grid connection (Thurles)
Thurles	IE_SE_G_158	Karstic	Portion of the grid connection (Thurles)

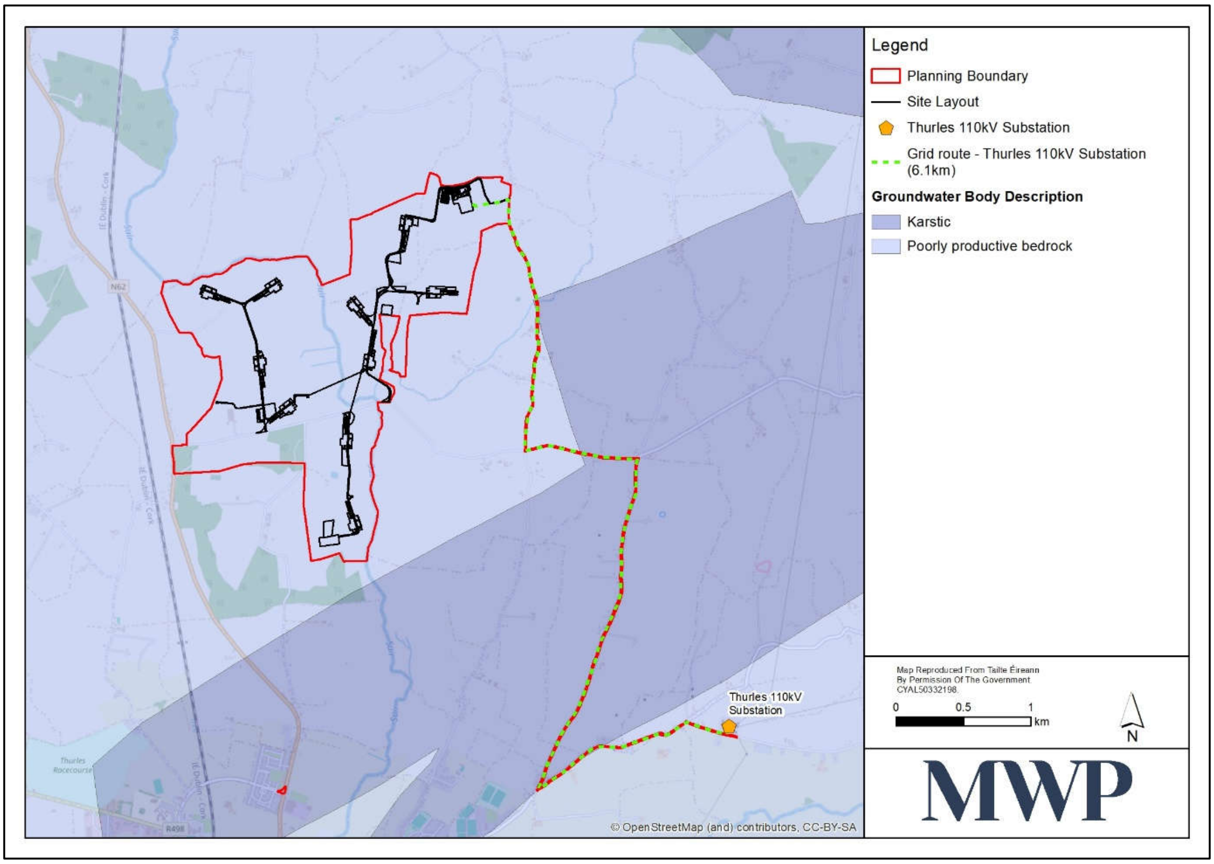


Figure 9-16: Groundwater Bodies

The Templemore GWB extends from Templemore towards Tipperary in Co. Tipperary. The area is very low lying with the River Suir meandering through a wide valley between Templemore and Cashel. The aquifer is comprised mainly of Dinantian Upper and Lower Impure Limestones. Permeability varies throughout the formation although estimate bulk values of permeability are taken as 10m/d at Templemore, 30m/d at Borrisoleigh and 15m/d at Twomileborris. The permeability in these aquifers depends on the development of faults, fissures and fractures, as indicated by pumping tests and site investigations, in addition to regional experience.

The Thurles GWB is located northeast of Thurles. The area is exceptionally flat, but with very few rivers. The boundary between the South Eastern River Basin District (SERBD) and Eastern River Basin District (ERBD) is located at the eastern extremity of this groundwater body. Limestone-derived tills are the dominant till type in this area. Limestone tills vary from light-brown/grey to dark brown/black in colour, depending on the parent material and the weathering processes that have occurred. Subsoil thickness in the area of this groundwater body is generally greater than 3 metres but with some isolated areas where rock is close to the surface. Areas of deeper subsoil thickness could possibly relate to subsoil in filling of faulted gullies that would have high bedrock permeability. (Motherway 2002). Groundwater flow in this aquifer is likely to be from northeast to southwest (GSI, 2024).

9.3.5.2 Aquifer Classification

An aquifer is defined as a geological formation that is capable of yielding quantities of water. While most rock types are aquifers, their supply varies. Geological strata are categorised for hydrogeological purposes as:

- Major Aquifers (Regionally Important):
- Minor Aquifers (Locally Important): or
- Unproductive Rocks (Poor Aquifers/Aquitards).

The majority of the proposed project site and grid connection are situated within an aquifer that is described by Geological Survey Ireland (GSI) as a Locally Important Bedrock Aquifer, which is Moderately Productive only in Local Zones (Category Ll) (**Figure 9-17**). Parts of the grid connection route to Thurles is situated within an aquifer which is described as a Regionally Important Aquifer, which comprises of bedrock which is Karstified (diffuse) (Category Rkd) and a locally important aquifer with bedrock that is generally moderately productive (Category Lm).

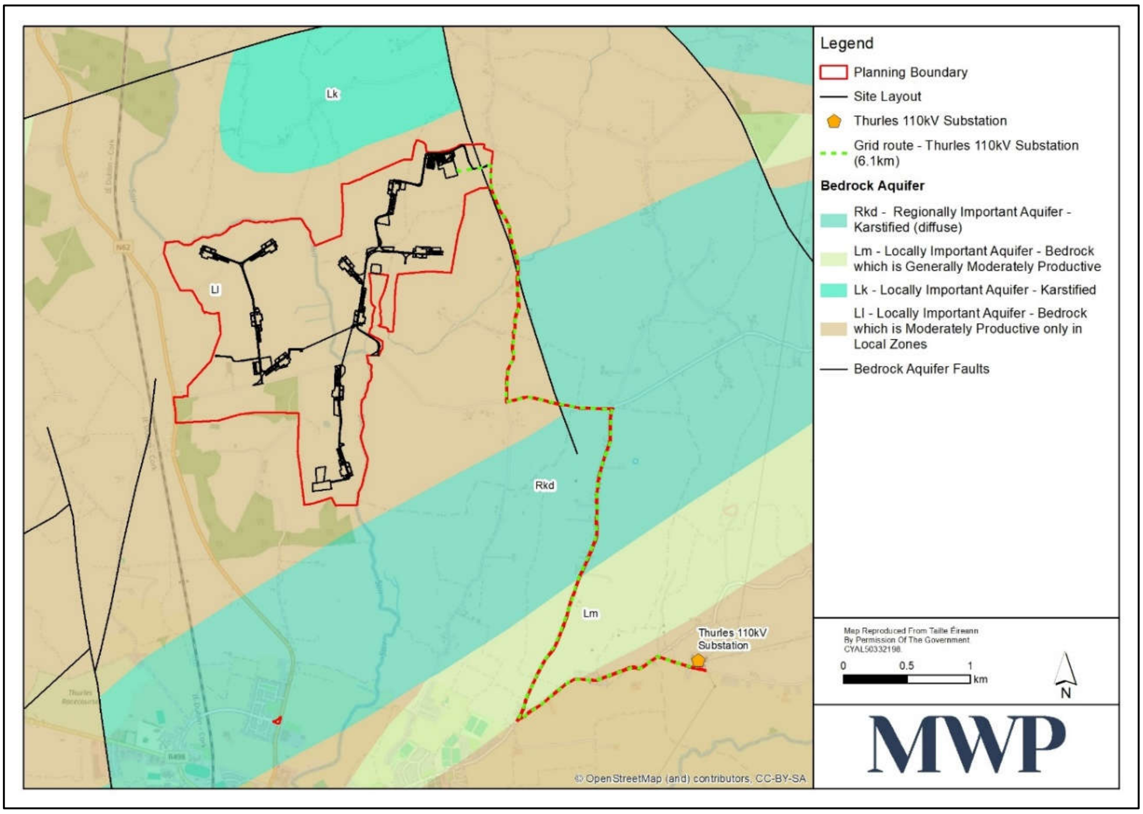


Figure 9-17: Groundwater Resources (Aquifer) Map

9.3.5.3 Abstraction (Wells and Springs)

The GSI database lists sixteen boreholes and one dug well in proximity to the proposed project site. The current use of most (10) of these boreholes is unknown with the remainder for agricultural and domestic use (Table 9-9and Figure 9-18). The Yield Class ranges between poor and moderate for these boreholes with some of them having an unknown yield class.

The current turbine locations are not located within any Groundwater Group Schemes or Public Supply Source Protection Area. The closest turbine to a Group Scheme is approximately 500m.

Table 9-9: Groundwater Wells and Springs

GSI Name	Well Type	Drill Date	Depth (m)	Source Use	Yield Class	Yield m3/d	Easting	Northing
2015NWW142 Original Name: Group Schemes 1979	Borehole	29/12/1899	396.2	Unknown	Failure	-	212450	162040
2015NWW095	Borehole	18/09/1974	26.8	Unknown	Poor	32.7	212450	162240
2015NWW110	Borehole	13/06/1970	26.8	Unknown	Moderate	70.9	212450	162150
2015NWW084	Borehole	02/07/1974	37.2	Unknown	Poor	38.2	212430	164400
2015NWW085	Borehole	02/09/1974	28	Unknown	Moderate	45.8	212420	164330
2015NWW083	Dug Well	29/12/1899	6.7	Unknown	Unknown	Unknown	212430	164450
2015NWW094	Borehole	03/08/1973	21.9	Unknown	Moderate	98.2	213400	164300
2015NWW119	Borehole	01/08/1998	45.7	Agri& Domestic	Moderate	43.6	213000	164440
2015NWW158	Borehole	29/12/1899	Unknown	Agri& Domestic	Unknown	Unknown	214570	164590
2015NWW093	Borehole	24/09/1973	28	Unknown	Moderate	43.6	214700	164380
2015NWW112	Borehole	12/05/2000	76.2	Agri& Domestic	Moderate	43.6	214680	163760
2015NWW151	Borehole	29/12/1899	18.3	Group Scheme	Moderate	54.5	214270	162490
2015NEW265	Borehole	29/12/1899	152.4	Agri& Domestic	Unknown	Unknown	215280	161860
2015NEW224	Borehole	04/01/1974	29.8	Unknown	Moderate	41.5	215240	161010
2015NEW225	Borehole	01/08/1960	26.8	Unknown	Unknown	Unknown	215250	160970
2015SEW226	Borehole	29/12/1899	56.4	Agri& Domestic	Unknown	Unknown	215230	159910
2015NEW277	Borehole	29/12/1899	39.6	Agri& Domestic	Moderate	54.5	215700	160200
2015NEW272	Borehole	29/121899	Unknown	Agri& Domestic	Unknown	Unknown	215790	160120

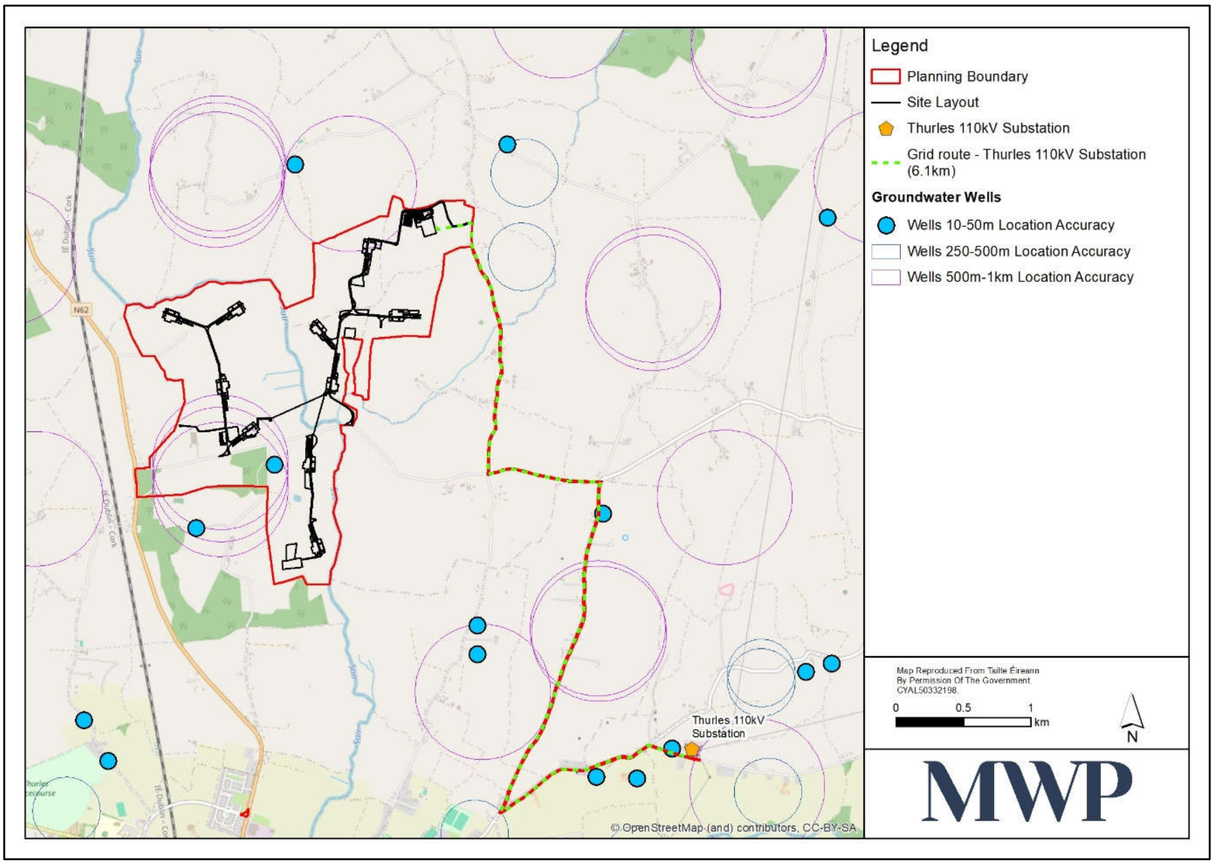


Figure 9-18: Groundwater Wells and Springs

9.3.5.4 Groundwater Vulnerability and Risk

The Water Framework Directive (WFD)requires 'Good Water Status' for all European water by 2015, to be achieved through a system of river basin management planning and extensive monitoring. 'Good status' means both' Good Ecological Status' and 'Good Chemical Status'.

The Groundwater Body underlying the site is the Templemore and Thurles Groundwater Body's (GWB). Currently, the EPA classifies the Templemore GWB as having WFD Status (2016-2021) of 'Good', with a current WFD risk score of 'At risk'. The Thurles GWB has a WFD Status (2016-2021) of 'Good', with a current WFD risk score of 'Not at risk'Figure 9-19 below presents the most recent data from the EPA website on groundwater body risk.

Groundwater vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. Mapping provided by the GSI indicates that the majority of the site is underlain by aquifer of moderate to high vulnerability. Refer to Figure 9-20, for groundwater vulnerability mapping beneath the site and within the greater area.

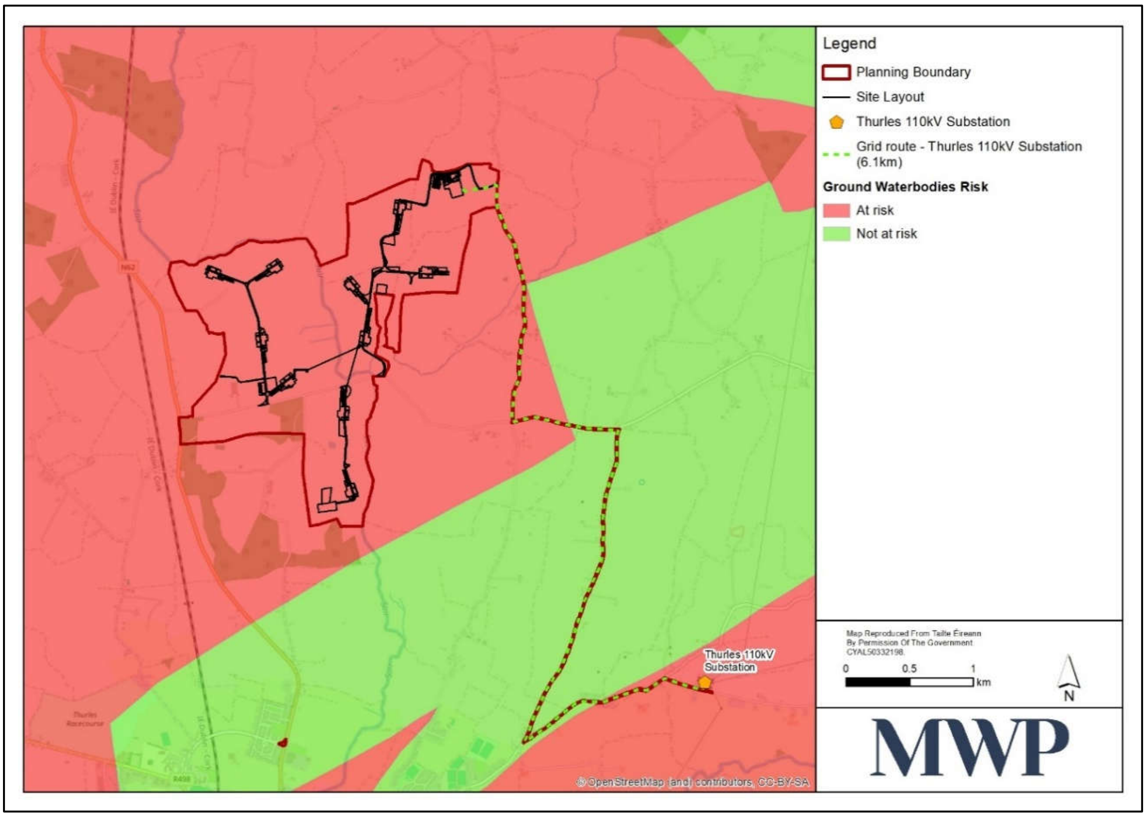


Figure 9-19: EPA Groundwater Body Risk

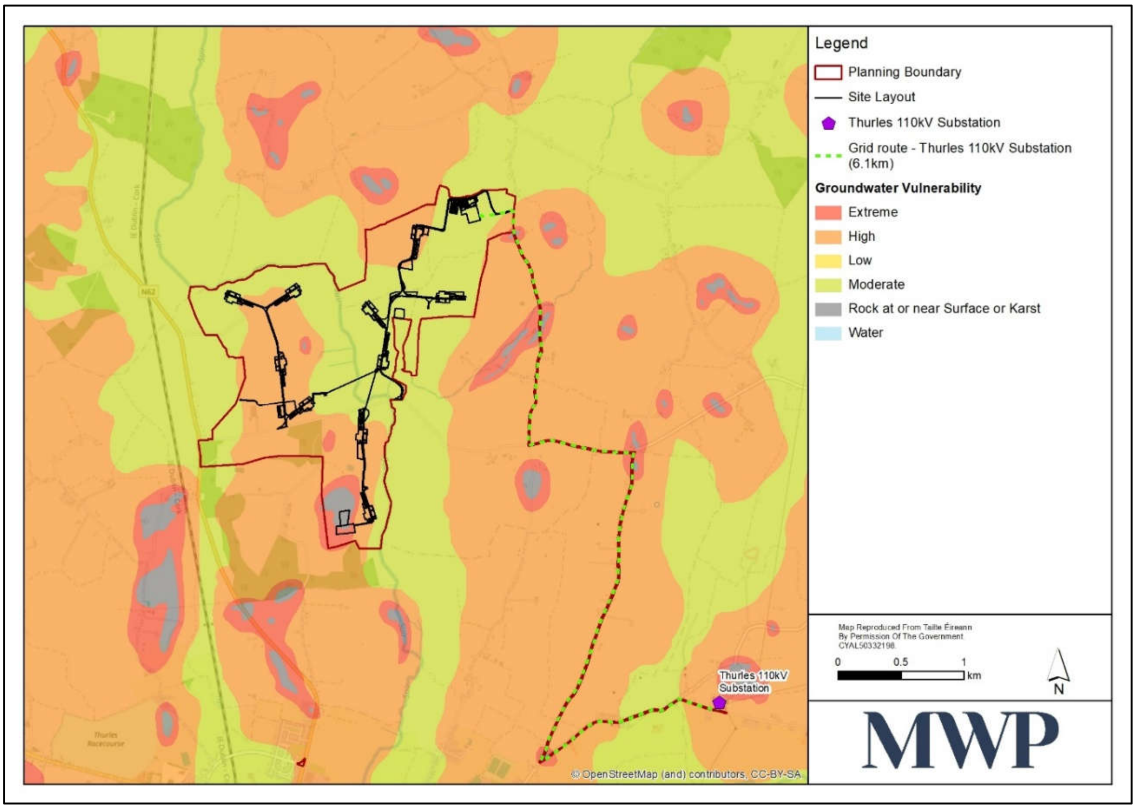


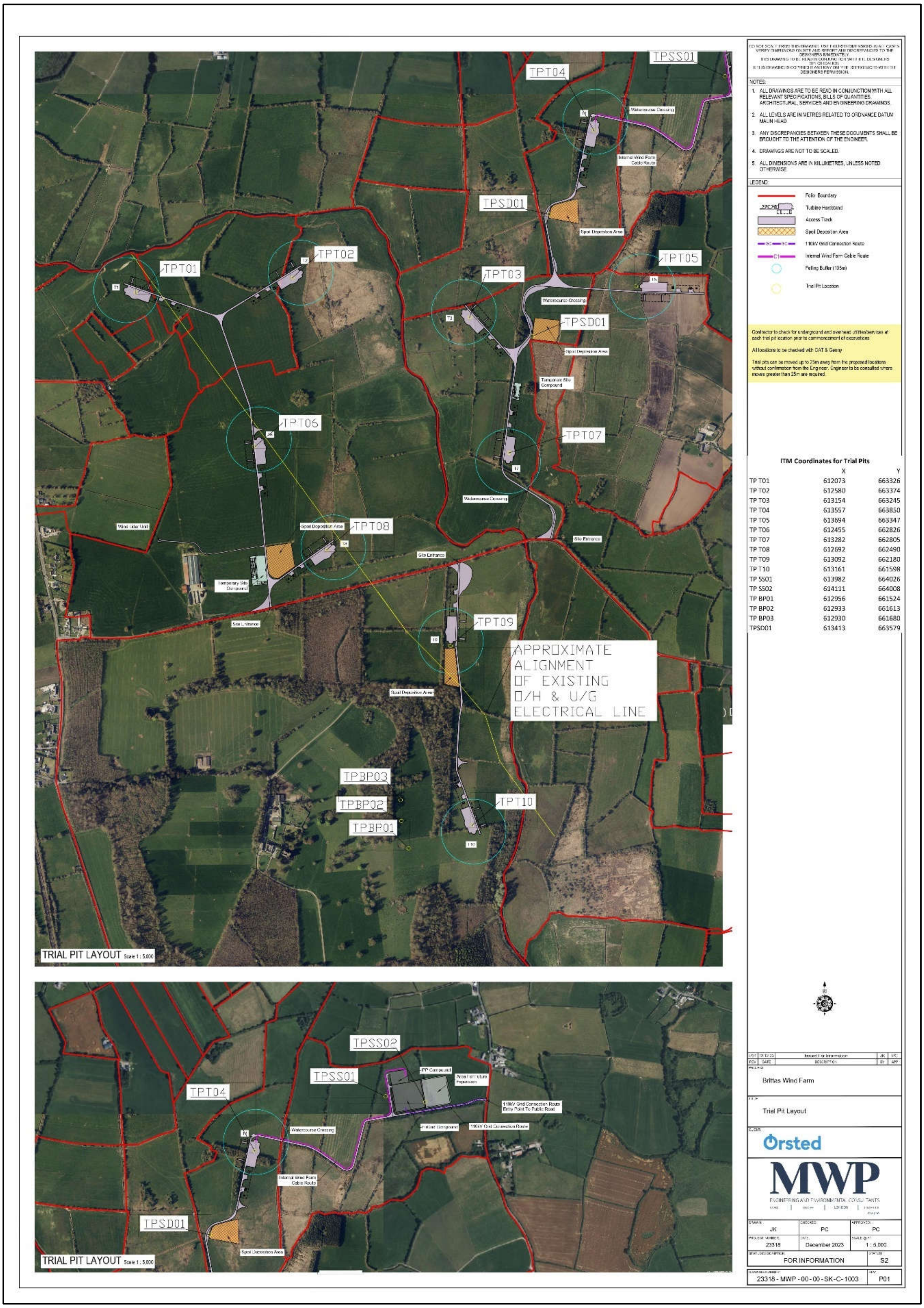
Figure 9-20: Groundwater Vulnerability Classification

Groundwater was encountered during the excavation of several trial pits during site investigations carried out by Northwest Geotech in 2024. The water strike depth for the applicable trial pits is provided in Table 9-10 and the location of the trial pits is presented in Figure 9-21.

Table 9-10: Water Strike Depth in Trial Pits

Trial Pit Reference	Water Strike Depth
TPSD01	3.20
TPSS01	2.20
TPSS02	3.00
TPT03	3.80
TPT04	2.30
TPT05	3.50

MWP



ITM Coordinates for Trial Pits

	X	Y
TP T01	612073	663326
TP T02	612580	663374
TP T03	613154	663245
TP T04	613557	663850
TP T05	613694	663347
TP T06	612455	662826
TP T07	613282	662805
TP T08	612692	662490
TP T09	613092	662180
TP T10	613161	661598
TP SS01	613982	664026
TP SS02	614111	664008
TP BP01	612956	661524
TP BP02	612933	661613
TP BP03	612930	661680
TPSD01	613413	663579

Figure 9-21: Trial Pit Locations

9.3.6 Designated Sites and Habitats

Within the Republic of Ireland, designated sites include:

- Natural Heritage Areas (NHAs);
- Proposed Natural Heritage Areas (pNHAs);
- Candidate Special Areas of Conservation (cSAC);
- Special Areas of Conservation (SAC); and
- Special Protection Areas (SPAs).

Local designated sites in the area and downstream of the proposed project site are shown on Figure 9-22 Surface waterbodies draining the proposed project eventually flow into the Lower River Suir SAC (Site Code: 002137) south of Thurles. At its closest point this designated site is located approximately 5.5km downstream of the proposed project site and is hydrologically connected with the site via the River Suir.

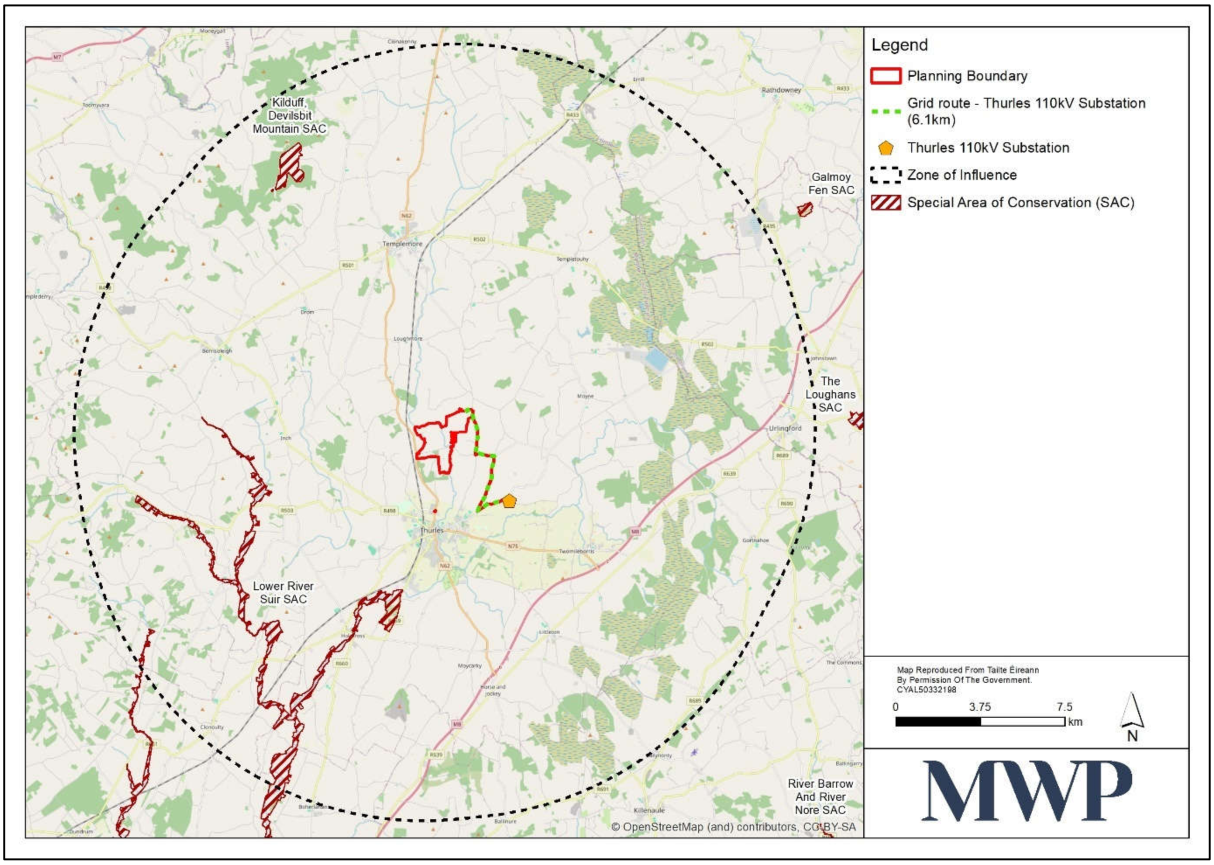


Figure 9-22: Designated Sites

9.3.7 Receptor Sensitivity

Due to the nature of the proposed project and the near surface construction activities, likely significant effects on groundwater are generally negligible.

The primary risk to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages. These are common potential impacts on all construction sites.

Groundwater along the majority of the proposed project can be classed as having a medium sensitivity to pollution, as permeabilities in the upper few metres of the bedrock are often high, and in places within the proposed project, bedrock is classified as a Locally Important Aquifer. Along the proposed grid connection route, the underlying bedrock is classified as a Regionally Important Aquifer. The ground water along the section of the grid route within the Thurles GWB can also be classed as having a medium sensitivity, as there may be areas where the bedrock is karstified. In general, it is likely that any contaminants which may be accidently released during the construction works are more likely to travel to nearby streams within surface runoff. Surface waters such as the River Suir, Rossestown Bridge Stream, Rossestown Stream, and associated tributaries have a high sensitivity to potential contamination.

The designated site that is mapped within close proximity of and hydraulically connected (surface water flow paths only) to the proposed project is the Lower River Suir SAC. This designated site can be considered to have a very high sensitivity in terms of potential impacts.

Comprehensive surface water mitigation and controls are outlined in Section 9.5 to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff, specifically during the construction phase will be of high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the proposed project site.

9.4 Likely Significant Effects

This section addresses the potential impacts on the hydrological environment from activities arising during construction, operation and decommissioning of the proposed project and makes a determination on the likelihood of occurrence. The project has incorporated some elements of mitigation into the construction and operational design of the project. Assessments are therefore based on mitigation being implemented.

9.4.1 Do-Nothing

If the proposed wind energy development for which this document has been prepared does not go ahead, it is assumed that the land use will remain unchanged without the construction of the wind farm. Agricultural practices will remain the same. There will be no alteration of the existing hydrological or hydrogeological regime.

9.4.2 Mitigation incorporated into the Design of the Project

This section details the proposed mitigation measures that have been developed through the design of the proposed project (mitigation through design) to protect water resources. The design of the project has been outlined in detail in Chapter 02 Description of the Proposed Project and Chapter 03 Civil Engineering of this EIAR and repeated in this chapter.

Sediment such as clay or silt can cause pollution during the construction phase of a civil engineering project due to the erosion of exposed soil by surface water runoff. The wind farm has been designed in order to control erosion and prevent sediment runoff during the construction phase. The implementation of sediment and erosion control measures is essential in preventing sediment pollution and impacting on water resources. The system was designed having regard to:

- Knowledge of the site's environmental conditions;
- Previous experience of environmental constraints and issues from construction of wind farms in similar environmental conditions;

- Technical guidance and best management practice manuals (see further details in Chapter 03 Civil Engineering and Section 9.2.4).

The settlement ponds and check dams described in the following sections provide the essential mechanism for the removal of silt from construction related runoff and the controlled return of the treated runoff to the downstream watercourses. The drainage and treatment system will ensure that the construction and early post-construction phases of the proposed wind farm will not create adverse effects on the aquatic environment.

9.4.2.1 Site Drainage Design Principles

The site drainage system was designed integrally with the proposed wind farm infrastructure layout as a measure to ensure that the proposal will:

- Not change the existing flow regime across the site;
- Not deteriorate water quality; and
- Safeguard existing water quality status of the catchments from sediment runoff.

The design allows for site specific measures to manage water on site and it will be constructed specifically for the site to attenuate run-off, guard against soil erosion and safeguard downstream water quality. The drainage system will be implemented along all work areas including all internal site access tracks, storage areas, crane hardstand areas and temporary site construction compounds. Refer to Chapter 03 Civil Engineering of this EIAR for further details.

A fundamental principle of the drainage design is that clean water flowing in the upstream catchment, including overland flow and flow in existing drains, is allowed to bypass the works areas without being contaminated by silt from the works. This will be achieved by intercepting the clean water and conveying it to the downstream side of the works areas either by piping it or diverting it by means of new drains or earth mounds.

This process will cause the normally dispersed flow to be concentrated at specific discharge points downstream of the works. To disperse this flow, each clean water drain will be terminated in a discharge channel running parallel to the ground contours that will function as a weir to disperse the flow over a wider area of vegetation. An alternative method is to allow the water to discharge through perforated pipes running parallel to the ground contours. Both methods will prevent erosion of the ground surface and will attenuate the flow rate to the downstream receiving waters. The specific drainage measures to be used at each location are shown on the drainage layout, Planning Drawing 23318-MWP-00-00-DR-C-5025 to 5033 included with the planning application.

The clean water interceptor drains, or earth mounds will all be positioned upslope to prevent any mixing of the clean and dirty water. The outflow from these drains is then piped under the road at suitable intervals and at low points depending on the site topography.

Separating the clean and dirty water will minimise the volume of water requiring treatment on site. The dirty water from the works areas will be collected in a separate drainage system and treated by removing the suspended solids before overland dispersal. Dirty water drains will be provided on one or both sides of the access tracks and along the periphery of the turbines, crane hardstands, substation compound, met lidar, borrow pit and the temporary site construction compounds.

The treatment system will consist of a series of settlement ponds at designated locations throughout the site (refer to Section 9.4.2.10 of Chapter 03 Civil Engineering of this EIAR for further details). The outflow from the treatment system will be dispersed over vegetation in the same manner as the clean water dispersion and will become diluted through contact with the clean water runoff in the buffer areas before eventually entering the downstream watercourses.

The clean water interceptor drains, or earth mounds are all positioned upslope to prevent any mixing of the clean and dirty water. The outflow from these drains is then piped under the road at suitable intervals and at low points depending on the site topography. In the illustration 'dirty water' drains collect all incident rainwater that falls on the infrastructure. This water then drains to settlement ponds for removal of sediment before it is discharged via overland dispersal to the downstream watercourse.

The site drainage layout is presented in Planning Drawings 23318-MWP-00-00-DR-C-5025 with drainage details presented in Planning Drawings 23318-MWP-00-00-DR-C-5026 to 23318-MWP-00-00-DR-C-5033. The drainage layout is overlaid on background OSI mapping in the A1 drawings that accompany the planning application.

9.4.2.2 Flood Attenuation

The creation of impermeable areas within the proposed project site has the effect of increasing rates of runoff into the downstream drainage system and this may increase flood risk and flood severity downstream. This applies particularly to urban areas that drain to closed pipe systems which do not have the capacity to cater for increased hydraulic loads. The proposed wind farm is located within a large rural catchment with an open drainage system. The footprint of the impermeable areas and the associated increase in runoff rate is very small in the context of the catchment size and therefore represents a negligible increase in downstream flood risk. Flood attenuation will be provided to limit the flowrate into the settlement ponds during high intensity storm events so that the settlement ponds do not become overloaded. This will also attenuate the flow to the downstream watercourses.

The volume of water requiring attenuation relates to direct precipitation on the tracks and other infrastructure footprint only. The developed surfaces have some permeability, and this reduces the attenuation requirement.

Temporary storage will be provided within the drainage channels by creating stone dams within them at regular intervals. The spacing of the dams is typically 100 metres but depends on the channel slope, with steeper channels requiring shorter intervals. The dams, which are constructed with small sized aggregate held in place by large aggregate, also reduce the flow rate through the drainage system and are an effective means of providing flow control. Silt fences will also provide storage and flow control.

9.4.2.3 Design to Mitigate Flood Risk

To ensure that there is no unacceptable flood risk, the following design flood levels will be implemented:

- The design flood level for the proposed sub station is the 0.1%AEP MRFS 95% CI flood level plus 500mm freeboard; and
- The design flood level for the proposed 10 no. turbines is the 1%AEP MRFS flood level plus 300mm freeboard.

In the Flood Risk Assessment undertaken (attached as Appendix 9A in Volume III of the EIAR), it was concluded that, once the above flood levels are implemented, the proposed project would not have an adverse impact on flooding elsewhere.

9.4.2.4 Drainage / Stream Channel Crossings

<u>Wind Farm</u>

The selection criteria for crossing natural / artificial drains and streams within the site were:

- Avoid crossing drains or streams at acute angles where possible;
- Avoid meanders at the crossing location;
- Cross where foundations could be constructed without excess excavation; and

- Consider vertical alignment requirements.

Where crossings are cut into relatively deep channels these channels would require significant upfill to maintain vertical alignment criteria for turbine deliveries along access tracks. Clear span pre-cast concrete culverts are the preferred installation as this avoids significant instream works. Also, as spans increase the height can increase accordingly allowing significant light penetration under the culvert. The increase in height is complimentary to the vertical alignment requirements for access road design. The contractor may opt for a different method, such as a HDPE pipe, if the site conditions restrict the use of clear span pre-cast concrete culverts. The site restrictions can be, but are not limit to, boundary encroachment, existing vegetation or proximity to protected areas. Refer to Planning Drawing 233128-MWP-00-00-DR-C-5416 for further details. The design of a clear span pre-cast concrete culvert crossings will ensure that:

- The existing channel profile within the watercourse is maintained;
- Gradients within the watercourse are not altered;
- There is unrestricted passage for all size classes of fish by retaining the natural watercourse stream / riverbed;
- There are no blockages within the watercourse. The large size of a clear span culvert allows for the passage of debris in the event of flood flow conditions;
- The watercourse velocity is not changed; and
- The clear span of a culvert will ensure that the existing stream / riverbank is maintained during construction which will in turn avoid the occurrence of in-stream works.

Construction of any clear span crossings will be supervised by the Construction Manager, a suitably qualified engineer, the project manager, and the Environmental Manager in accordance with Inland Fisheries Ireland *"Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters, 2016"* and Office of Public Works *"Construction, Replacement or Alteration of Bridges and Culverts, 2013"*.

The installation works for the clear span pre-cast concrete culvert are proposed to comprise the following:

I. Prior to the commencement of works the design of the culvert will be submitted for approval to the Office of Public Works (OPW) under Section 50 of the Arterial Drainage Act, 1945 and to Inland Fisheries Ireland (IFI);

II. Upon design approval the extent of the excavations required for the culvert foundations at either side of the watercourse will be marked out. The foundations are to be set to an agreed minimum distance by IFI from the existing watercourse so as not to effect on the riparian habitat. Health and safety measures such as lifebuoys on stakes will be installed and where appropriate life jackets will be provided to persons working near the watercourse;

III. Appropriate environmental control measures such as, but not limited to, silt curtains, silt traps, mats will be erected on both sides of the watercourse. These environmental control measures will reduce the potential for sedimentation of the watercourse and can be seen in Section 3.14.3 of the Civil Engineering Chapter (3) of the EIAR.

IV. Excavators will begin to excavate the foundations to formation level where all excavations will be battered back to a safe angle of repose (minimum slope angle of 45°) and comply with the final CEMP to be produced by the appointed contractor for the proposed wind farm All excavation works will stop in the event of heavy rainfall.

V. All excavated material will be transported to the on-site deposition areas located outside of the 50m hydrology buffer zone at the proposed borrow pit. Some of the excavated material will subsequently be reused as backfill around the culvert abutments and structure upon installation. Bare ground will be minimised;

VI. Once formation is reached at suitable ground conditions; steel reinforcement and shuttering will be installed. The culvert abutments will be prepared for the pouring of concrete by dewatering standing water within the excavations, which is likely to contain suspended solids, via a pump to an adequately sized settlement pond located outside of the 50m hydrology buffer zone. The standing water will be treated through the settlement pond and clean filtration stone prior to outfall over vegetation away from the watercourse;

VII. Ready-mix concrete will be delivered to the culvert abutments by ready-mix concrete trucks and placed into each abutment by means of excavators. During the concreting works the watercourse will be temporary covered over with a tarpaulin to protect the watercourse from concrete spills. Upon completion the abutments will be covered and allowed to cure;

VIII. Following curing, the shuttering around the abutments will be struck and removed. A small temporary hardstand will be constructed so that a lifting crane, which will install the pre-cast concrete culvert components onto the abutments, can be set up;

IX. Deliveries of the pre-cast concrete culvert components will arrive to site. These components will be individually fitted and manoeuvred into position by the lifting crane onto the concrete abutments. The components will be inspected to ensure that each unit is level and secure;

X. Backfilling on either side of the culvert will commence using excavated material, in particular larger rock of a uniform size will be placed along the edge;

XI. The access track surface will be laid over the culvert structure using stone aggregate and compacted in maximum 250mm layers with the use of appropriately sized rollers. An internal cable trench will be installed within the carriageway of the culvert so that it can cross over the watercourse;

XII. Vegetated soil bunds will be installed to divert dirty water generated on the section of road over the culvert crossing into the dirty water system outside of the 50m hydrology buffer zone. This will ensure that dirty water will not enter the clean watercourse; and

XIII. Steel parapet railings and timber post and rail fencing will be installed at the sides and on the approaches to the culvert. This will prevent persons or vehicles falling into the watercourse while travelling across the culvert.

All crossings will be designed for a minimum 1 in 200-year return rainfall event. The invert of the pipe is submerged approximately $^{1}/_{4}$ of its diameter below the original drainage bed. Where natural gradients allow, a nominal back fall in the pipe will be incorporated to prevent scour and promote the settling of natural material along the invert of the pipe.

New turbine service tracks will be required to cross several minor drains / streams within the site. All such crossings will be in accordance with this application and/or conditions attached to a grant of planning permission and agreed with the OPW and IFI prior to construction.

Clean and dirty water separation will be put in place at drainage and watercourse crossings to ensure dirty water does not enter clean watercourses. For the proposed wind farm, the intention is to use vegetated soil bunds to divert dirty water generated on the section of road over the crossings to the dirty water system. Alternatively, silt curtains are proposed to be placed along the existing tracks within the 50m buffer zone. These silt curtains are proposed to run parallel to watercourses with a layer of stone placed along the bottom to prevent any seepage if there is a risk of silted runoff.

Grid Connection

The grid connection route crosses two watercourses. Both watercourse crossings are along public roads. The watercourse crossings on L4120-18 (Rossestown Road) and L8015-0 (Furze Road) are single span masonry arch span bridges. The 110kV cable will cross the bridge in a flatbed formation or alternatively a horizontal directional drill (HDD) methodology will be used. Descriptions of the methodologies proposed for crossing this bridge are given in subsequent sections of this report. No instream works will be required.

Option 1 - Flatbed Formation over Bridges

Where ducts are to be installed over an existing bridge and sufficient cover cannot be achieved by installing a standard trefoil arrangement (min 600mm cover required for Trefoil), the ducts will be laid in a much shallower trench. The ducts will be laid in a flatbed formation over the existing bridge and encased with galvanized steel plates in a concrete surround.

It may be necessary to locally raise the level of the existing road to achieve the required cover over the ducts. The increased road level will be achieved by overlaying the existing road with a new wearing course where any addition of new pavement will be tied back onto the existing road. Any works to locally raise the level of the existing road and potentially the bridge parapets are to be agreed with Tipperary County Council prior to commencement with all works and reinstatement carried out to their satisfaction. Once the ducts have crossed the bridge the ducts will resume to the standard trefoil arrangement.

Option 2 – Horizontal Directional Drilling under Bridges and Watercourses

If putting the ducts in a flatbed arrangement is not preferred by the Local Authority, directional drilling will be utilised, which will require a service trench (launch pit) for the drill in the road either side of the watercourse. The directional drill process will require that the depth of the service trench will deepen in a defined slope as it approaches the watercourse crossing on either side, as to have sufficient passing depth under the watercourse. This method crossing method is shown on Planning Drawing 23318-MWP-00-00-DR-C-5429. Horizontal Directional Drilling will be carried out as follows:

- The directional drilling machine will set up at a launch and reception pit (an enlarged portion of on-road trench, i.e., a service trench on either side of the crossing point at an appropriate distance back from the watercourse). The drill will then bore in an arc under the watercourse feature;
- The drilling head of the boring tool has a series of nozzles that feed a liquid bentonite mix along the bore direction, which provides both lubrication and seals the cut face of the bore;
- Once the bore reaches the far side, the duct is then attached to the drill head and the duct is pulled back along the route of the bore to the original drilling point;
- Any bentonite mix is deposited within the bore shaft and spillage is collected at either end of the bore with a dedicated sump; all excavated material and excess bentonite will be removed from site and brought to an authorised waste facility;
- Once the duct is in place under the watercourse, the normal process of road trenching can continue from either side of the watercourse structure; and
- The launch and reception pits will be backfilled in accordance with normal specification for backfilling excavated trenches and to the satisfaction of Tipperary County Council.

Where land drains are encountered on the proposed grid connection route there are two scenarios, as follows:

- The hardstand areas for the TDR will run off to the existing surrounding drainage network. The areas of hardstand required for the TDR are quite small in comparison to the wider drainage network;
- If there is adequate cover over the drain crossing, then the new ducts and trench will pass over the drain without interruption to the drain. No works will be required within the drain at these locations. The trench at these locations will be installed in the existing public / access road; and
- In the event where there is insufficient cover over a drain crossing point, the new grid connection route will have to be installed underneath the existing drain crossing. To do this the following approach is adopted:
    - The drain is blocked upslope of the crossing, and a sump is formed using sandbagging and stable clay soil material. This sump will accumulate water flow in the drain and will facilitate the use of an adequately sized submersible pump based on expected flow rates to over pump (fluming) the drain water across the road and back into the drain on the down flow section below the road;
    - Two silt fences and filters will be put in place on the downslope of the crossing point to prevent siltation/sedimentation. Once the sump and over-pumping mechanism is in place, then the service trench excavation will progress;
    - A section of drain crossing (pipe or stone culvert) is temporarily removed to allow the trench and duct to continue. The duct will pass under the drain and once in place it will be surrounded with lean mix concrete and then the trench will be backfilled with suitable stone from excavations or imported; and
    - The drain will then be put back in place, surrounded with stone/lean mix concrete and the track restored to its finished level. The over-pumping measure will then be removed and normal drain flow resumes. The duct/trench work can then progress over the remaining length of the public / access road.

9.4.2.5 Spoil Management

Excavated spoil will be reused for the backfilling, landscaping, and restoration around the proposed wind farm infrastructure such as turbines and hardstands. The calculated volume of excavated material is summarised in Chapter 03 Civil Engineering of this EIAR.

Dedicated spoil storage areas and a borrow pit are proposed within the site. The borrow pit will be used for generating material for the construction of access tracks and hardstands, and the spoil deposition areas will be used for spoil storage. The proposed locations for the borrow pit and spoil storage are shown on Planning Drawings 23318-MWP-00-00-DR-C-5006 to 5012.

Drainage and siltation control measures have been designed and will be put in place in all spoil storage areas. This will include a dedicated drainage network, temporary silt fences and settlement ponds designed to cater for the size of each storage area. Further details of the drainage philosophy that will be applied as well as siltation control systems and attenuation systems is given in Section 9.4.2.1 and 9.4.2.2 of this report.

9.4.2.6 Permanent Deposition Areas

On completion of extraction activities in any cell at the borrow pit; the pit will be used for the permanent storage of the excavated spoil material from the turbine bases, crane hardstands and internal access road construction. The proposed deposition areas will be subdivided into a series of cells. Each cell will be bunded by an embankment of engineered fill material capable of allowing a tracked excavator to move between the cells during deposition activities. The size of each cell will be dictated by the maximum working length of the excavators working the borrow pit. Each cell will be bunded on all downslope sides. The bund will be of adequate strength to retain the spoil stored within each cell.

Water build up within the disposal area will not be permitted. Water will free drain to the sump of the pit from where it will be discharged utilising a pump discharging to a settlement pond constructed for this purpose. Permanent design features as illustrated in Planning Drawings 23318-MWP-00-00-DR-C-5025 to 5033 will allow drainage function correctly over the deposition areas. Upon completion of each cell the surface of the deposited spoil will be profiled to a gradient not exceeding 5% and vegetated to prevent sediment run off .

9.4.2.7 Temporary Deposition Areas

Temporary engineered deposition areas will be designated at the turbine and hardstand locations to hold temporary stockpiles. These will be located away from drains and watercourses. Stockpiles that are at risk of erosion will be protected by a silt trapping apparatus such as a geo-textile silt fence to prevent contamination of runoff.

9.4.2.8 Construction Works Area

Runoff from the internal roadways, hardstands and other infrastructure will be isolated from the clean catchment runoff by means of a series of open drains that will be constructed within the works areas. These drains will be directed to settlement ponds that will be constructed throughout the site, downhill from the works areas and as shown on the drainage layout, Planning Drawings 23318-MWP-00-00-DR-C-5025 to 5033. Each drain will incorporate a series of check dams that will attenuate the flow and provide storage for the increased runoff from exceptional rainfall events. The ponds have been designed to a modular size to cater for a single turbine and hardstand area or a 1,200m^2 area of internal access road.

Dewatering of turbine base excavations can result in significant flow rates to the drainage and settlement system if high-capacity pumps are used. To avoid the need for pumping it is proposed to provide drainage channels from the excavations to prevent a build-up of water. Where this is not feasible, temporary storage will be provided within the excavations and dewatering carried out at a flow rate that is within the capacity of the settlement ponds.

9.4.2.9 Treatment Process

Contaminated runoff can be generated on the site access tracks, borrow pit, met Lidar, construction compound, substation site and turbine hard standing areas and is mainly due to excavation for the infrastructure or movement of delivery vehicles and on-site traffic.

Drains carrying construction site runoff will be diverted into settlement ponds that reduce flow velocities, allowing silt to settle and reducing the sediment loading. A modular approach has been adopted for the design of the settlement ponds which have been sized to cater for a catchment area of 1,200m^2 works area.

The settlement ponds have been designed as a three-stage tiered system and this has been proven to work effectively on wind farm construction sites. The three-stage system also facilitates effective cleaning with minimal contamination of water exiting the pond.

The settlement ponds have been designed with regard to the following:

- Runoff flow rate for the modular catchment area;
- Met Éireann Extreme Rainfall Data (statistical rainfall intensity / duration table);
- Character of the impermeable areas (runoff coefficients); and
- Design particle size and density.

The treatment process consists of primary, secondary and tertiary treatment as follows:

- The *primary treatment* consists of a three-stage settlement pond with an over-topping weir at each stage. The first chamber will remove most of the sediment load, while the remaining two chambers will remove most of the remaining load;
- Before the water is released onto the existing ground surface, it passes through a *secondary* treatment system in the form of a graded gravel filter bed; and
- The outflow from each interceptor is dispersed across a wide area of vegetation so that the velocity is minimised and the vegetation can filter out the residual sediment. This is the final or *tertiary* stage of the treatment process. Existing rills and collector drains within the tertiary treatment area are blocked off to prevent concentration of the flow.

Each sediment treatment unit has been sited using the contour maps and aerial photos to avail of any locally level areas and to ensure that the outflow is spread over as much vegetation as possible before entering an aquatic buffer zone.

Settlement ponds will require inspection and cleaning when necessary. This will be carried out under low or zero flow conditions so as not to contaminate the clean effluent from the pond. The water level would first be lowered to a minimum level by pumping without disturbing the settled sediment. The sediment would then be removed by mechanical excavator and disposed of in areas designated for deposition of spoil. Settlement ponds will include perimeter fencing and signage to ensure that there are no health and safety risks.

The design of the settlement pond system for the proposed project site is detailed in the Planning Drawing 23318-MWP-00-00-DR-C-5407. The hydraulic design of the settlement ponds is outlined in Appendix 3A.

The effluent from each settlement pond will discharge to an open channel, 8 to 10 metres in length, running parallel to the ground contours. This will form a weir that will overflow on its downhill side and disperse the flow across the existing vegetation. A minimum buffer width of 20m is specified between the overflow weir and downstream watercourses. Buffer widths are designed in line with *Forests and Water, UK Forestry Standard Guidelines (Forestry Commission, 2011)* on protection of watercourses during forestry operations and management. This method buffers the larger volumes of run-off discharging from the drainage system during periods of high precipitation, further reducing suspended sediment load to surface watercourses. The outflow weirs will not be located on slopes steeper than 3:1. Existing drains within the dispersion zone will be blocked off where necessary to provide additional attenuation, disperse the flow across a larger area of ground and prevent the re-concentration to a single flow.

9.4.2.10 Sediment Pond Design

Generally, high-intensity rainfall events have a short duration and lower-intensity rainfall events tend to have a longer duration. The Met Éireann Extreme Rainfall Data for the area demonstrate that the chance of occurrence of a storm event of a given duration decreases (higher return period) as intensity increases.

For a given return period the total depth of rainfall increases with storm duration but the actual rainfall rate over that period of time decreases. For the operation of the settlement ponds, it is the rate of flow rather than the total rainfall that is relevant. The return period is a measure of the likelihood that a storm of a particular intensity will occur in a given year. However, it is important to note that the chances of occurrence of a storm event with a particular return period are the same in each year but should on average occur once in that time period. This is expressed as an annual exceedance probability (AEP) of 1%; that is, it has a 1% chance of being equalled or exceeded in any year.

The runoff control measures for the proposed wind farm have been designed in the context of storm events of varying duration and intensity. The settlement ponds have been designed to cater for a maximum continuous flow rate associated with a medium-intensity rainfall event. Higher intensity runoff will be attenuated by the open drain collection system which provides temporary storage and limits the rate at which it enters the settlement ponds. This is achieved by the use of check dams within the open drains as described in Section 9.4.2.13. Longer duration storms of 24 hours or more generally have very low intensity and are not critical in terms of the runoff rates that they generate.

The modular settlement ponds are designed to operate effectively for the runoff rate associated with a continuous high rainfall rate of 20 mm/hour. This is approximately equal to a 60-minute duration storm event with a 10-year return period (M10-60). These rates are taken from the Met Éireann Point Rainfall Frequency table for the site location.

Theoretically, the pond depth is not relevant but in practice, a minimum depth is required to ensure laminar flow and to allow temporary storage of settled silt. The modular settlement pond has been designed with a surface area of 24m^2 (12m x 2m) and a depth of 1.25m. This is divided into three chambers of equal length and in practice, it has been found that most of the settlement occurs in the first chamber with very low turbidity levels being achieved in the final effluent. The design is conservative and therefore has sufficient redundancy to cater for occasional higher runoff rates or sediment loads.

9.4.2.11 Attenuation Design

For rainfall intensities above the design value of 20mm/hour, the excess runoff needs to be temporarily stored. The storage is provided in the drainage channels by installing check dams at intervals along the channel as described below.

The storage volumes required for 10-year storm events of various durations are detailed in Section 3.14.4.9 of Chapter 03 Civil Engineering of this EIAR. The volumes are based on a catchment area of 1,200m^2 and a runoff coefficient of 0.70. The maximum storage volume required is 6.61m^3 for 15 minutes storm duration. This is equivalent to 24 minutes of flow through the settlement pond at the design-through flow rate of 5.10 litres/second. The stored water will drain off gradually as runoff from the works area subsides. The storage volume represents an average depth of 0.055m in a 200m long, 0.60m wide open drain and can therefore be easily accommodated in the drainage system.

9.4.2.12 Access Track Construction

On-site experience in wind farm construction and forestry development across the country has shown that the single most effective method of reducing the volume of sediment created by construction is the finishing of all service tracks with high quality, hard wearing crushed aggregate such as basalt, granite or limestone laid to a transverse grade. When surface water drains transverse across a road constructed from hard wearing aggregate, as opposed to low class aggregate, the level of suspended solids is reduced significantly. The internal tracks will be finished with a hard-wearing aggregate. This can have the added benefit of contributing a balancing pH to help protect water quality from acidic runoff. The proposed project is serviced by a local quarries (detailed in Chapter 02 Description of the Proposed Project of the EAIR) which can be used as a source of hard-wearing aggregate for road construction.

9.4.2.13 Check Dams

Check dams will be placed at regular intervals, based on gradient, along all drains to provide flow attenuation, slow down runoff to promote settlement and to reduce scour and ditch erosion. Check dams are relatively small and constructed with gravel, straw bales, or other suitable material. They will be placed at appropriate intervals and heights, depending on the drain gradient, to allow small pools to develop behind them.

9.4.2.14 Silt Fences

Silt fences placed along drains are an alternative method of reducing the volume of suspended sediment. They will be placed at the end of any locally steep section of drain. They have the double benefit of effectively producing a localised swale to reduce scour effects and attenuating and filtering the discharge

9.4.2.15 Borrow Pit

The borrow pit proposed within the site will be used to obtain site won stone aggregate for use in the construction of the proposed wind farm. This borrow pit will be located within the southern area of the site where it will be used as a source of hardcore for the construction of access tracks, crane hardstands and construction compound. The proposed location of the borrow pit is shown on Planning Drawings 23318-MWP-00-00-DR-C-5415.

Prior to commencement of excavation works, an interceptor drain will first be excavated upslope to intercept existing overland flows and divert them around the borrow pit prior to discharge via a buffer zone on the downslope side. Any subsoil material overlying the rock will be excavated and stockpiled. The stockpile will be sealed, and a perimeter drain installed to intercept any run-off so that it can be discharged through an appropriately designed silt trap.

Standing water, any surface water runoff or water pumped from within the borrow pit is likely to contain an increased concentration of suspended solids. Runoff or pumped water from the borrow pit will be isolated from the clean catchment runoff by means of a series of open drains that will be constructed within the area. These drains will be of check dams that will attenuate the flow and provide storage for the increased runoff from exceptional rainfall events. The settlement ponds have been designed to a modular size where if larger areas of runoff must be catered for at a single discharge point the size of the settlement pond will be increased pro rata.

Inspections of the borrow pit will be made by a geotechnical engineer through regular monitoring of the opening works. The appointed contractor will review work practices at the borrow pit where periods of heavy rainfall are expected where work will be stopped to prevent excessive runoff from being generated. Excavators will extract the stone using buckets and a ripper attachment or rock-breaker attachments may be utilised in the borrow pit location. It is expected that excavators will be utilised in tandem in the extraction of rock from the borrow pit.

9.4.3 Construction Phase

9.4.3.1 Effect 1: Increased Surface Runoff

Progressive replacement of the vegetated surface with impermeable surfaces could potentially result in an increase in the proportion and speed of surface water runoff reaching the surface water drainage network. The proposed wind farm footprint comprises turbine hardstanding, access tracks, spoil depositions areas, an electrical sub-station compound, BESS, two temporary construction compounds, the grid connection and the TDR. Temporary works also include local road widening. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems, or increase the flood risk downgradient.

The infrastructure footprint for the impermeable surfaces within the proposed project are relatively small. The increase in runoff from the proposed project will, therefore, be negligible compared to the flows of the receiving waters. This is even before proposed mitigation measures will be implemented. Refer to Table 9-11 for the effect rating if not mitigated.

MWP

Table 9-11: Construction Effect 1 Rating

Effect 1: Increased Surface Runoff								
	Quality of Effect	Spatial Extent	Duration	Other Relevant Criteria	Likelihood	Magnitude	Sensitivity	Significance
Pre - Mitigation	Negative	Localised	Permanent	Indirect	Likely	Low	High	Moderate

9.4.3.2 Effect 2: Increase in Suspended Solids

Activities that result in the release of suspended solids to surface watercourses, could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality aquatic species of downstream water bodies. There are a number of associated activities which could lead to an increase in total suspended solids in water. These include:

- Earthworks resulting in the removal of vegetated material within the site development area;
- Cut and fill activities;
- Excavation of soil within the site development area;
- Activities associated with the grid route works and the accommodation works for the TDR;
- Inappropriate site management of excavations and of excavated soil within the site development area;
- Insufficient management of the drainage of spoil deposition areas; and
- Cable trenches could act as a conduit for surface water flows.

Refer to Table 9-12 for the effect rating if no mitigation is implemented.

Table 9-12: Construction Effect 2 Rating

Effect 2: Increase in Suspended Solids								
	Quality of Effect	Spatial Extent	Duration	Other Relevant Criteria	Likelihood	Magnitude	Sensitivity	Significance
Pre - Mitigation	Negative	Localised	Short term	Indirect	Likely	Moderate	High	Significant

9.4.3.3 Effect 3: Hydrocarbon Spill

Use of machinery during construction could result in spillage of fuel, oils, lubricants, or other hydrocarbons to surface waters and groundwater, with potentially adverse effects on local groundwater quality and surface water quality in downstream areas. During the construction phase, there is a risk of accidental pollution incidences from the following sources:

- Spillage or leakage of fuels (and oils) stored on site;
- Spillage or leakage of fuels (and oils) from construction machinery or site vehicles; and
- Spillage of oil or fuel from refuelling machinery on site.

Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent when exposed to the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.. Refer to Table 9-13 for the effect rating if no mitigation measures are implemented.

Table 9-13: Construction Effect 3 Rating

Effect 3: Hydrocarbon Spill								
	Quality of Effect	Spatial Extent	Duration	Other Relevant Criteria	Likelihood	Magnitude	Sensitivity	Significance
Pre - Mitigatio n	Negative	Localised	Short term	Indirect	Likely	Moderate	High	Significant

9.4.3.4 Effect 4: Cement Spill

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative effects on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of ≥ 6 ≤ 9 is set in *S.I. No. 293 of 1988 Quality of Salmonid Water Regulations*, with artificial variations not in excess of ± 0.5 of a pH unit.

Entry of cement-based products into the proposed project site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses, represents a risk to the aquatic environment. Batching of wet concrete will not occur onsite, therefore concrete truck chute washing, wheel washing, and the placement of machinery are the activities most likely to generate a risk of cement-based pollution.

Refer to Table 9-14 for the effect rating if no mitigation measures are carried out.

Table 9-14: Construction Effect 4 Rating

Effect 4: Cement Spill								
	Quality of Effect	Spatial Extent	Duration	Other Relevant Criteria	Likelihood	Magnitude	Sensitivity	Significance
Pre - Mitigatio n	Negative	Localised	Temporary	Indirect	Likely	Low	High	Moderate

9.4.3.5 Effect 5: Morphological Changes to Surface Water Courses & Drainage Patterns

Several watercourse crossings will be required for the internal access road, internal cables and grid connection. This section details the crossings in relation to the wind farm and the grid connection. Wind Farm Site

Seven water crossings will be required at the Wind Farm site for the internal access roads and underground cables.

Where an open drain or watercourse is encountered during the installation of the internal site cable trenches; the cable trenches will cross the open drain or watercourse within the road carriageway via new or existing road crossing points to minimise the requirement for in-stream works. Refer to Figure 9-23 for the location of these watercourse crossings.

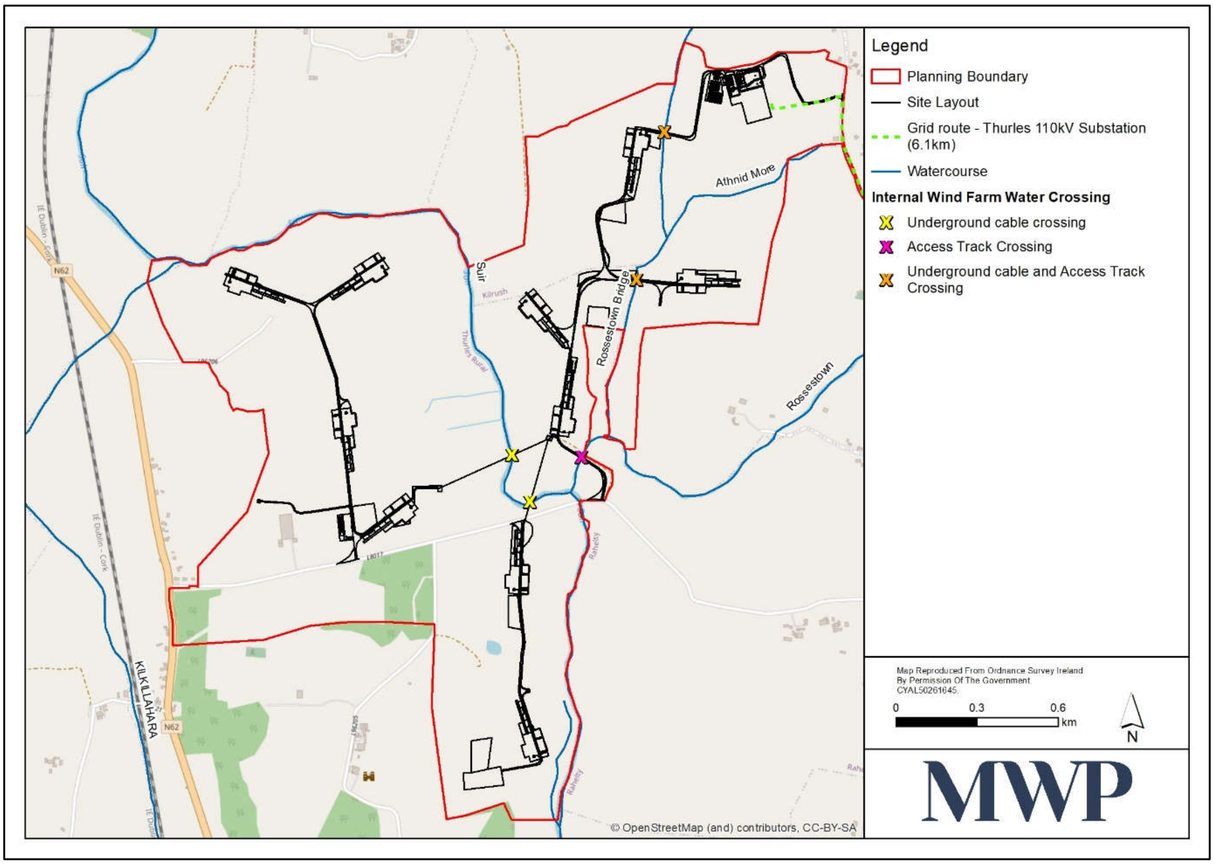


Figure 9-23: Windfarm Watercourse Crossing Locations

<u>Grid Connection</u>

There are two watercourse crossings associated with the proposed grid route to Thurles. Refer to Table 9-15 for details of each crossing and Figure 9-24 for the location of these crossing. The watercourse crossings on L4120-18 (Rossestown Road) and L8015-0 (Furze Road) are single span masonry arch bridges. The 110kV cable will cross the bridge in a flatbed formation or alternatively a horizontal directional drill (HDD) methodology will be used. Descriptions of the methodologies proposed for crossing this bridge are given in Section 9.5.1.2of this report. Overall, in-stream works are not required along the proposed grid connection route.

Table 9-15: Grid Watercourse Crossings

Crossing Number	Crossing Type	Cover Assessment	Crossing Methodology	In-Stream Works Required	Public/Private Land Requirement
1	Single span arch stone	Unknown	HDD/Flatbed	No	Heavily vegetated in the vicinity of the bridge
2	Single span arch stone	Low Cover	HDD/Flatbed	No	A detailed survey of the existing services crossing the bridge is required to determine if a corridor is available for the proposed cable. If a corridor is available, then separation distances from existing services will need to be maintained

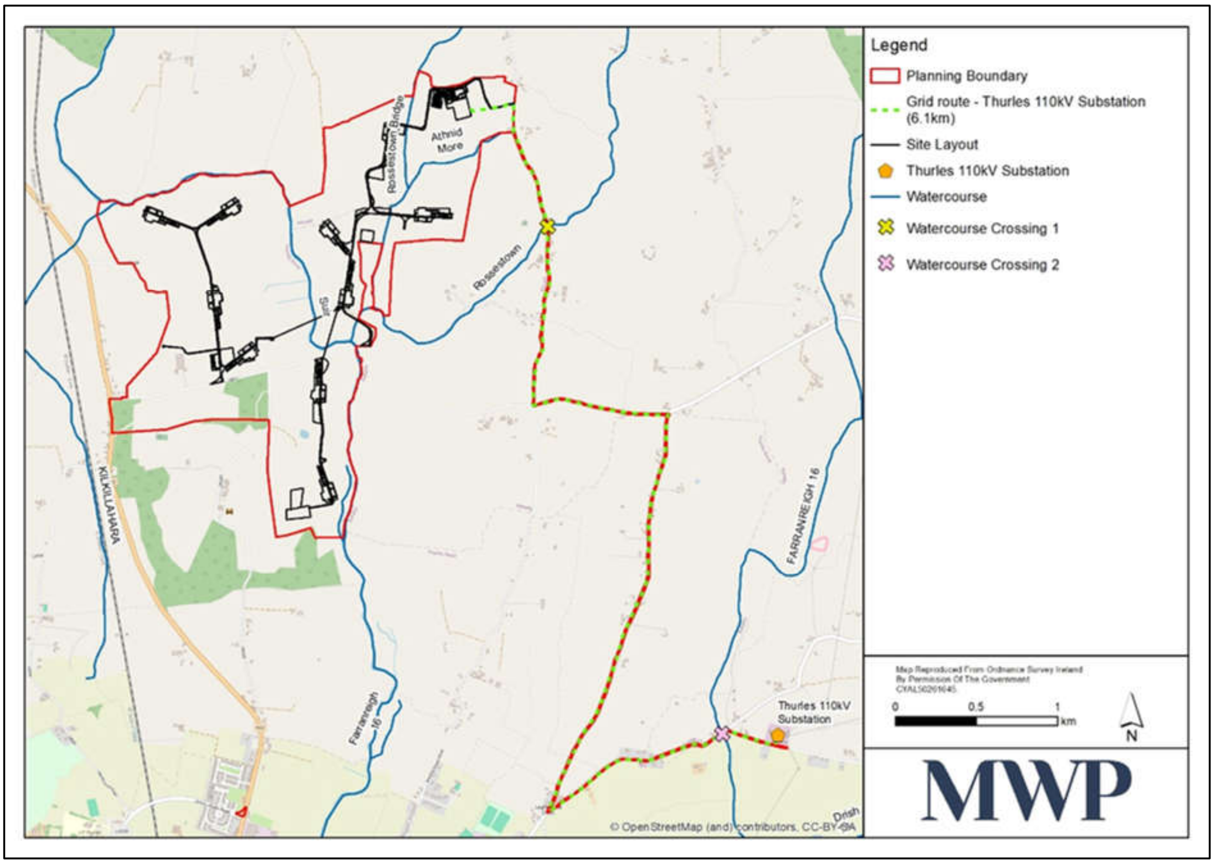


Figure 9-24: Grid Connection Watercourse Crossing Locations

Diversion, culverting and bridge crossings of surface watercourses can result in morphological changes, changes to drainage patterns and alteration of aquatic habitats. Construction of structures over watercourses within the proposed project site has the potential to interfere with water quality and flows during the construction phase.

Refer to Table 9-16 for the effect rating if mitigation measures are not implemented.

Table 9-16: Construction Effect 5 Rating

Effect 5: Morphological Changes to Surface Water Courses & Drainage Patterns								
	Quality of Effect	Spatial Extent	Duration	Other Relevant Criteria	Likelihood	Magnitude	Sensitivity	Significance
Pre - Mitigation	Negative	Localised	Short Term	Direct	Likely	Low	High	Moderate

9.4.3.6 Effect 6: Wastewater Disposal

Biological contamination from leaking sanitary waste from welfare facilities could lead to contamination of receiving waters. Wastewater from welfare facilities on site will drain to integrated wastewater holding tanks associated with the facilities. The stored effluent will then be collected on a regular basis from site by a permitted waste contractor and removed to a licenced waste facility for treatment and disposal. Refer to Table 9-17 for the effect rating if no mitigation measures are implemented.

Table 9-17: Construction Effect 6 Rating

Effect 6: Wastewater Disposal								
	Quality of Effect	Spatial Extent	Duration	Other Relevant Criteria	Likelihood	Magnitude	Sensitivity	Significance
Pre - Mitigation	Negative	Localised	Temporary	Indirect	Likely	Low	High	Moderate

9.4.3.7 Effect 7: Groundwater Levels and Local Well Supplies During Excavation Works and from the Proposed Borrow Pit

As no groundwater will be abstracted as part of the proposed project, groundwater wells and springs identified in Section 9.3.5.3 will be unaffected by any activity associated with the proposed site development.

Groundwater levels may however be lowered as a result of dewatering due to excavation works and dewatering of the proposed borrow pit. This has the potential to affect local well supplies in close proximity of the site. It is not anticipated that large volumes of groundwater will be encountered within the borrow pits. Therefore, it is unlikely that there will be any effect on neighbouring wells as a result of the proposed project. Refer to Table 9-18 for the effect rating if not mitigated.

Table 9-18: Construction Effect 7 Rating

Effect 7: Groundwater Levels and Local Well Supplies During Excavation Works and from the Proposed Borrow Pit								
	Quality of Effect	Spatial Extent	Duration	Other Relevant Criteria	Likelihood	Magnitude	Sensitivity	Significance
Pre - Mitigation	Negative	Localised	Temporary	Indirect	Unlikely	Low	Medium	Slight

9.4.4 Operational Phase

9.4.4.1 Effect 1: Increased Surface Runoff

The main potential operational phase hydrological effect of the development is a slight increase in run-off from a storm event to the streams within the site due to a minor decrease in ground permeability at the turbine hardstands, grid connection, BESS and substation compound. The duration for concentration of surface water flows will decrease as a result of the additional hard-surfaced areas, resulting in additional flows being discharged to the drains adjacent to access tracks during rainfall events. Potential effects associated with the grid route are not expected as this will remain in situ during the operational phase. Any activities needed for additional transporting of spare turbine components along the TDR will be minimal and temporary. Therefore no significant effect will occur.

Refer to Table 9-19 for the effect rating if no mitigation measures are implemented.

Table 9-19: Operational Effect 1 Rating

Effect 1: Increase in run-off from								
	Quality of Effect	Spatial Extent	Duration	Other Relevant Criteria	Likelihood	Magnitude	Sensitivity	Significance
Pre - Mitigation	Negative	Localised	Permanent	Indirect	Likely	Negligible	High	Not significant

9.4.4.2 Effect 2: Hydrocarbon Spill

During the operational phase, oil will be used in cooling the transformers. As a result, there is a potential for oil spills at the substation and BESS; however, the transformer will be located in a concrete bund which will prevent loss of oil to the external environment in the event of a spill. It is not envisaged that the maintenance activities taking place on the wind farm, involving general maintenance of the wind turbines, maintenance of the drainage system, material storage areas and reinstated areas, will give rise to any significant effects on the hydrological regime of the area. Refer to Table 9-20 for the effect rating if not mitigated.

Table 9-20: Operational Effect 2 Rating

Effect 2: Hydrocarbon SPill								
	Quality of Effect	Spatial Extent	Duration	Other Relevant Criteria	Likelihood	Magnitude	Sensitivity	Significance
Pre - Mitigation	Negative	Localised	Short term	Indirect	Likely	Negligible	High	Not significant

9.4.5 Decommissioning Phase

At the end of the 35-year lifespan of the proposed project, the Developer will make the decision whether to repower or decommission the turbines. Any further proposals for development at the site during or after this time will be subject to a new planning permission application. If planning permission is not sought after the end of life of the turbines, the site will be decommissioned and reinstated with all 10 No. wind turbines and towers removed. Removal of infrastructure will be undertaken in line with landowner and regulatory requirements and subject to approval of the local authority. The information below outlines the likely decommissioning tasks based on current requirements and best practice.

Prior to the decommissioning work, the following will be provided to Tipperary County Council for approval:

- A plan outlining measures to ensure the safety of the public workforce;; and
- A comprehensive reinstatement proposal, including the implementation of a program that details the removal of all structures and landscaping.

If the site is to be decommissioned, cranes of similar size to those used for construction will disassemble each turbine. The towers, blades and all components will then be removed.

Wastes generated during the decommissioning phase will be taken off site and disposed of at an authorised waste facility. Any materials suitable for recycling will be disposed of in an appropriate manner.

At present it is anticipated that underground cables connecting the turbines to the selected substation will be cut back and left underground. The cables will not be removed if an environmental assessment of the decommissioning operation demonstrates that this would do more harm than leaving them *in situ*. The assessment will be carried out closer to the time to take into account environmental changes over the project life.

Hardstand and turbine foundation areas will be left in situ and covered with soil to match the existing landscape. Access roads will be left for agricultural use.

The grid cable will remain a permanent part of the national grid and therefore decommissioning is not foreseen. In the event of decommissioning, it will involve removing the cable from the ducting but leaving the ducting and associated supporting structure in place. It is also likely the substation will remain in place and will previously have been taken in charge by the system operator, after the wind farm is connected to the national electricity grid.

Effects resulting from decommissioning activities (increased traffic onsite and removal of wind farm infrastructure) on water resources include:

- Increased surface runoff resulting in an increase in suspended solids; and
- Hydrocarbon spills.

The main potential decommissioning phase hydrological effect is a slight increase in run-off from a storm event to the streams within the site due to a minor decrease in ground permeability as the turbine hardstands will be left in situ. The duration for concentration of surface water flows will decrease as a result of the hard-surfaced areas, resulting in additional flows being discharged to the drains adjacent to access tracks during rainfall events. The infrastructure footprint for the impermeable surfaces to remain are relatively small. The increase in runoff will therefore be negligible compared to the flows of the receiving waters. Any activities needed for additional removing turbine components from the site will be minimal and temporary. Therefore, no significant effect will occur. Hydrocarbon spills could arise from vehicles and machinery used to removed turbine components. This will however be temporary in nature and no significant effect will result.

9.4.6 Risk of Major Accidents and Disasters

This section presents an assessment of the vulnerability of the proposed project in relation to major accidents and disasters. It assesses the likelihood of the proposed project to cause an increased risk of major accidents and disasters.

Major accidents can relate to any incident, technological or otherwise, which has the potential to have a significant effect on the facility or on the receiving environment. Examples of major accidents which have such potential are fire, explosion, traffic collisions, contamination and pollution.

A natural disaster is an all-encompassing term which describes any severe natural event which has the potential to cause disturbance to an individual, development or population. The severity depends on the receptor and the type of disaster. Examples of natural disasters are earthquakes, flooding, tsunamis, lightning strikes, hurricanes or any other extreme natural event. This section has considered the potential increased risk of such events occurring as a result of climate change, such as sea-level rise and increased frequency in the occurrence of extreme weather events.

The principle risk associated with the proposed project in relation to water and hydrology relates to increased flood risk due to the increase in impermeable hard standing across the site. As discussed previously under Section 9.3.4.4, a detailed Flood Risk Assessments (FRA) was undertaken. In order to allow for the effects of climate change, the calculated flows have were increased by a factor of 1.2. This corresponds to the Mid-Range Future Scenario (MRFS). The design flood level is the 1% AEP plus the mid-range future scenario (MRFS) which corresponds to a 20% increase in flow. A scenario was run to assess the risk from the 1%AEP MRFS. As would be expected, this event would result in an increase in flood level and extent throughout the proposed project. At most locations the increase would not cause flooding to the turbines and hardstanding areas and the extents would not differ significantly from the current scenario (refer to Section 9.3.4.4). However, there are certain locations where an exceedance flow could have a more significant impact on flood risk at Turbine 4 and Turbine 4 hardstanding areas. However, the design event for the proposed 10 no. turbines is the 1% AEP MRFS flood level plus 300mm freeboard.

The reports concluded that the site is not at risk of flooding, nor will the proposal have an adverse effect on flooding elsewhere and the residual risks are considered acceptable.

It is considered that there is no potential for the proposed project to cause a major accident or disaster. Furthermore, there is no increased risk to the development from a major accident or disaster.

9.5 Mitigation and Monitoring Measures

9.5.1 Construction Phase

9.5.1.1 Site Clearance (Tree Felling)

Felling of 1.4 ha of forestry and removal of 4086m of hedgerow is required within and around the proposed wind farm infrastructure to accommodate the construction of foundations, hardstands and access tracks as well as to facilitate assembly of turbines and provide ecological buffers. It is proposed to fell to a distance of up to 105m around turbines. The proposed felled areas are detailed in Chapter 02 Description of the Proposed Project.

All forestry felling will be undertaken in accordance with a forestry felling licence, using good working practices as outlined by the Department of Agriculture, Food, and the Marine (DAFM) Standards for Felling and Reforestation (2019). These standards deal with sensitive areas, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel, and machine oils. All conditions associated with the felling licence will be complied with.

9.5.1.2 River Crossings

No work will take place within 50m buffer zones of EPA mapped watercourses except for construction works detailed in Section 9.4.2.4.

Any works taking place in the vicinity of unmapped watercourses or land drains will be undertaken in accordance with the mitigation measures set out in this Chapter and in the CEMP (attached as Appendix 2B of Volume III). Working near watercourses during or after intense or prolonged rainfall events will be avoided and work will cease entirely near watercourses when it is evident that there is a risk that pollution could occur. All construction method statements will be developed in consultation with Inland Fisheries Ireland and in accordance with the details in the CEMP accompanying this application. The selection criteria and other details of the proposed crossings can be found in Chapter 03 Civil Engineering. These crossings will be subject to a Section 50 application to ensure flood risk upstream and downstream of the crossing is not increased.

9.5.1.3 Concrete Control

During the pouring of concrete, the following measures will be implemented to avoid spilling concrete outside construction areas and to prevent concrete entering any part of the drainage system:

- Concrete pours will be supervised by the construction manager, who will ensure the area of the pour is completely drained of water before a pour commences;
- Pours will not take place during heavy rainfall; and

- Concrete trucks will be washed out off site at the source quarry. Wet concrete operations are not envisaged for the proposed development within or adjacent to watercourses or aquatic zones. No batching will take place on site. However, if wet concrete operations are required in such locations, a suitable risk assessment will be completed prior to works being carried out.

9.5.1.4 Plant and Refuelling

The following will be undertaken in relation to plant and refuelling:

- Only qualified persons shall operate machinery or equipment;
- Machinery and equipment shall be checked on a regular basis to ensure they are working properly (no oil/fuel leaks etc.);
- No refuelling shall take place within 50m of any watercourse;
- Fuel will be stored in doubly-bunded bowsers or in bunded areas at the site compound;
- Plant nappies and spill kits will be readily available on plant equipment or when working with fuel operated heavy tools;
- To mitigate against sources of contamination, refuelling of plant and vehicles will only take place within designated areas of the site compound or in other areas specifically designated for this purpose;
- Only emergency breakdown maintenance will be carried out on site;
- Appropriate containment facilities will be provided to ensure that any spills from breakdown maintenance vehicles are contained and removed off site;
- There will be no discharge of any priority or hazardous substances to groundwater and surface waters; and
- A suitable permanent fuel and oil interceptor will be installed to deal with all substation surface water drainage. Temporary petrol and oil interceptors will be installed at the site compound for plant repairs/storage of fuel/temporary generator installation.

9.5.1.5 Inspection and Maintenance

The drainage and treatment system for the proposed wind farm will be continuously managed and monitored and particularly after heavy rainfall events during the construction phase. The drainage and treatment system will be regularly inspected and maintained to ensure that any failures are quickly identified and repaired so as to prevent water pollution. A programme of inspection and maintenance will be designed and dedicated construction personnel assigned to manage this programme as outline in the CEMP. A checklist of the inspection and maintenance control measures will be developed, and records kept of inspections and maintenance works. These drainage controls will be kept in place during the operational phase of the proposed wind farm until the vegetation is re-established.

9.5.1.6 Weather Monitoring

Weather monitoring is a key input to the successful management of the drainage and treatment system during the construction of the proposed wind farm. This will involve 24 hour advance meteorological forecasting (Met Éireann download) and on site rain gauge linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g., 1 in 5 year storm event), planned responses will be undertaken. These responses will involve control measures including the cessation of construction until the storm event has passed over and flood flows have subsided. Dedicated construction personnel will be assigned to monitor weather. Refer to the CEMP attached as Appendix 2B of Volume III for further details of the control measures and relevant personal.

9.5.1.7 Wheel Washes

Wheel washes will be provided for heavy vehicles exiting the site to ensure that tracks outside of the site boundary are clean. These can take the form of dry or wet wheel wash facilities. In the case of a wet wheel wash a designated bunded and impermeable wheel wash area will be provided, and the resultant wastewater will be diverted to a settlement pond for settling out of suspended solids.

9.5.1.8 Water Quality Monitoring

A programme for water monitoring will be prepared in consultation with Inland Fisheries Ireland prior to the commencement of the construction of the proposed wind farm. The plan will include monitoring of water during the pre-construction, throughout and post construction phases.

Further baseline water quality monitoring of all streams near the development site will be undertaken prior to construction to confirm existing conditions at the time of construction. This baseline data will include the main components of a full hydrograph for the streams including both high spate flow and base flow where possible.

During the construction phase of the project, a surface water monitoring schedule, finalised prior to construction, will be followed. In summary, weekly field monitoring of surface water quality chemistry will be carried out at the identified and agreed surface water quality monitoring locations. The following parameters will be measured:

- pH (field measured);
- Electrical Conductivity (field measured);
- Temperature (field measured);
- Dissolved Oxygen (field measured);
- Total Dissolved Solids (TDS) (field measured); and
- Turbidity (field measured).

Continuous, in-situ, monitoring equipment will be installed at selected locations upstream and downstream of the proposed project. The monitoring equipment will provide continuous readings for turbidity levels, flow rate and water depth in the watercourses.

Each month, the EcoW (refer to the CEMP Appendix 2B in Volume III of the EIAR for details of the person to be appointed) will take samples from each location and bring to a laboratory for analysis on a range of parameters with relevant regulatory limits and EQSs. This will be compared with the baseline data obtained prior to construction from the EPA and from sampling. If the measured value exceeds the baseline values, the cause will be determined, and remedial measures put in place as necessary.

The analytical determinants of the monitoring programme (including limits of detection and frequency of analysis) will be as per S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations and European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009. The likely suite of determinants will include:

- pH;
- Total Petroleum Hydrocarbons (TPH);
- Temperature;

- Total Phosphorus;
- Chloride;
- Nitrate;
- Nitrite;
- Total Nitrogen;
- Orthophosphate;
- Ammonia N;
- Biochemical Oxygen Demand; and
- Total Suspended Solids.

Periodic visual observations at each of the monitoring points will be recorded with specific reference to flow, stream substrate and water colour. Photos will be taken to support visual observation, and inspection sheets including visual observation results and photographic records will be kept on site.

Visual observations will also be completed after major rainfall events along with photographs which will be collected and assessed by the EcoW.

The elements which will be included in the visual checklist are as follows:

- Appropriate period visual inspection of all watercourses which drain the proposed development by the ECoW or a suitably qualified and competent person delegated by the EcoW;
- Groundwater seepage, water ponding and wetting of previously dry spots;
- All elements of drainage system will be monitored including settlement ponds, check dams, interceptor drains etc. Corrective action will be carried out if there is a visual indication of discolouration, oily sheen, odour or litter.
- Event based visual inspections by the ECoW as follows:
    - Following a high intensity localised rainfall event (10mm/hr);
    - Heavy rainfall within a day (25mm in a 24 hour period); and
    - Higher than monthly rainfall within a week period.
- A record of all visual inspections will be included in the Construction Environmental Management Plan (CEMP) and maintained on site.

The ECoW will be responsible for presenting the surface water monitoring results at or in advance of regular site meetings.

The reports will include results from field monitoring as well as visual inspections and laboratory analysis completed for that period. The reports will describe how the results compare with baseline results. Any deterioration in water quality deemed to be caused by construction activity will be flagged and appropriate remediation or corrective actions recommended.

9.5.1.9 Environmental Manager

The CEMP is a living document, it will be revised to take account of planning conditions and implemented during construction works providing a commitment to water quality mitigation and follow-up monitoring, reducing the risk of pollution, and improving the sustainable management of resources.

The implementation of the environmental control measures, mitigation measures, monitoring, and follow-up arrangements and management of effects will be managed through the CEMP. The CEMP provides the client and main project contractor with a practical guide to ensuring compliance with Planning and Environmental requirements by all parties.

An Environmental Manager with appropriate experience and expertise will be employed by the appointed Principal Contractor for the duration of the construction phase to ensure that all the environmental design, control and mitigation measures outlined in the EIAR and supporting planning documentation in relation to the water environment are implemented. The Environmental Manager together with an environmental team will deal with drainage maintenance, mitigation measures and monitoring. The Environmental Manager will have the authority to stop construction activity if there is potential for adverse environmental effects to occur.

9.5.2 Operational Phase

The measures for control of runoff and sediment relate to the construction phase of the project when there is continuous movement of site vehicles and delivery vehicles moving around the proposed wind farm. During the operational phase, the amount of on-site traffic will be very low and there will be negligible risk of sediment runoff. It is therefore proposed to partly fill the sediment ponds with stone so that they will not present a long-term safety risk. Runoff from the tracks, hard-standings, and other works areas will continue to be directed to these ponds and from there to the outfall weirs. Check dams within the drainage channels will also remain in place. The retention of this drainage infrastructure will ensure that runoff continues to be attenuated and dispersed across existing vegetation before reaching the downstream receiving waters. This infrastructure will be inspected regularly by the operational maintenance personnel.

The regular inspections during the operational phase will ensure culverts are free from blockages, and there is no damage or erosion of the stream crossing wing walls, particularly after storm events. Silt ponds will also be inspected and maintained before the drains and verges have vegetated.

Potential effects on water quality due to the operation and maintenance of the wind farm is principally related to the minor risk of oil spillages. This risk is mitigated by design through the provision of adequate bunding and implemented in the construction stage.

All vehicular movement during operation and maintenance will be restricted to the internal access tracks and hardstands.

9.5.3 Decommissioning Phase

The potential effects on the water environment during the decommissioning stage will be similar to those during the construction phase, and as such the proposed mitigation for the decommissioning phase are similar to those outlined previously. Moreover, due to the relative long life of the wind farm infrastructure, it is likely that a revised/updated environmental assessment will be required at the time of decommissioning to account for any changes in baseline conditions at the proposed project site, and potential changes in assessment guidelines and legislation and technology and advancements.

9.6 Residual Effects

By implementing the above mitigation measures, the significance of the residual effects on the water environment during the construction, operation and decommissioning phase of the development is assessed as being imperceptible to not significant. Mitigation by design has been implemented from the early concept and design stage to prevent adverse effects and mitigation measures will be implemented and monitored throughout the construction and operation phases. It is considered that the proposed project design including control measures, together with mitigation measures, will ensure that there will be no significant negative effect on surface water quality, surface water flows or groundwater resources. Refer to Table 9-21.

Mitigation measures, where required, will be put in place before development work commences. As a result of the measures to be implemented, the proposed project is expected to have a low impact on the receiving environment. Consequently, the proposed project is not expected to contribute to any cumulative negative effects with other existing or proposed projects in the vicinity. When the mitigation measures are implemented in full, a high degree of confidence can be assured that any negative effects on the receiving environment will be imperceptible/not significant. In particular, the development and operation of the wind farm, when undertaken as proposed, is not expected to have a significant negative effect on the groundwater regime. The risks associated with sedimentation and contamination of the aquifers due to erosion and runoff will be reduced to minimal levels as areas are re-vegetated and construction traffic is no longer present. Hydrological or hydrogeological conditions would not be altered to a degree that would affect the local or wider area.

Additionally, as previously mentioned, a Natura Impact Statement (NIS) has been completed for the proposed project and determined that there will be no adverse effects on any qualifying interests of protected Natura 2000 sites hydrologically linked and downstream of the proposed site. Therefore, there will be no significant adverse effects on the hydrological or hydrogeological regime pertaining to the development site.

Table 9-21: Residual Hydrological and Hydrogeological Effect Significance on Sensitive Receptors

Activity	Potential Effect	Receptor	Pre-mitigation	Post-mitigation	Mitigation Measures
Construction Phase					
Removal of vegetated surface leading to increase in impermeable areas for turbine hardstands, access tracks, met lidar hard stand, substation and associated compound.	Increase in Surface Runoff	Surface Waterbodies	Significance: Moderate Likelihood: Likely Duration: Permanent	Significance: Slight Likelihood: Unlikely Duration: Long term	Refer to Section 9.5.1.1
Earthworks such as removal of vegetation, excavation of soil and rock, inappropriate excavated material/spoil management.	Increase in Suspended Solids	Surface Waterbodies and Groundwater	Significance: Significant Likelihood: Likely Duration: Short term	Significance: Slight Likelihood: Unlikely Duration: Short term	Refer to Section 9.5.1.1
Spillage of fuel, oil, lubricants, or other hydrocarbons during construction.	Potential Release of Hydrocarbons	Surface Waterbodies and Groundwater	Significance: Significant Likelihood: Likely Duration: Short Term	Significance: Not Significant Likelihood: Unlikely Duration: Short term	Refer to Section 9.5..1.4
Spillage of cement-based products.	Release of Cement Based Products	Surface Waterbodies and Groundwater	Significance: Moderate Likelihood: Likely Duration: Temporary	Significance: Imperceptible Likelihood: Unlikely Duration: Temporary	Refer to Section 9.5.1.3
Diversion, culverting and bridge crossing of surface watercourses.	Morphological Changes to Surface Watercourses & Drainage Patterns	Surface Waterbodies	Significance: Moderate Likelihood: Likely Duration: Short term	Significance: Not significant Likelihood: Unlikely Duration: Short term	Refer to Section 9.4.2
Leaking sanitary waste or release of effluent from domestic wastewater treatment systems.	Groundwater and Surface Water Contamination from Wastewater Disposal	Surface Waterbodies & Groundwater	Significance: Moderate Likelihood: Likely Duration: Temporary	Significance: Imperceptible Likelihood: Unlikely Duration: Temporary	Refer to Section 9.5
Dewatering due to excavation works and dewatering of the proposed borrow pit.	Groundwater Levels and Local Well Supplies	Down Gradient Water Supplies	Significance: Slight Likelihood: Likely Duration: Short term	Significance: Imperceptible Likelihood: Unlikely Duration: Short term	Refer to Section 9.5.1
Operational Phase					
Decrease in permeability due to hardstand areas, access tracks, substation and associated compound.	Increase in Surface Runoff	Surface Waterbodies	Significance: Not Significant Likelihood: Likely Duration: Permanent	Significance: Imperceptible Likelihood: Unlikely Duration: Long term	Refer to Section 9.5.1.

Activity	Potential Effect	Receptor	Pre-mitigation	Post-mitigation	Mitigation Measures
Spillage of fuel, oil, lubricants, or other hydrocarbons during operation and maintenance.	Potential Release of Hydrocarbons	Surface Waterbodies and Groundwater	Significance: Not Significant Likelihood: Likely Duration: Short term	Significance: Imperceptible Likelihood: Unlikely Duration: Short term	Refer to Section 9.5.1.4

9.7 Cumulative Impacts and Effects

Cumulative effects relate to the addition of many minor or insignificant effects, including effects of other projects, to create larger, more significant effects. A list of proposed and approved/permitted developments assessed in the EIAR for cumulative impact assessment with the proposed project is provided in Chapter 01 Introduction.

The closets of the significant planning applications to the proposed development include:

- Four multiple housing developments in Thurles;
- 1 incomplete powerline (Borrisoleigh to Thurles – note there are 2 planning applications for this line);
- A community health care centre and pharmacy (Thurles); and
- A multifunctional spectator stand for a sports facility with three pitches in Thurles.

One multi-housing development (86 units) in Thurles was permitted in Feb 2024, another in Feb 2023 (26 units) and a third in Sept 2022 (63 dwellings). One multi-housing planning application in Thurles is still under consideration. These are all located at least 3km south and downstream of the proposed wind farm site.

These large projects will be put through a rigorous design process for obtaining planning permission. Where relevant, these projects/plans have incorporated Construction Environmental Management Plans (CEMPs) and Appropriate Assessments to ensure that there will be no adverse effects on hydrology or hydrogeology.

The only potential development where direct cumulative effects that could reasonably be foreseen is the incomplete powerline which transects the proposed Brittas WF development site (see Figure 2-25 in Chapter 02 Project Description). This c.6.94 km of incomplete powerline requires either new poles to be erected or that existing poles be strung. The structures to be erected comprise either twin or predominately single timber pole structures strung or to be strung with a twin line. This development was permitted in mid-2023 and is likely to be constructed prior to construction phase of the proposed project. The wind farm developer will submit a separate planning application for the rerouting of this line through the wind farm site to Tipperary County Council, in consultation with ESB. The possible options for this re-routing are outlined in Chapter 04 Alternatives of the EIAR.

The construction of this powerline will be completed prior to construction of the Brittas windfarm project and will therefore not have any additional cumulative effects in combination with the proposed wind farm. This EIAR has assessed the potential effects of rerouting this powerline during the construction of the wind farm – as part of the project. Therefore, an assessment of cumulative effects is not relevant.

There are 35 smaller planning projects within 5km of the proposed project. These include agricultural sheds and shed extensions, livestock facilities, dwelling houses, and extensions to dwelling houses, attic conversions, domestic wastewater treatment systems, property entrances and roads, sports facilities, garages, demolitions, and retention permission applications etc. Six of these small planning applications were permitted in 2023, two in 2022, six in 2021, seven in 2020 and four in 2019. The construction of these developments will likely be completed, and their planning permissions expired by the time construction of the proposed project would potentially begin (at the end of 2028). Consequently, such dispersed small scale domestic and agricultural developments are not expected to have significant cumulative effects with the proposed project. Cumulative effects would therefore be insignificant with the proposed project in terms of hydrology and geohydrology.

There are several other wind farm developments within 20km of the proposed project. The closest of these is the Lisheen Wind Farm which is located approximately 9.8km to the north east. The nearest Solar farm to the proposed project is the ENGIE Solar Farm which is proposed to be located approximately 5km south-west of the proposed project. In terms of cumulative hydrological effects arising from elements of the proposed project, the potential for effects on water quality or flood flows is low as they are all contained within the proposed project site. Therefore, they will be within the wind farm drainage catchment where all construction water will be attenuated and treated as described.

Therefore, the construction phase cumulative effect of the proposed project in combination with the related projects mentioned on hydrology and geohydrology aspects is considered to be negative, imperceptible and temporary (the construction phase of the proposed project will be no more than 18 months).No significant cumulative effects will occur during the operational phase of the proposed development or the decommissioning phase.

9.8 Compliance with the Water Framework Directive

In line with the requirements of the EU Water Framework Directive (WFD) (2000/60/EC) (WFD), all Member States are required to protect and improve water quality in all waters so that good ecological status is achieved by 2027 at the latest. The WFD establishes an integrated and coordinated framework for the sustainable management of water.

Developments that have the potential to affect 'water bodies' as designated by the WFD are required to demonstrate that actions would not result in a deterioration in 'Good' status. This chapter of the EIAR speaks directly to the potential effect of the proposed project on the water resources located within the vicinity of the development. The chapter also details the mitigation measures that will be implemented during the construction, operation and decommissioning phases of the development to ensure that the risk to any water resources is significantly reduced. A full Water Framework Directive Report is provided in Appendix 9B. The proposed project will not result in any deterioration of WFD status of any water body or jeopardise the achievement of good status under the WFD for any water body.

The mitigation measures proposed in Section 9.5 to ensure compliance with the WFD are summarised below;

- Site Clearance – Mitigation measures will be implemented in accordance with the Forestry and Water Quality Guidelines (DMNR, 2000);
- River Crossings – All construction method statements will be developed in consultation with Inland Fisheries Ireland and in accordance with the details in Chapter 03 Civil Engineering of this EIAR the CEMP and accompanying this application;
- Drains – A robust drainage system will be put in place including maintenance and enhancement of existing drainage, as well as new systems, to minimise sediment release during construction. Settlement ponds, check dams, silt fencing, interceptor drains and silt traps will also be implemented;
- Sediment Control – The runoff from the existing and new internal access tracks will be collected in open drains on both sides of the track. Each outfall will have a silt fence to collect the sediment in the runoff. The runoff from each of the turbine and crane hardstand sites will be collected separately from the access track runoff and directed to settlement ponds;
- Settlement Ponds – Dedicated settlement ponds will be provided adjacent to access tracks, hardstands, substation, and storage areas;
- Concrete Control – During the pouring of concrete, effective containment measures will be implemented to avoid spilling concrete outside construction areas and to prevent concrete entering any part of the drainage system;
- Borrow Pit – Standing water, any surface water runoff or water pumped from within the borrow pit is likely to contain an increased concentration of suspended solids. Runoff or pumped water from the

borrow pit will be isolated from the clean catchment runoff by means of a series of open drains that will be constructed within the area. These drains will be of check dams that will attenuate the flow and provide storage for the increased runoff from exceptional rainfall events;

- Storage Areas & Deposition Areas – Materials will be stored as described in Section 9.4.2.6;
- Access Track/Temporary Road Widening Construction – To mitigate against siltation of storm water runoff, access track construction material will consist of crushed aggregate with low fines content. Silt fencing will be erected;
- Plant and Refuelling – Appropriate plant and refuelling measures outlined previously will ensure no contamination to hydrological or hydrogeological receptors occur;
- Waste - A dedicated storage area will be provided at the site compound for building materials such as cables, geotextile membranes, blocks, tools and equipment, fence posts and wire, booms, pipes etc. A Waste Management Plan will be prepared by the Appointed Project Contractor for the construction phase;
- Monitoring - During the construction phase of the project, a surface water monitoring schedule, finalised prior to construction, will be followed; and
- Environmental Management – The CEMP will be updated and implemented during construction works providing a commitment to water quality mitigation and follow-up monitoring, reducing the risk of pollution, and improving the sustainable management of resources.

9.9 References

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