7. AQUATIC ECOLOGY

7.1 Introduction

The Aquatic Services Unit (ASU), University College Cork, were commissioned by Ørsted to provide the Aquatic Ecology chapter to the EIAR (prepared by MKO) in relation to the Proposed Repowering of the Existing Kilgarvan Wind Farm, Co. Kerry.

The area of the EIAR Site Boundary is approximately 775 hectares (ha) covering townlands as set out in Chapter 1, Section 1.1.2. Where the 'Proposed Development' is referred to in this chapter, this relates to all the project components described in detail in Chapter 4 of this EIAR. Where 'the site' is referred to, this relates to the primary study area for the EIAR, as delineated by the EIAR Site Boundary in green as shown on Figure 1-1 in Chapter 4 of this EIAR.

The aquatic impact assessment identifies aquatic ecological receptors and examines the potential effects and their significance during the construction, operation and decommissioning phases of the Proposed Development.

The objectives of the Aquatic Ecology assessment are as follows:

- Produce a baseline study of the existing surface water environment and aquatic ecological receptors in the study area that are hydrologically connected to the Proposed Development.
- Identify any potential effects on surface waters and aquatic receptors during construction, operation and decommissioning phases and determine those effects that are "likely" and "significant" in relation to the Proposed Development.
- Assess cumulative effects of the Proposed Development in combination with other catchment activities and projects.
- Identify mitigation measures to avoid, prevent and reduce potentially significant negative direct, indirect and cumulative effects.
- Assess residual effects of the Proposed Development on aquatic ecological receptors.

7.2 Statement of Authority

The Aquatic Services Unit (ASU) is an environmental consultancy specialising in water quality assessment, environmental monitoring, environmental impact assessment and statutory reporting requirements. The unit is based in the Environmental Research Institute of University College Cork (UCC). It consists of three different sections – Freshwater Ecology, Marine Ecology and Water Analysis Laboratory. The unit engages in collaborative research within UCC and with institutes in Ireland and abroad. The work of the ASU is overseen by Gerard Morgan MSc who has managed the business since it was set up by UCC in 1986. Assessing the nature of freshwater habitats has been at the core of ASU's business for more than three decades.

This chapter of the EIAR was prepared by Lauren Williams and Gerard Morgan of ASU, UCC.

Gerard Morgan BSc (Hons) MSc designed and implemented the field survey strategy for water chemistry, macroinvertebrate/Q-value assessments and electrofishing surveys for this project. Ger has 35yrs professional consultancy experience, specialising in water quality impacts of a wide range of infrastructural projects including roads, bridges, pipelines, wind farms, power transmission lines and port & harbour facilities. He also specialises in protected species surveys, including fish and pearl mussels. He is a specialist in algal surveys and identifications in rivers and lakes and is recognised by the EPA as a practitioner of the Q-value biotic index system. He has conducted water quality monitoring of the construction phase of large wind farm developments and written EIAR aquatic

ecological chapters for numerous large infrastructural developments in marine and fresh waters. He was the manager and principal senior ecologist of ASU from 1986 to 2023.

Lauren Williams BSc PGDip MCIEEM carried out aquatic baseline studies and impact assessment for this project. She is a qualified freshwater ecologist with over 22yrs professional consultancy experience working in New Zealand (2yrs) and in Ireland (past 19yrs). Lauren holds a BSc in Zoology (University of Otago, NZ); a Certificate in Environmental Law (Open Polytechnic of NZ) and a Post Graduate Diploma in Environmental Monitoring Assessment and Engineering (with Distinction) from Trinity College Dublin. She is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). Lauren specialises in water quality assessment, monitoring, aquatic ecological impact assessment and protected aquatic species and habitat surveys; regularly undertaking specialised aquatic field studies and preparing Ecological Impact Assessment (EcIA) reports and EIAR chapters, plus Appropriate Assessment reporting (AA Screening/NIS) in relation to a wide range of large infrastructural developments, including renewable energy (wind, solar), pipelines, cables, wastewater discharges, and large road and rail projects. She carries out aquatic sampling and reporting as part of national river monitoring programmes and is a recognised aquatic protected species surveyor (freshwater pearl mussel and white-clawed crayfish).

7.3 Methodology

7.3.1 Approach

Watercourses potentially affected by the Proposed Development were characterised by a combination of detailed field study, backed up by desk studies. Field survey methods were consistent with standard and published protocols. Desk-based review of available existing information was used to underpin the aquatic baseline characterisation.

7.3.2 Legislation and Guidance

The ecological impact assessment was prepared in accordance with relevant legislation and guidance documents as follows:

EU Legislation

- European Union Directive 2011/92/EU as amended by Directive 2014/52/EU. (the 'EIA Directive')
- EU Habitats Directive - Council Directive 92/43/EEC (1992).
- EU Water Framework Directive (2000/60/EC) (the "WFD")

National Legislation

- The Wildlife Acts 1976 to 2022 (as amended) which provide for the protection and conservation of wild fauna and flora, specifically from injury, disturbance, and damage to breeding and resting sites.
- Part XAB of the Planning and Development Act, 2000 (S.I. 30/2000) as amended and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477/2011) as amended that transpose the EU Habitats Directive into Irish law.
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003)as amended which give legal effect in Ireland to the WFD.

Guidance

- EPA (2022) *Guidelines on the Information to be contained in Environmental Impact Statements.*

- CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine by the Chartered Institute of Ecology and Environmental Management.
- NRA (2009) Guidelines for assessment of ecological impacts of national road schemes, Revision 2.
- NRA (2003) Guidelines for assessment of ecological impacts of national road schemes, Revision 1.
- IFI (2016) Guidelines on protection of fisheries during construction works in and adjacent to waters. Inland Fisheries Ireland.

7.3.3 Zone of Influence

With regards to aquatic surveys and impact assessment, the downstream Zone of Influence (ZoI) was considered and determined using expert judgement, taking into account existing watercourse morphology, gradient, size and flow type in terms of potential for downstream export of pollutants. There was no fixed distance applied for downstream ZoI because site-specific conditions determine the potential for pollutant generation, downstream transport and any consequent effects. Given the Proposed Development is set in the headwater areas of several small tributaries (Thureehouma, Lettercannon and Glanlee) of the Roughty River, the tributaries were investigated at locations that covered their full length between the site and the tributary confluences with the Roughty River (a distance of up to 3km being the longest of the tributaries). The main channel of the Roughty River was investigated along its length from the confluence of the tributaries to approximately 9km downstream of the site.

7.3.4 Desk Study

A thorough desk-based search of available baseline information was undertaken to identify key aquatic values and/or sensitivities. Verified online information, plus published and unpublished literature were utilised for the impact assessment. The scientific literature was consulted where appropriate. The following publicly available sources were each accessed numerous times between early 2022 and May 2024, with all data informing the desk study current as of May 2024:

- Environmental Protection Agency (EPA) maps and data (https://gis.epa.ie/EPAMaps/)
- Water Framework Directive (WFD) maps and data (https://www.catchments.ie/)
- Catchment Assessment Reports for Draft 3rd Cycle River Basin Management Plans (RBMPs) (EPA 2021a, 2021b, 2023)
- NPWS maps and data (https://www.npws.ie/maps-and-data).
- Formal data request to NPWS (June and July 2022, in relation to pearl mussel records for Roughty, Flesk and Sullane sub-catchments)
- Geohive historical mapping (https://www.geohive.ie/)
- Geological Survey of Ireland (GSI) mapviewer (https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx)
- National Biodiversity Data Centre (NBDC) maps and data (https://biodiversityireland.ie/)
- Inland Fisheries Ireland (IFI) and WFD fish survey data (http://wfdfish.ie/)
- "© OpenStreetMap contributors" attributes images used to create maps (Figs 7-1, 7-2 and 7-3) from data available under Open Database License (https://www.openstreetmap.org/copyright)

7.3.5 Field Studies

7.3.5.1 Sampling Schedule

Field studies were conducted in the Spring and Summer of 2022 to: (1) identify key aquatic receptors, and (2) fully characterise baseline conditions of instream habitats. Specific survey dates are set out in Table 7-1. Locations of survey sites (ITM) were recorded using hand-held GPS. Photographs were taken to record representative views of each survey reach within the study area. General habitat descriptions were recorded at sites during key surveys and sampling (Q-value, electrofishing, water chemistry). Site coordinates and type of survey(s) conducted at each location are shown in Table 7-2. Survey site details are listed in Appendix 7-1, which includes stream order, EPA name and River Water Body (RWB) code, plus current EPA ecological status (2018-2021). Maps showing survey locations are in Appendix 7-2.

Table 7-1 Aquatic Ecology Survey Dates 2022

Survey Type	Survey Date	No. Sites
Biological water quality (Q-value) Roughty River Catchment	4/5 May 2022	18
Biological water quality (Q-value) Flesk / Sullane River catchments	23 September 2022 3 October 2022	7
Water chemistry sampling – Run 1	13 April 2022	19
Water chemistry sampling – Run 2	9 May 2022	19
Electrofishing (1)	19/20 August 2022	7
Electrofishing (2)	29 September 2022	3
Freshwater Pearl Mussel (Roughty)	5 July 2022	1.4km reach
Freshwater Pearl Mussel (Flesk)	3 October 2022	9km reach

Table 7-2 Aquatic Ecology Survey Sites, Types and Locations

Sub-catchment	Site			Q-value	Water	Fish	Habitat
Roughty (Thureehouma)	K3	506739	577246		√		√
	K4	506766	577119	√	√		√
	K5	506526	577031	√	√	√	√
	K27	505850	575788	√	√	√	√
Roughty (Lettercannon)	K23	506750	575270	√	√	√	√
	K25	507489	545658	√	√	√	√
	K9	509976	576170	√	√		√
Roughty (Glanlee)	K12	509149	576307		√		√
	K13	509061	576218	√	√		√
	K14	508824	576199		√		√
	K16	508928	575840	√	√	√	√
	K17A	508870	575242	√	√	√	√
	K18	507930	575117			√	√
	K18B	508078	575311	√	√	√	√
	K20A	509786	576634	√	√		√
	K19	507240	574589	√	√	√	√

Sub-catchment	Site			Q-value	Water	Fish	Habitat
	K19 US	507162	574725	√	√		√
Roughty (Main channel)	K19 DS	507213	574584	√	√		√
	K23 US	506754	575187	√			√
	K23 DS	506679	575282	√	√		√
	K27 US	506029	575696	√			√
	K27 DS	505770	575764	√			√
	K29	505909	575718		√		√
Flesk	F1	510171	582038				√
	F2	509534	581783	√			√
	F3	508595	581517	√			√
	F4	510632	582024	√			√
	F5	510560	581867	√			√
	F6	511012	581963	√			√
	F7	509714	581792	√			√
	F8	510278	581020	√			√
	F9	511583	579783				√
	F10	511418	579525				√
	F11	511177	578911				√
	F12	511160	578808				√
	F13	510797	578499				√
	F14	510846	578319				√
Sullane	S1	510608	577630	√			√
	S2	510608	577630				√

7.3.5.2 Biological Water Quality

In Ireland, biological water quality is assessed using the Q-value metric. This system is based on field sampling and observations, which evaluates habitat quality and macroinvertebrate diversity and abundance to interpret ecological status as set out in Table 7-3.

Table 7-3 Q-value relationship to water quality and WFD status

Q-value	EQR	Quality Description	Water Quality	[1]WFD Ecological Status
Q5	1.0	Unpolluted	Good	High
Q4-5	0.9	Unpolluted	Fair-to-Good	
Q4	0.8	Unpolluted	Fair	Good
Q3-4	0.7	Slightly Polluted	Doubtful-to-Fair	Moderate
Q3	0.6	Moderately Polluted	Doubtful	Poor
Q2-3	0.5	Moderately Polluted	Poor-to-Doubtful	

[1] *Status assigned in this report is "potential" WFD status as it is not part of the EPA's formal WFD river monitoring programme.*

Q-value	EQR	Quality Description	Water Quality	[1]WFD Ecological Status
Q2	0.4	Seriously Polluted	Poor	Bad
Q1-2	0.3	Seriously Polluted	Bad-to-Poor	

Potentially affected watercourses were sampled in accordance with EPA protocols to determine Q-value and water quality implications. This involved taking 2-minute, travelling kick-samples in a fast flowing (riffle) area of each stream using a professional long-handled sampling net (250 mm width, mesh size 0.25mm). Stone washing was employed to ensure "clinging" species were adequately collected. Samples were identified on the bankside using a large white tray with a volume of water covering the sample to record relative abundance of aquatic macroinvertebrates (identified to species level where possible; family level at minimum). The abundance of each group and sensitivity to pollution are then used to assign Q-value in accordance with published methods of Toner *et al.* (2005).

The Ecological Quality Ratio (EQR) represents the relationship between the values of the biological parameters observed for a given body of surface water and the values for these parameters in reference (pristine) conditions applicable to that body. The EQR classifies sites according to ecological quality status as required by river basin management planning under the WFD. It allows comparison of water quality status across the European Union since each member state has an EQR value for 'High'; 'Good', 'Moderate', 'Bad' and 'Poor', based on an intercalibration of boundaries between water quality categories (McGarrigle & Lucey, 2009). Under the WFD all surface waters must be maintained or restored to at least Good Ecological Status (Q4). High status waters (Q4-5 and Q5) must not suffer deterioration.

The Q-value provides a more long-term indication of watercourse conditions, in contrast to snap-shot water chemistry analysis, which provides useful information for that moment in time. The Q-value assists in the detailed characterisation of water and habitat quality given that water quality is primary determinant of habitat quality for aquatic organisms.

7.3.5.3 Physico-chemical Sampling

Key sites on watercourses were selected for water sample analysis. Two sampling runs were conducted, the first (13 April 2022) during average flow conditions and the second (9 May 2022) a few hours past the peak of a rainfall event when flows were still elevated. Samples were taken in 1-litre HDPE bottles, all collected within a short period of time. They were stored in cooler boxes with freezer packs between sites and while in transit and were then refrigerated at the ASU lab. Analysis was commenced as soon as possible, either on the evening samples were returned to the lab, or the following morning. The ASU laboratory is EPA approved for all parameters reported. Along with expert knowledge of water chemistry indicators on this geology and soil type, physico-chemical parameters were interpreted with respect to legally binding Environmental Quality Standards (EQS) defined in Surface Water Regulations (S.I. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations as amended by S.I. 77 of 2019) to support the achievement of high and good ecological status, as set out in Table 7-4.

Table 7-4 Physico-chemical boundary values for Irish rivers ([2]S.I. 77 of 2019)

	High Status	Good Status
MRP (mg P/l)	≤ 0.025 (mean) and ≤ 0.045 (95%ile)	≤ 0.035 (mean) and ≤ 0.075 (95%ile)
Ammonia (mg N/l)	≤ 0.040 (mean) and ≤ 0.090 (95%ile)	≤ 0.065 (mean) and ≤ 0.140 (95%ile)
BOD (mg O_2/l)	≤ 1.3 (mean) or ≤ 2.2 (95%ile)	≤ 1.5 (mean) or ≤ 2.6 (95%ile)
Dissolved Oxygen (% sat.)	80 -120%	

[2] *S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019*

7.3.5.4 Electrofishing Surveys

An electrofishing authorisation was obtained under section 14 of the Fisheries Consolidation Act 1959 as substituted by Section 4 of the Fisheries (amendment) Act, 1962. In conformity with the conditions of the authorisation all equipment, containers and nets used for the electrofishing surveys were firstly cleaned, dried and disinfected with 1% Virkon Aquatic as prescribed by the IFI biosecurity protocols which are designed to prevent the spread of fish disease or invasive species (IFI, 2010). Surveys were carried out on 19/20 August and 29 September 2022, by fully trained and experienced personnel.

A battery powered back-pack fisher was used, operated at 400 volts (giving an output of ~200 volts) with low ampage. The aim was to conduct ten-minute timed passes at smaller stream sites, although fishing times were reduced if there was inadequate habitat or access problems. A quantitative 3-pass depletion fishing with stop-nets was carried out on one of the Roughty River main channel sites. At each site a detailed habitat description was undertaken. All fish captured were placed in a holding bucket with plenty of clean, well oxygenated water. They were then anaesthetized with a few drops of clove oil, identified, measured to the nearest millimetre, placed in a well oxygenated recovery bucket and returned to the survey reach once recovered.

In addition, field-based fisheries habitat assessments were conducted at all sites, involving visually assessing the principal in-channel and bank-side habitats (e.g., substrates, flow type), and their suitability as spawning and or nursery sites for fish including salmonids, lampreys and eel.

7.3.5.5 Freshwater Pearl Mussel Survey

Pearl mussel *(Margaritifera margaritifera)* surveys were carried out on 5 July and 3 October 2023 under NPWS Licence C82/2022 (Exp. 31 December 2022) pursuant to Wildlife Acts 1976 to 2022, as amended – Sections 23 and 34, adhering to published Stage 1 and 2 survey guidelines (Anon., 2004). Upstream and downstream co-ordinates for the overall survey reaches of the Roughty and Flesk river channels are set out in Table 7-5.

Selected stretches within the survey reach were snorkelled, focusing on the best potential habitat at the river margins. Snorkelling ensured a high level of river coverage, covering otherwise difficult to access terrain, without physical impact on mussels and high confidence in results. The most upstream reaches on the Roughty River, nearest the tributary confluences, were shallow and accessible and were surveyed using bathyscopes. All mussels observed were counted and recorded. A formal data request was made to NPWS for existing pearl mussel records from the Roughty and Flesk catchments, which located all pre-existing records for pearl mussel in these catchments. The data is sensitive, so cannot be presented in full in this document. NPWS records showed locations downstream of the Proposed Development had positive records for mussels in the past. Such information was used to help focus surveys within the selected river reaches downstream of the Proposed Development.

Table 7-5 Roughty and Flesk River Pearl Mussel Survey Reach

River	Reach co-ordinates ITM (X,Y)
Roughty	US: 507115, 574856
	DS: 500659, 572951
Flesk	US: 509670, 581888
	DS: 508595, 581517

7.3.5.6 General Habitat Descriptions

During the above specific field surveys (Q-value, water chemistry, electrofishing) the river and stream sites were visually assessed to characterise bankside and in-channel habitats in terms of their aquatic ecological value for fish, macroinvertebrates and aquatic biodiversity. Site habitat characteristics

recorded included: substrate and flow types, depth and width, shading, surrounding land-use and general morphological character. The latter were assessed based broadly on criteria for river hydromorphology using the principles of the River Hydromorphology Assessment Technique (RHAT) (NIEA, 2014).

7.3.6 Assessment Criteria and Significance

7.3.6.1 Ecological Valuation of Watercourses

The criteria used for assessment of ecological value of watercourses are adapted from NRA (now Transport Infrastructure Ireland - TII) Ecological Impact Guidelines (NRA, 2003, 2009) involving careful consideration of fisheries value, water quality and consideration of contextual information for the resource at a geographic level. The evaluation criteria used to classify sites is shown in Table 7-6. This is mainly based on NRA (2003) guidelines which reference aquatic habitats or fisheries, with slight modifications in accordance with NRA (2009) to set out criteria that classify aquatic habitat value within the study area. NRA (2003) guidelines provided more direction on classification of aquatic habitats, while NRA (2009) focused on terrestrial habitats. Only criteria with direct relevance to aquatic habitats and fisheries have been retained in Table 7-6. Baseline survey results and observations were assessed against the criteria in the context of national trends, guidelines and regulations and EU WFD criteria for ecological status, as appropriate.

Table 7-6 Ecological evaluation criteria (Adapted from NRA, 2003, 2009)

Relevant Criteria	Category
International Importance: › Sites designated (or qualifying for designation) as an SAC. › Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988) › Major salmonid (salmon, trout, or char) lake fisheries	**A**
National Importance: › Sites or waters designated or proposed as an NHA, Statutory Nature Reserve or National Park › Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU habitats directive. › Resident or regularly occurring populations (assessed to be important at the national level) of species protected under the Wildlife Acts; and/or; species listed on a Red Data list. › Major trout fishery rivers; › Waterbodies with major amenity fisheries value; › Commercially important coarse fisheries.	**B**
County Importance: › Small water bodies with known salmonid populations or with good potential salmonid habitat, › Undesignated sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive; › Large water bodies with some coarse fisheries value; › Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.	**C**
Local Importance (Higher Value): › Small water bodies with some coarse fisheries value or some potential salmonid habitat. › Any waterbody with unpolluted water (Q-value rating 4-5, Q5)	**D**

Relevant Criteria	Category
Local Importance (Lower value): › Water bodies with no current fisheries value and no significant potential fisheries value.	**E**

7.3.6.2 Impact Assessment Criteria

The level of significance of potential direct, indirect and cumulative effects associated with the Proposed Development were assessed in accordance with criteria set out in EPA Guidelines (EPA, 2022). Guidance was also sought from CIEEM (2018) and NRA (2003, 2009). Identified aquatic receptors have been highlighted, where they occur, as Important Ecological Features (IEFs), hence requiring specific assessment within this Ecological Impact Assessment. Ecological features were assigned as an IEF for a variety of reasons (e.g., quality and extent of designated sites or habitats, habitat / species rarity at a geographic level) (CIEEM, 2018). The magnitude, extent, timing and duration of potential impacts have been considered, as well as their likelihood of occurring (EPA, 2022; CIEEM, 2018). Types of effects and levels of significance were assigned according to the terminology of EPA (2022), as set out in Tables 7-7 and 7-8, also determined using the significance matrix per ecological quality category, set out in Appendix 7-3.

Table 7-7 Ecological Effect Significance Criteria (from EPA, 2022)

Effect Significance	Criteria
Neutral	No effect
Imperceptible	An effect capable of measurement but without noticeable consequences
Not significant	An effect which causes noticeable changes in the character of environment but without significant consequences
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging trends
Significant Effects	An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound Effects	An effect which obliterates sensitive characteristics

Table 7-8 Ecological Effect Duration Criteria (from EPA, 2022 and CIEEM, 2018)

Effect Duration	Criteria
Momentary Effects	Effects lasting from seconds to minutes
Brief Effects	Effects lasting less than a day
Temporary Effects	Effects lasting less than a year
Short-term Effects	Effects lasting one to seven years

Effect Duration	Criteria
Medium-term Effects	Effects lasting seven to fifteen years
Long-term Effects	Effects lasting fifteen to sixty years
Permanent Effects	Effects lasting over sixty years
Reversible Effects	Effects from which spontaneous recovery is possible within a reasonable timescale or which may be counteracted by mitigation.
Irreversible Effects	Effects from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it.

7.4 Receiving Environment

7.4.1 Overview

The Proposed Development site is located approximately 5.5km northeast of the village of Kilgarvan, Co. Kerry and approximately 6km west of Coolea, Co. Cork. It is set on upland blanket bog, primarily on the western flank of the Derrynasaggart Mountains entirely within the EPA delineated sub-catchment: Roughty_SC_010 (21_7). Several small, first order streams rise within the site and drain to the main channel of the Roughty River. The access track to the Proposed Development site is 7.9km in length, originating at the N22 road and intersecting several small upper headwater streams of the Flesk and Sullane river sub-catchments Flesk (Kerry)_010 (22_8) and Sullane_SC_010 (19_10). Figure 7-1 shows the general direction of flows from the Proposed Development site via the relevant sub-catchments. Field survey sampling sites referred to in this report are marked on maps found in Appendix 7-2.

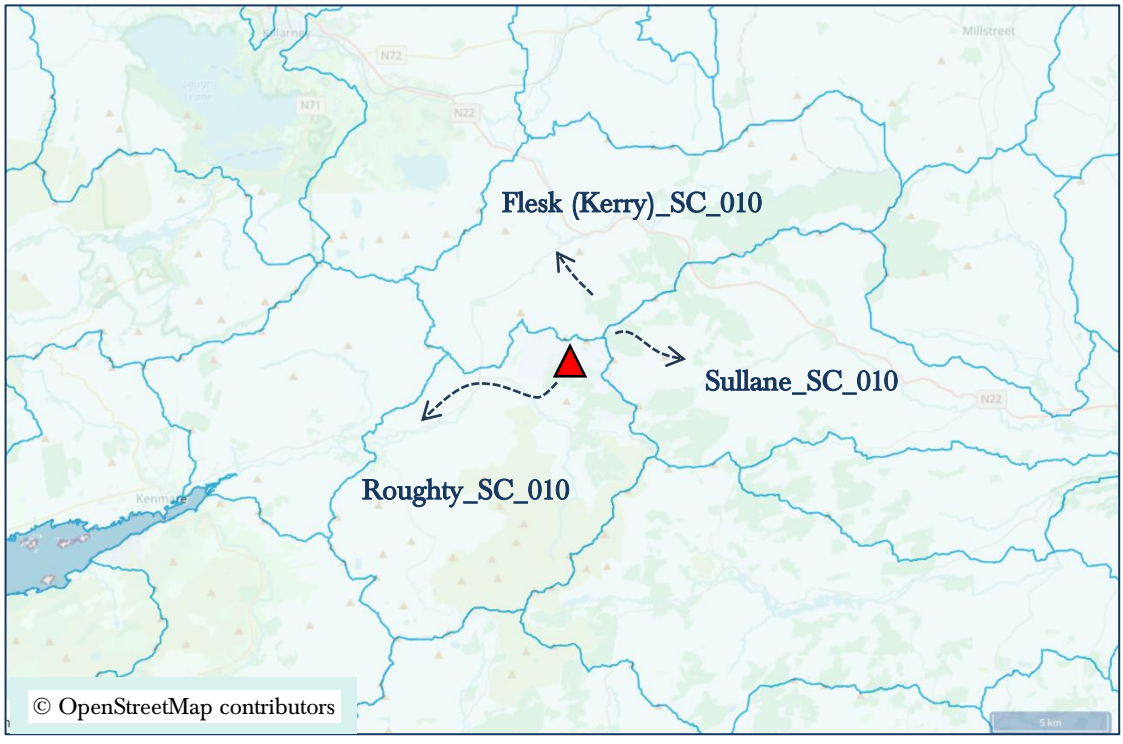

Figure 7-1 Location of Proposed Development (red triangle) showing relevant EPA sub-catchments

Roughty sub-catchment: The Proposed Development site is drained by 3 no. tributaries of the Roughty River, hereafter referred to as Glanlee, Lettercannon and Thureehouma. These mountain streams each confluence with the Roughty main channel between 6.5km and 8.3km upstream of Kilgarvan. The Roughty then flows westwards for c.15km, discharging to the Atlantic Ocean at Kenmare Bay.

Flesk sub-catchment: The site access track travels up from the N22, crossing the mountains high above the Flesk River, intersecting 1 no. small tributary (unnamed)) near the existing 110kV Clonkeen substation and the existing site entrance to the north of the site off the N22 and 3 no. small headwater streams of the Owgarriv Tributary of the Flesk River (2 no. branches of Coumacullen stream and Cloonkeen 22 stream). The tributaries confluence 23.5km and 27.5km, respectively, upstream of Killarney, before discharging via Killorglin (Laune River) to the Atlantic Ocean at Dingle Bay.

Sullane sub-catchment: A very small proportion of access track drainage connects, mainly via existing forestry drains to a small headwater (Barr Duinse) tributary of the upper Sullane River. A single existing culverted watercourse is intersected 11km upstream of Baile Bhuirne, Co. Cork and connects to the River Lee via Macroom and Cork City, discharging to Cork Harbour >65km away.

Underlying geology of the Proposed Development is sedimentary Old Red Sandstone (grey and green-grey sandstone & purple siltstone). In addition to the existing wind farm infrastructure, the site includes remnant wet heath and cutover bog with a patchy mosaic of conifer forest of various plantation age classes. Within afforested areas there are pre-existing networks of forest drains that connect to the EPA delineated watercourses that are the subject of this assessment.

7.4.2 Biological Water Quality Data

A total of eighteen (18 no.) sites draining the wind farm area of the Proposed Development site were kick-sampled in the Roughty sub-catchment on 4/5 May 2022 and assigned Q-values. A further seven (7 no.) sites from the Flesk and Sullane sub-catchments representing tributaries draining the access track were sampled and evaluated on 23 September and 3 October 2022. Macroinvertebrate lists are presented in Appendix 7-4. Table 7-9 summarises Q-values, showing corresponding water quality and WFD status indications. The paragraphs below interpret the data by sub-catchment. Refer to Section 7.4.6 for habitat summary descriptions and representative images of sampling sites.

Table 7-9 Q-value Summary – Roughty, Flesk and Sullane Sites

Sub-catchment	Site	Q-value	Water Quality Indication	[3]Potential WFD status
Roughty (Thureehouma)	K4	Q4-5	Unpolluted / Fair-to-Good	High
	K5	Q4-5	Unpolluted / Fair-to-Good	High
	K27	Q4-5	Unpolluted / Fair-to-Good	High
Roughty (Lettercannon)	K23	Q4-5	Unpolluted / Fair-to-Good	High
	K25	Q4 (4-5)	Unpolluted / Fair	Good
Roughty (Glanlee)	K9	Q4	Unpolluted / Fair	Good
	K13	Q4	Unpolluted / Fair	Good
	K16	Q4 (4-5)	Unpolluted / Fair	Good
	K17A	Q4	Unpolluted / Fair	Good
	K18B	Q4	Unpolluted / Fair	Good
	K20A	Q4 (4-5)	Unpolluted / Fair	Good

[3] *Status is termed "potential" as these classifications are derived from field study and are not part of the formal EPA WFD monitoring and reporting programme.*

Sub-catchment	Site	Q-value	Water Quality Indication	[3]Potential WFD status
	K19	Q4-5	Unpolluted / Fair-to-Good	High
Roughty (Main channel)	K19 US	Q4-5	Unpolluted / Fair-to-Good	High
	K19 DS	Q4-5	Unpolluted / Fair-to-Good	High
	K23 US	Q4-5	Unpolluted / Fair-to-Good	High
	K23 DS	Q4-5	Unpolluted / Fair-to-Good	High
	K27 US	Q4-5	Unpolluted / Fair-to-Good	High
	K27 DS	Q4-5	Unpolluted / Fair-to-Good	High
Flesk	F2	Q4-5	Unpolluted / Fair-to-Good	High
	F4	Q4	Unpolluted / Fair	Good
	F5	Q4	Unpolluted / Fair	Good
	F6	Q3-4	Slightly polluted / Doubtful-to-Fair	Moderate
	F7	Q4-5	Unpolluted / Fair-to-Good	High
	F8	Q4-5	Unpolluted / Fair-to-Good	High
Sullane	S1	Q4-5	Unpolluted / Fair-to-Good	High

Roughty Sub-catchment

On-site Q-values indicate 'good' and 'high' ecological status (Q4, Q4-5) for waters in the three tributary streams draining the Proposed Development site. The outlet site for each of the tributaries (K19, K23, K27) were all potential 'high' status. The upper tributary sites tended to be slightly poorer, although still meriting 'good' status meaning all are compliant with WFD objectives. The Roughty River main channel sites were each potential 'high' status (Q4-5) which aligns with high density of juvenile salmonids during electrofishing and low nutrient levels during water sampling surveys. The Roughty River was at high status (Q4-5) during on-site surveys in 2022, which aligns with current EPA classification of 'high' status (2016-2021) (see Table 7-10).

Flesk Sub-catchment

On-site Q-values represented 'high' ecological status (Q4-5) on the main channel of the Flesk River (F2) in the reach downstream of the relevant tributary confluences. This aligns with current EPA classification of 'high' status (2016-2021) (see Table 7 10). Owgarriv tributary sites (F7, F8), receiving drainage from the middle section of the access track, and the Sullane tributary (S1) which receives drainage from the westerly extent of the access track were each at potential 'high' status (Q4-5). Flesk tributaries A and B drain the easterly extent of the access track and it is possible they are ephemeral (dry at times). In September 2022, Flesk A was Q3-4, potential 'moderate' status in the upper reach (F6), but 'good' status downstream (F4), nearer the Flesk River confluence. Flesk B (F5) is a small, low volume gully stream fed by forestry drains and was at Q4, potential 'good' status. Flesk A and B tributaries have been physically impacted by pre-existing forestry drainage (deepened, incised).

Sullane Sub-catchment

The single representative site sampled was indicative of 'high' status (Q4-5) based on the sensitive macroinvertebrate community present. High levels of forestry activity were noted in the catchment upstream of the sample site.

7.4.2.1 EPA Q-value Data

Tables 7-10, 7-11 and 7-12 set out EPA Q-value data for nearest long-term monitoring sites on the Roughty, Flesk and Sullane rivers for the (combined) years 2002-2022. This encompasses the construction and operational phases for the Existing Kilgarvan Wind Farm.

Table 7-10 EPA Q-value Data Roughty River 2003 – 2020

EPA River Station Code	EPA name	River Station	2003	2006	2009	2012	2015	2018	2020
21R010060	Roughty	Inchee Bridge (RHS)	Q4-5	Q4-5	Q4-5	Q4-5	Q4-5	Q4-5	Q4-5
21R010250	Roughty	Ford d/s Slaheny R confluence	Q4	Q4	Q4-5	Q4-5	Q4-5	Q4-5	Q4-5

Roughty River: Q-value (Table 7-10) has been at 'high' status (Q4-5) at the EPA Inchee Bridge station between 2003 and 2020. Between 2009 and 2020 the site (Ford d/s Slaheny R confluence: RS21R010250) downstream of the wind farm tributaries was also 'high' status (Q4-5) but was 'good' status (Q4) prior to that. Note that this site is downstream of Kilgarvan, a considerable distance downstream of the wind farm tributaries, therefore influenced by other catchment activities. According to this EPA data, the Roughty River currently meets WFD objectives (maintenance of high status).

Table 7-11 EPA Q-value Data Flesk River 2005 – 2022

EPA River Station Code	EPA name	River Station	2005	2007	2010	2013	2016	2018	2022
22F020060	Flesk	Poulgorm Bridge	Q5	Q5	Q5	Q5	Q5	Q5	Q5

Flesk River: The relevant EPA monitoring site at Poulgorm Bridge (N22 crossing) has been at 'high' status (Q5) between 2005 and 2022 (Table 7-11) and therefore consistently meets WFD objectives (maintenance of high status).

Table 7-12 EPA Q-value Data Sullane River 2002 – 2021

EPA River Station Code	EPA name	River Station	2002	2005	2008	2011	2014	2017	2021
19S020100	Sullane	Bridge near Coolea	Q4-5	Q4	Q4	Q4-5	Q4-5	Q4-5	Q4

Sullane River: The upper catchment station near Coolea varied between 'good' (Q4) and 'high' (Q4-5) status between 2002 and 2021 (Table 7-12). Although the site currently attains good status, the more recent decline from high to good status is not compliant with WFD objectives.

7.4.3 Physico-chemical Sampling Data

A total of 21 no. sites were sampled for water chemistry analysed across two sampling runs (13 April 2022 and 9 May 2022). All sites were within the Roughty sub-catchment, covering the three main

tributaries - Thureehouma (K3, K4, K5, K27), Lettercannon (K23, K25), Glanlee (K9, K12, K13, K14, K16, K17A, K18, K18B, K19, K20A), and the Roughty River main channel (K19US, K19DS, K23US, K23DS, K29). Results are set out in Appendix 7-5. Refer to Appendix 7-7 for summary habitat descriptions and representative images of sampling sites.

The following paragraphs interpret the data by tributary sub-basin and the Roughty River main channel. Where criteria for 'high' or 'good' status are stated, refer to Table 7-4, Section 7.3.5.3 for threshold values set out under Surface Water Regulations.

Thureehouma Tributary: Sites K3, K4 and K5 are in the upper headwaters nearest the proposed T7 turbine, while K27 is located at the tributary outlet, just upstream of the Roughty confluence. Each of the samples showed waters of low conductivity, marginally acidic-to-neutral pH (range 6.6 – 7.1) with low alkalinity, which is typical of upland peat headwaters on sedimentary geology. Low nutrient conditions characterise the sites, with very low phosphate (SRP), ammonia and Biological Oxygen Demand (BOD) during both sampling runs. Iron, Dissolved Organic Carbon (DOC) and labile aluminium were very low, as were suspended solids, even in the hours immediately following a rainfall event (9 May 2022). Water chemistry results are indicative of 'high' status according to Surface Water Regulations and support Q-value assessments (above), aligning with 'good' to 'high' ecological status and "unpolluted" waters.

Lettercannon Tributary: Sites K25 is in the upper headwater nearest the proposed T11 turbine, while K23 is located at the tributary outlet, just upstream of the Roughty confluence. Low nutrient conditions characterise both sites, with exceptionally low phosphate (SRP), ammonia and BOD during the sampling runs. Iron and labile aluminium were very low, as were suspended solids, even in the hours immediately following a rainfall event (9 May 2022). DOC was very low in the context of peatland sites in an Irish setting (Cummins and Farrell, 2003b; Barry et al, 2016). Water chemistry results are indicative of 'high' status according to Surface Water Regulations and support Q-value assessments (above), aligning with 'good' to 'high' ecological status and "unpolluted" waters.

Glanlee Tributary: Sites K9 and K20A are the most upstream locations, both on the Glanlee tributary, nearest to the proposed T1 and T3 turbines. Downstream of there, respectively were K12, K13 and K16 on the main stem of the Glanlee tributary, nearest the proposed T2 turbine. K14 is on a small tributary that confluences between K13 and K16. Sites K17A and K18 are on the main stem of the Glanlee tributary (K18 being the most downstream). K18A is on a small tributary, located just upstream of the Glanlee main channel. K19 is located at the Glanlee tributary outlet, just upstream of the Roughty confluence, and therefore representative of the combined input to the Roughty River.

Low nutrient conditions characterise each of these sites, with very low phosphate (SRP), ammonia and BOD during the sampling runs. DOC was very low in the context of peatland sites in an Irish setting. Labile aluminium was low at each site and, in combination with circumneutral pH, would not present a risk to salmonids. Suspended solids were slightly elevated following a rainfall event (but by no means excessive) at the more upstream sites (K9, K20A, K13), but diminished with distance downstream. Iron levels were higher in this tributary system compared to the others, potentially related to the higher proportion of forestry present. Iron levels typically become elevated in headwater streams draining peatland where there is forestry drainage and/or cutover bog, as naturally occurring iron is mobilised from soils. Overall, the Glanlee water chemistry results are indicative of 'high' status according to Surface Water Regulations and support Q-value assessments (above), aligning with 'good' to 'high' ecological status and "unpolluted" waters.

Roughty River: Main channel sites were selected either side of Glanlee tributary input (K19US, K19DS) and Lettercannon tributary input (K23US, K23DS) with one site downstream of the Thureehouma tributary input (K29). Each of the main channel sites during both sample rounds showed waters of low conductivity, marginally acidic-to-neutral pH (range 6.7 – 7.3) with low alkalinity, which is typical of upland peat headwaters on sedimentary geology. Phosphate (SRP), ammonia, (BOD) and DOC were each very low during both sampling runs, even after a rainfall event (9 May 2022), indicating there are no significant upstream nutrient sources. One notable upstream/downstream difference was in iron

concentrations, which were elevated at the most upstream location (K19US) in the May sampling run but diminished within the 900m downstream to Site K23DS and remained low thereafter. The result may be caused by forestry drainage in the catchment upstream of K19US but could also be caused by localised, non-forestry related drainage (natural or anthropogenic) - anywhere there is a disturbance of the iron pan. In any case the effect does not persist downstream. There was a 3mg/l increase in suspended solids downstream (K29) of the three relevant tributary inputs (compared to upstream - K19US) in the hours following a spate on 9 May 2023. The source of the increase, however, does not appear strongly linked to the tributary inputs which each showed low suspended solids concentrations following the spate. Roughty River water chemistry results are indicative of 'high' status according to Surface Water Regulations and support project-specific and EPA Q-value assessments (above), aligning with 'high' ecological status, "unpolluted" waters.

7.4.4 Electrofishing Data

A total of ten (10 no.) locations were electrofished in the Roughty River sub-catchment on 19/20 August 2022 (7 no. sites) and 29 September 2022 (3 no. sites). The surveys covered the 3 no. tributaries draining the Proposed Development, plus the Roughty River. Appendix 7-6 contains detailed descriptions of electrofishing sites and results, including photographs and coordinates of the downstream end of each sampling reach. Size frequency graphs for salmon and trout are also shown in Appendix 7-6. Table 7-13 summarises results of electrofishing survey. Figure 7-2 illustrates the data, showing (1) upper tributary sites were negative for fish, (2) lower tributary sites support both salmon and trout, (3) mid-reaches of the Glanlee tributary support trout only. Presence of impassable barriers (waterfalls, rock faces) were recorded in all three catchments and clearly affect fish distribution.

Table 7-13 Electrofishing result summary

	Site Code	Easting (ITM)	Northing (ITM)	Fish
Thureehouma Tributary	K5	506526	577031	No fish
	K27	505850	575788	Low density of juvenile salmon and brown trout (mainly 0+)
Lettercannon Tributary	K25	507489	545658	No fish
	K23	506750	575270	Good numbers of juvenile salmon and brown trout (0+ and 1+)
Glanlee Tributary	K16	508928	575840	No fish
	K17A	508870	575242	No fish
	K18	507930	575117	Very low density of juvenile trout
	K18B	508078	575311	Very low density of juvenile trout
	K19	507240	574589	Moderate density of juvenile salmon; low density of brown trout (0+ and 1+)
Roughty River	K23 DS	506679	575282	Very high density of salmon and high density of brown trout (0+, 1+ and older)

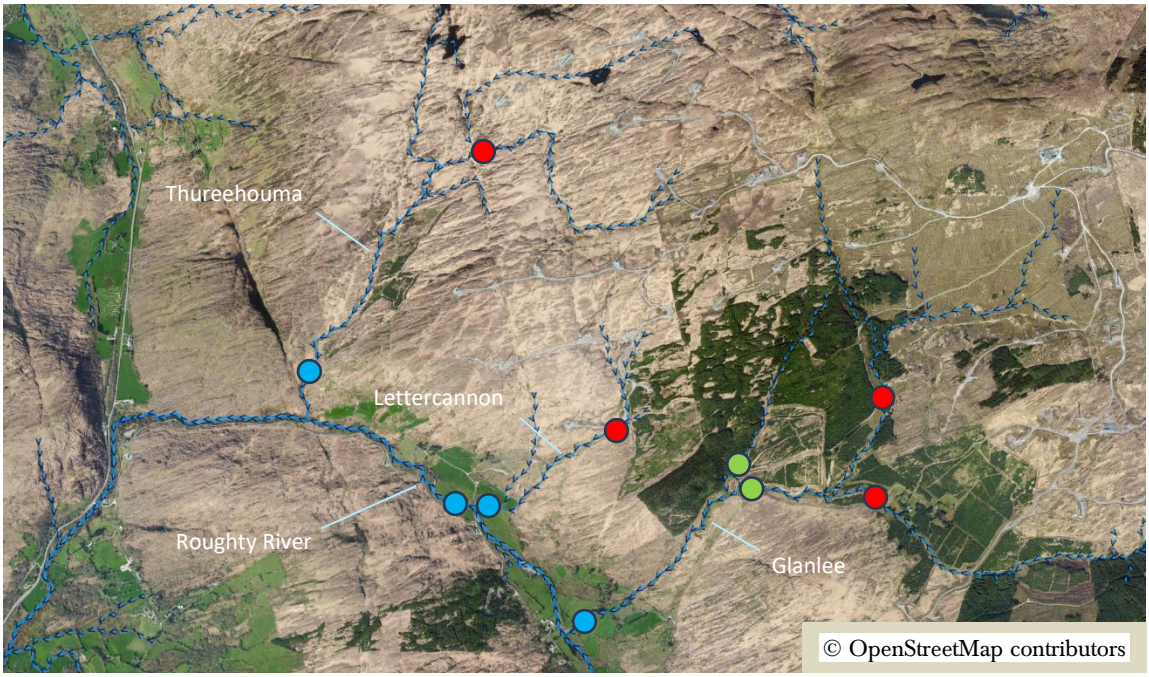

Figure 7-2 Fish Survey Sites (Blue = salmon & trout; Green = trout only; Red = No fish)

Thureehouma Tributary: Site K5 is in the upper headwaters nearest proposed T7 turbine. It is a small channel at that point with some salmonid potential, but fish were not present. The channel was steep in parts, and likely subject to flashy flows, with the likelihood of scouring of finer substrates (i.e., spawning gravels) and presence of natural fish passage barriers that preclude both salmon and a sustainable trout population in the upper reaches near the Proposed Development site. Site K27 is located on the lower Thureehouma tributary, just upstream of the Roughty confluence where juvenile salmon and trout (mainly young-of-the-year) were recorded in relatively low numbers. Appendix 7-6 shows salmon and brown trout size-frequency distributions. The channel is bouldery and lacking in finer gravel material suited to spawning habitat. The channel was difficult to fish, and numbers were almost certainly underestimated.

Lettercannon Tributary: Site K25 is in the upper headwater nearest the proposed T11 turbine and whilst potential salmonid habitat was noted, there were no fish captured. The channel was steep in parts, and likely subject to flashy flows, with the likelihood of scouring of finer substrates (i.e., spawning gravels) and presence of natural fish passage barriers that preclude both salmon and a sustainable trout population in the upper reaches near the Proposed Development site. Site K23 is located on the lower Lettercannon tributary, just upstream of the Roughty confluence where good numbers of juvenile salmon and trout (0+ and 1+) were recorded. Appendix 7-6 shows salmon and brown trout size-frequency distributions. The channel had a high proportion of cobble and relatively less gravel, meaning spawning sites are probably limited. Some fish may be foraging upstream into the lower Lettercannon tributary from the Roughty main channel. The channel was difficult to fish due to combination of coarse substrate and very shallow flows and numbers were almost certainly underestimated.

Glanlee Tributary: The most upstream sites electrofished in this tributary system were K16 (on the wind farm branch of Glanlee) and K17A (easterly branch of Glanlee), neither of which had fish present; attributed to observed and probable natural fish passage barriers downstream (waterfalls, steep rockfaces). Small numbers of trout were present at K18, in the mid-catchment reaches of the Glanlee main channel, despite presence of good salmonid habitat. Absence of salmon tends to confirm a downstream impassable barrier. Site K18B, on a small tributary near K18, also had very low numbers of trout (n=2), both fish captured were slightly larger with no evidence of young-of-the-year, hence localised spawning habitat is likely sparse. Salmonid numbers were relatively low at K19, the most downstream site, located at the tributary outlet near the Roughty confluence. A total of 2 no. trout and

15 no. salmon were captured. Appendix 7-6 shows the salmon size-frequency distribution - all young-of-the-year fish, suggesting localised spawning, but that the habitat is not particularly attractive to older juvenile (1+) fish, potentially due to heavy shade and low instream productivity. Larger juveniles may drop down to the abundant nursery habitat of the nearby Roughty River.

Roughty River: A quantitative 3-pass depletion survey with stop nets was conducted at K23 DS, downstream of the Lettercannon tributary confluence. High densities of juvenile salmon (0+ and 1+) and brown trout representing several age classes (0+, 1+ and older), were recorded as shown in size-frequency distributions in Appendix 7-6. This confirms the importance of the Roughty as a spawning and nursery river and aligns with Q4-5, 'high' status waters as demonstrated by macroinvertebrate community metrics (Section 7.4.2) and water sample analysis (Section 7.4.3). Minnows were also present in moderately low numbers.

7.4.5 Freshwater Pearl Mussel

Roughty River: Selected reaches of the Roughty River covering a total of 9km downstream of the Proposed Development tributary confluences revealed a patchy distribution of *Margaritifera margaritifera*. The reaches were selected based on previous positive records for pearl mussels as derived from NPWS data request. In general, over 70% of the channel is completely unsuitable for mussels owing to the bare, sculpted nature of bedrock pools, rapids and chutes, where mobile gravels and cobbles settle, but are subject to movement during regular spates. The remaining 30% of habitat had very limited habitat suitability owing to obvious scouring during higher flows. Some individual mussels observed at margins appeared to be "just hanging on", with most of the shell sitting proud from the substrates. This concurs with previous pearl mussel work on the Roughty River (Ross, 2015) which also reported large extents of unstable habitat (mobile gravels), unsuitable substrate (bedrock) and sub-optimal hydraulic conditions (swift cascades, rapids and bedrock chutes). It would not be unreasonable to deduce that mussels are subject to dislodgement and downstream movement, where they settle as a spate subsides. Mussel numbers recorded in the current 2022 survey on the Roughty River were fewer than those observed by Ross (2015) as part of the EIAR for the (now constructed and commissioned) Grousemount Wind Farm. The difference in numbers between 2015 and 2022 may be explained by the mobility of channel substrates, with natural die-off of the clearly aged population also likely to be a factor. For confidentiality reasons details of mussel locations and numbers are not reported in detail within this EIAR but were the subject of an internal technical note and were reported to NPWS as part of survey licence conditions.

Flesk River: There were no mussels observed in the surveyed reach which spanned 1.3km of the River Flesk downstream of Poulgorm Bridge (N22 crossing). This reach encompasses input from the Owgarriv tributary (which drains the Proposed Development access road) terminating just upstream of the Loo River confluence (which is not impacted by the Proposed Development). Instream habitat was at least 90% unsuitable for pearl mussels owing to long sections of sculpted bedrock with bare chutes, cascades, rapids and vertical drops. There were very limited patches of stable cobble/gravel at channel margins in the lower survey reaches. The channel appeared to be deepened by historical drainage and was too compacted and/or scoured for the species. NPWS records show a single pearl mussel recorded in 2013 approximately 1.8km downstream of the Owgarriv tributary confluence. Rapid assessments (Ross, 2007) showed no evidence of mussels in the upper Flesk River, with the nearest cluster of mussel population located near the N22 road bridge at Brewsterfield (c.4km and c.5km downstream, respectively, from Owgarriv and Cloonkeen tributaries).

Sullane River: NPWS records show that despite survey efforts, no evidence of mussels has been recorded in the upper Sullane catchment. The nearest records occur near Coolea, ca.8km downstream of the access track to the Proposed Development. *Margaritifera* is considered widespread in the Sullane River, but numbers are low and there is no recruitment evident, with only larger adults throughout (Moorkens, 2007, 2017). The damming of the Lee for hydropower has remove natural migration of salmon (host species to mussels) which likely contributed to the collapse of the Lee/Sullane mussel population.

7.4.6 Baseline Habitat Summary

Appendix 7-7 contains habitat description summaries of all sites surveyed within the study area and in the downstream ZoI, including photographs and ITM coordinates.

7.4.6.1 Ecological Valuation

Table 7-14 lists ecological valuation categories for each of the Aquatic Ecology survey sites covering the Roughty, Flesk and Sullane Sub-catchments.

Table 7-14 Aquatic Survey Site Ecological Valuation Summary

Sub-catchment	Site Code	Ecological Valuation Category (NRA, 2009)	Reason
Roughty_SC_010	**K3**	D – Local Importance (High)	Some potential trout spawning / nursery habitat.
	K4	D – Local Importance (High)	No significant salmonid potential, but high status (Q4-5) waters.
	K5	D – Local Importance (High)	Some potential trout spawning / nursery habitat. High status (Q4-5) waters.
	K27	C - County Importance	Salmon and trout nursery confirmed. High status (Q4-5) waters.
	K9	E – Local Importance (Low)	No significant potential fisheries value.
	K12	E – Local Importance (Low)	No significant potential fisheries value.
	K13	D – Local Importance (High)	Some potential trout spawning / nursery habitat.
	K14	D – Local Importance (High)	Some potential trout spawning / nursery habitat.
	K16	D – Local Importance (High)	Some potential trout spawning / nursery habitat.
	K17A	D – Local Importance (High)	Some potential trout spawning / nursery habitat.
	K18	D – Local Importance (High)	Trout nursery habitat.
	K18B	D – Local Importance (High)	Trout nursery habitat.
	K19	C - County Importance	Salmon and trout nursery confirmed. High status (Q4-5) waters.
	K25	D – Local Importance (High)	Some potential trout spawning / nursery habitat.
	K23	C - County Importance	Salmon and trout nursery confirmed. High status (Q4-5) waters.
	K19US, K19DS, K23US, K23DS, K27US, K27DS,K29	B – National Importance	Roughty main channel - high fisheries significance – important salmon and trout spawning / nursery / holding river. High status (Q4-5) waters.

Sub-catchment	Site Code	Ecological Valuation Category (NRA, 2009)	Reason
Flesk_SC_010	**F1 to F3**	B – National Importance	Flesk main channel - high fisheries significance – important salmon and trout spawning / nursery / holding river. High status (Q5) waters.
	F4 / F6	D – Local Importance (High)	Some potential trout nursery habitats
	F5	D – Local Importance (High)	Some potential trout nursery habitats
	F7	D – Local Importance (High)	Some potential trout spawning / nursery habitat. High status (Q4-5) waters.
	F8	D – Local Importance (High)	Some potential trout spawning / nursery habitat. High status (Q4-5) waters.
	F9	D – Local Importance (High)	Some potential trout spawning / nursery habitat. High status (Q4-5) waters.
	F10	E – Local Importance (Low)	No significant potential fisheries value.
	F11	E – Local Importance (Low)	No significant potential fisheries value.
	F12	E – Local Importance (Low)	No significant potential fisheries value.
	F13	E – Local Importance (Low)	No significant potential fisheries value.
	F14	E – Local Importance (Low)	No significant potential fisheries value.
Sullane_SC_010	**S1**	C - County Importance	Salmon and trout spawning and nursery habitats. High status (Q4-5) waters.
	S2	D – Local Importance (High)	Some potential (very limited) trout spawning / nursery habitat.

7.4.6.2 Aquatic Receptor IEFs

Table 7-15 sets out the aquatic receptors that are Important Ecological Features (IEFs) within the ZoI and are therefore considered in this assessment.

Table 7-15 Aquatic Receptors and IEFs

Sub-catchment	Channel	Aquatic Receptors that are IEFs	Overall Ecological Valuation Category (NRA, 2009)
Roughty_SC_010	**Roughty River**	Excellent salmon & trout habitats (spawning, nursery, holding), macroinvertebrates (high status), freshwater pearl mussel, European eel	B – National Importance
	Thureehouma Tributary	Salmon, trout & eel in lower reaches, but no fish in upper reaches nearest the development site; macroinvertebrates merit high status.	C - County Importance
	Lettercannon Tributary	Salmon, trout & eel in lower reaches, but no fish in upper	C - County Importance

Sub-catchment	Channel	Aquatic Receptors that are IEFs	Overall Ecological Valuation Category (NRA, 2009)
		reaches nearest the development site; macroinvertebrates merit high status.	
	Glanlee Tributary	Salmon, trout & eel in lower reaches, but no fish in upper reaches nearest the development site; macroinvertebrates merit high status.	C - County Importance
Flesk_SC_010	**Flesk River**	Excellent salmon & trout habitats (spawning, nursery, holding), macroinvertebrates (high status), freshwater pearl mussel, European eel	B – National Importance
	Cloonkeen Tributary	No fisheries significance	E – Local Importance (Lower Value)
	Owgarriv Tributary	Trout habitats in lower reaches, but no fisheries significance in the upper reaches near the access track macroinvertebrates (high status), European eel	C - County Importance
Sullane_SC_010	**Barr Duinse Trib. (upper)**	Trout (limited habitat), European eel	D – Local Importance (High)
	Sullane River (upper)	Salmon & trout spawning / nursery habitats, macroinvertebrates (high status), freshwater pearl mussel, European eel	C - County Importance

7.5 Ecological Impact Assessment

7.5.1 Relevant Characteristics of the Proposal

Refer to the project description in Chapter 1 for details of the Proposed Development. Three river sub-catchments are potentially affected and are considered in the aquatic assessment: Roughty_SC_010, Flesk_SC_010 and Sullane_SC_010. A timeline of the proposed work schedule is set out in Chapter 4. Removal of the existing turbines will occur in advance of the construction phase.

The following activities have potential for effects on downstream aquatic receptors, primarily linked with potential suspended sediment wash out during construction:

- Removal of 28 no. existing turbines, with hardstanding's not being utilised in the Proposed Development, being allowed to naturally regenerate, while concrete foundation areas will be reinstated (top-soiled and reseeded)
- Construction of 11 no. new turbines, involving excavation of 8 no. new hardstand areas and 3 no. refurbished (existing) hardstandings
- Construction of short sections of new access road and improvements to existing access roads
- 1 no. new watercourse crossing in the upper Lettercannon Tributary
- Upgrades of existing culverted stream crossings over small headwaters, noting some of these are in-situ and are adequate for continued use. Tables 7-16 and 7-17, below, set out the watercourse crossing details and locations.
- Trenching and electrical cabling alongside internal access roads
- Forestry felling totalling 5.75ha in Roughty_SC_010 and 3.16ha in Flesk_SC_010. (see Fig. 4-12, Chapter 4 for detail of felling areas)
- Installation of site drainage – generally over the edge to vegetated swale with existing piped drains and culverts (see details of drainage design, Chapter 4, Appendix 4-4)
- Excavations from the proposed extension of the existing borrow pit
- Tracking by heavy plant, machinery and construction traffic

Table 7-16 Proposed Development Watercourse Crossing

Proposed Development	Watercourse and location	Existing crossing	Type of structure
Lettercannon Tributary	Small (1st order), unnamed upper headwater ~190m north of T11 [ITM 507796, 576207]	No	New pipe culvert on watercourse of no localised fisheries significance. Pipe dimensions to be determined by Section 50 consent: minimum ø900mm with 300mm embed below existing bed level

Table 7-17 Access Track Watercourse Crossing

Access Track	Watercourse and location	Existing crossing	Type of upgrade
Flesk Sub-catchment	Small (1st order) tributary of Flesk River (unnamed) [ITM 510674, 582018] near Site F4	Yes	Extension of existing pipe culvert on watercourse of no fisheries significance

7.5.1.1 Source-Pathway-Receptor Linkages

Potential direct and indirect impacts and effects are related to source-pathway-receptor linkages between the Proposed Development and aquatic IEFs. The driver of indirect impacts for this project is rainfall, potentially causing pollutant wash out to drains and watercourses. The primary waterborne pollutants and their effects on IEFs are set out under the headings below (suspended solids, cement, hydrocarbons, forestry felling related pollutants). Site specific effects are examined in Sections 7.5.3 to 7.5.5, below.

Suspended Solids

Aspects of the Proposed Development which may be sources of suspended solids include silt and sediment export arising from new earthworks for road construction, erosion of soil stockpiles, erosion of newly laid or stockpiled road resurfacing materials during road upgrades, erosion of decommissioned foundation reinstatement areas, cable trenching, forestry felling and watercourse crossings. Risk of escapement of suspended solids during the construction phase is particularly relevant in upland peatsoil catchments because the organic soils are highly vulnerable to erosion and steep topography is common.

Whilst sediment loss from deeper mineral soils and imported crushed stone is predominantly inorganic, erosion of upland peatsoils during earthworks, can lead to enhanced delivery of particulate organic matter to streams and rivers. Small amounts of organic matter can positively influence instream productivity, but excessive levels can lead to enhanced oxygen depletion through biological degradation in the benthic and hyporrheic zones and localised changes in water chemistry (Aspray et al., 2017). This can cause decline in macroinvertebrate biodiversity and drift responses (e.g., Brown et al., 2018; Aspray et al. 2017) and mortality of fish eggs, fry and juvenile pearl mussels.

Escaped solids can settle in watercourses; smothering of plants and macroinvertebrates (including freshwater pearl mussel) and in the case of fish, causing them to abandon the area temporarily or short-term. At worst, such sedimentation could occur over salmonid spawning beds of the main channels (primarily the Roughty) and the lower reaches of the wind farm repower site tributaries. The effect may be reduced recruitment of young fish from affected reaches because of egg and fry mortalities. Elevated concentrations of suspended solids and resulting turbidity within the water column can potentially damage the gills, physiology and behaviour of fish (e.g., respiration, migration, feeding) and/or benthic macroinvertebrates (e.g., respiration, drift responses) including freshwater pearl mussel.

Presence of existing access and internal roading means there is significantly less risk of sediment wash out during construction, but the combined effects from various sources means that sediment loss and consequent effects are examined in detail, below.

Forestry Felling Related Pollutants

Potential Nutrient Loss Effects during Forestry Felling

Nutrient losses to watercourses during forestry operations have been quantified in a number of Irish studies but it is important to note these relate to clear-felling of entire felling coupes and not the small scale, keyhole or marginal felling proposed for this project. Nutrient losses from forestry felling areas have the potential to cause eutrophication; the process of nutrient enrichment of receiving waters. Phosphorus (P) and Nitrogen (N) are the main cause of concern as these drive cycles of aquatic plant growth and decay, resulting in reductions to in-stream oxygen availability which can negatively impact on in-stream fauna (fish and macroinvertebrates). Phosphorus can be lost in soluble or particulate forms, the latter more associated with poor onsite harvesting management practice and less applicable to peat soils owing to their poor capacity to bind P.

P-loss from felling areas on Irish blanket peatland has primarily been linked to leaching from harvesting residue, i.e., needles, leaves, and brash (Asam et al., 2014; Finnegan et al., 2012). Irish studies also show

that increases of N as nitrate or ammonia can occur in drains and streams draining clear-fell areas, but this effect has been attributed not to leaching from brash residue (which acts as an N-sink immediately after clearfelling) but to increased microbial activity and N-mineralisation in peat soils beneath harvesting residue (Asam et al., 2014). In general, P-loss on blanket peat begins during and immediately after felling but often doesn't peak until the first and or second year post felling, reducing thereafter to return to pre-felling levels around four years post felling (Cummins & Farrell, 2003a; Rodgers et al., 2010; O'Driscoll et al., 2013). N-loss (as a result of mineralisation of peat beneath brash) appears to peak earlier and reduce back towards baseline levels within two years (Asam et al., 2014).

A number of studies show that while there are post-harvesting increases in P concentrations in site drains and small natural watercourses close to the fell site, there is often no significant increase in P concentrations in larger channels further downstream (Neal et al. 2004; Rodgers et al., 2010; O' Driscoll et al., 2013). O'Driscoll et al. (2013) demonstrated P-loss from felling sites on western Irish blanket peatlands, but effects were only significant in small channels near the clearfell sites, with just slight P concentration increases recorded in the next larger channel downstream. There was no risk of altering ecological status of the higher order stream site on the basis of P-concentrations. Instream macroinvertebrate communities were altered as a felling response on upland peat in the small channels (decreased biological water quality) but were unaffected in the larger channels downstream (O' Driscoll et al., 2013). Similar results were obtained for P-concentrations in small versus larger channels by Rodgers et al. (2010) downstream of felling on Irish blanket peat.

Potential Sediment Loss Effects during Forestry Felling

Sediment run-off can arise mainly from the effects of machines cutting the peat surface along poorly managed access and extraction routes and, most significantly, at unbridged stream crossings (Giller et al., 2002). Irish and international studies have shown the importance of good forestry operation management to avoid and limit impacts arising from sediment loss (Giller et al., 2002). Rodgers et al. (2011) found no significant increases in suspended solid concentrations in streams downstream of felling where well managed harvesting was conducted on a peatland site in the west of Ireland. In contrast, a number of clearfelling studies on similar geology on western Irish blanket peat showed significant downstream differences between pre- and post-felling suspended solids (SS) concentrations during floods (Ryder et al. 2010, Rodgers et al., 2008). In Rodgers et al. (2008) maximum suspended solids concentrations occurred in the first two months post-felling, but compared to baseline levels, statistically significant increases were recorded for the first 6 months following felling of a 17.7ha coupe on western Irish peatland. This suggests a critical, early post-felling period for ensuring on-site sediment control measures are adequate and well maintained.

Felling areas for the Proposed Development are very small relative to catchment area but the combined impact from various sources, including felling (along with nutrient pulses), if not managed carefully, gives rise to potential cumulative effects and are therefore considered in the detailed assessment, below.

7.5.1.2 Construction and Environmental Management

The CEMP (Appendix 4-3, Chapter 4) contains detail on surface water drainage design and sets out the overarching measures (i.e., 'mitigation measures) that will be employed to protect water quality during the construction phase of the Proposed Development. The proposed drainage design incorporates specific construction phase measures for the avoidance, reduction and control of water borne emissions from the Proposed Development. This includes the following features: attenuation / settlement ponds, silt traps, hydrocarbon interceptors, silt fencing, check-dams, cut-off drains, swales /filter beds. Contractors will adopt the CEMP as their own and adhere to its contents, plus update their Construction Method Statements and the CEMP to include any further requirements conditioned in the permission.

7.5.2 Do Nothing Scenario

If the Proposed Development was not developed, the site will continue to function as it does at present, with no changes made to the current land-use of a wind farm combined with areas of commercial forestry. If the Proposed Development were not to proceed, the Existing Kilgarvan Wind Farm turbines would eventually be decommissioned as per their existing permissions. The opportunity to capture an even greater part of County Kerry's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

It would be expected that effects on aquatic receptors would be the same as those described in Section 7.5.5, below. There are not expected to be any likely significant negative effects as a result of the future decommissioning.

7.5.3 Potential Construction Phase Effects

7.5.3.1 Forestry Felling

Table 7-18 Forestry Felling - Construction Phase Effects

Description of Potential Effect	Degradation of water quality and aquatic habitats associated with forestry felling causing possible direct effects and/or indirect effects on downstream aquatic IEFs.
Watercourses Potentially Affected	Proposed Development - Wind Farm (total felling area = 5.75ha): › Lettercannon Tributary (T11) – sites K25, K23 › Glanlee Tributary (T8) – sites K18B, K19 › Glanlee Tributary (T2, T3) – sites K16, K18, K19 › Roughty River - main channel downstream of tributaries Proposed Development - Site Access Road (total felling area = 3.15ha): › Flesk - Cloonkeen Tributaries – sites F4, F5 › Flesk River - main channel downstream of tributary
Construction Phase Characterisation of Unmitigated Effect	The total felling areas in each sub-catchment are small and are made up of isolated keyhole and/or marginal areas within existing coupes. In the Roughty River catchment, discrete felling plots are centred around proposed T2, T8, T11 and T3, with a small amount of fell to waste proposed for the habitat restoration area just north of proposed T8, as detailed in Appendix 6-8. In each case the keyhole felling has a considerable rough vegetation buffer between the felling plot and any watercourse which will facilitate nutrient uptake locally. It is noted that the discrete felling areas in the Roughty catchment are at a minimum 100m from the EPA delineated watercourse (i.e., an 'aquatic zone'), providing opportunity for management of the pathway between source and receptor. Linear felling is proposed in the Flesk River catchment to facilitate road widening on the site access track near the N22 entrance. The felling plots represent a tiny fraction of total sub-basin area in each of two sub-catchments [0.1% of Roughty_030; 0.17% of Flesk (Kerry)_030]. Such low magnitudes of felling mean the potential for forestry related impacts and consequent effects on water quality are relatively low. In addition, within these small areas there is substantial scope

	to implement focused on-site management of forest residues and surface water run-off, i.e. compared to broad scale clearfell operations. However, there is still expected to be localised sharp elevations in P-concentrations (MRP) in drainage water immediately post-felling even from these small felling areas. Cummins and Farrell (2003a), for example, monitored forest drains at a 1ha felling area on western Irish peatland showing MRP increased in 2 no. drains, from pre-felling average of 0.013mg/l to post-felling maxima of 3.53mg/l and 4.164mg/l occurring in the year following clearfell, with subsequent steady declines. The monitored 1 ha plot was felled in November of 1999 and, in one of the two drains, MRP only reached maximum 1-year post-felling. Soluble P-loss from Proposed Development felling areas will likely increase P-concentrations in: (1) on-site drains and (2) locally in the upper reaches of the Lettercannon and Glanlee (Roughty sub-catchment) but the literature (see **Section 7.5.1.1**, above) shows there is a low risk of nutrient effects in the Roughty River downstream of the tributaries. On the access track, which drains to the Flesk sub-catchment, the 2 no. Cloonkeen tributaries at the track entrance (Sites F4, F5) may also have a short-term peak in P-concentrations, although the felling levels are very small. Depending on the felling month, P concentrations will peak locally in any lower gradient on-site drains by 1-year post-felling, returning thereafter to low baseline levels. The generally steep nature of the streams draining the fell area sites means the nutrient loss impact would be short-lived, and concentrations would diminish with downstream distance. In all cases changes to MRP would be highly unlikely to be detectable in the much larger, more turbulent Roughty or Flesk rivers, downstream of the small tributary confluences. Some modest increase in N run-off may occur post-felling, again most evident in localised drains and locally in the upper reaches of any connected small first order tributaries, but very unlikely to be detectable at larger channels downstream. The effect on aquatic organisms is likely to be temporary to short term increases in filamentous algal growth locally in the on-site forest drains and upper reaches of the headwater streams affected (principally the upper Glanlee), owing to bioavailability of (mainly) phosphorus. This may contribute to short-term slight decrease in the sensitivity and diversity of macroinvertebrate communities locally but, according to the scientific literature (see **Section 7.5.1.1**, above, would not likely be discernible in larger channels further downstream. “Boom and bust” populations of filter feeding groups of macroinvertebrates, especially black fly larvae (Simuliidae) often occur downstream of felling, linked with fine particulate matter, causing temporary changes in relative abundance of macroinvertebrate groups. There are no sensitive fisheries habitats in the upper headwater reaches of any of the potentially impacted tributaries, therefore no significant impact on fish populations is predicted as a result of nutrient losses. The more sensitive trout and salmon nursery areas are, in all cases, well downstream of the individual proposed small felling plots. It is noted that these streams are currently very oligotrophic in nature (low nutrient) and small pulses of (not excessive) nutrient can potentially promote instream productivity leading to positive impacts on trout growth rates and survival, which could occur in the lower Glanlee and Lettercannon tributaries. Given the steep topography that characterises the proposed felling areas, there will be some loss of disturbed, erodible peat soils from these relatively small source areas as a result of flashy run-off events. Sediment may settle

	very locally to the felling areas as the hydrograph recedes after an event, and thereafter is not likely to settle until it reaches the lower gradient reaches further downstream. Depending on the amounts involved, solids export from catchments can potentially endanger salmonid spawning grounds by clogging redds thereby reducing hatching success of deposited eggs and the survival of emerging fry in the lower reaches of the Lettercannon and Glanlee (Roughty sub-catchment). There is much lower risk to salmonid habitat of the Flesk tributaries which have no salmonid value locally and the proposed fell area is small.
Construction Phase Assessment of Significance prior to Mitigation	*Roughty sub-catchment*: Localised, moderate, short-term, reversible negative effect on macroinvertebrate diversity in upper headwater area of the Lettercannon tributary (related to T11 felling). Localised slight short-term, reversible negative effect on macroinvertebrate diversity in upper headwater area of the Glanlee tributary, related to small, discrete felling plots at T8, T1, T2 and T3). In each case the negative effects would be limited to forest drains and a short distance downstream of where they connect to either the upper Lettercannon or upper Glanlee tributary. Absence of salmonids in the upper reaches of these tributaries, means that temporary, slight, reversible negative effects (related to sediment and nutrient) could occur on trout and salmon that occur in the lower reaches of the Lettercannon and Glanlee. However, there is also some potential for short-term positive effects on trout growth and survivability in these otherwise nutrient poor streams. At worst, **moderate, short term, reversible negative** effects on salmonid spawning/nursery habitat for a short distance downstream of the Glanlee and Lettercannon tributary confluences with the main channel of the Roughty River main channel owing to turbidity. *Flesk Sub-catchment*: Localised, short-term, moderate, reversible negative effect on macroinvertebrate diversity in the Owgarriv (Flesk) and unnamed Cloonkeen (near N22) tributaries (sites F5, F4) for a short distance downstream of the felling areas and any connected forest drains. Neutral fisheries impact owing to absence of salmonids in these streams. At worst, a **temporary, slight negative reversible** effect on salmonid and pearl mussel habitat in the Flesk River.
Construction Phase Potential for Cumulative Effect	In the absence of mitigations, there is potential for **likely significant negative cumulative** effects on aquatic receptors arising from these felling operations in combination with all on-site activities that have potential for generation of suspended solids wash out to drains and watercourses. Combined suspended solids sources / pathways from the Proposed Development site have potential to cause damage to salmonid habitats of the lower Lettercannon and Glanlee tributaries as well as sensitive fisheries and pearl mussel habitats of the Roughty River (Roughty sub-catchment). The combination of felling and road widening in the Flesk sub-catchment on the access track from the N22 has potential for at least short-term, moderate, negative reversible effects on the Flesk tributaries and the Flesk River, localised to the area distance downstream of the tributary confluences. See **Section 7.5.6**, below, for details of wider catchment cumulative effects.
Construction Phase Mitigation	Tree felling will be the subject of a Felling Licence from the Forest Service and will be in accordance with the conditions of such a licence. The following Guidelines & Standards apply and will be complied with during felling operations:

- Forestry & Water Quality Guidelines (DAFM, 2000a)
- Forest Harvesting & the Environment Guidelines (DAFM, 2000b)
- Standards for Felling and Reafforestation (DAFM, 2019)

The appointed qualified and experienced ECoW (see Section 4.1.2 of the CEMP, Appendix 4.) will ensure all felling related water quality protection guidelines and standards are complied with during the pre-commencement and felling operation phases.

The ECoW will carry out daily visual checks of all measures employed to avoid or reduce impact of forestry residues, erosion, including inspections of temporary drainage infrastructure (e.g., drain crossings), silt control measures, extraction routes and log storage areas.

A detailed and comprehensive pre-felling pre-commencement confirmatory audit of the minor drainage channels within the proposed felling areas and their proposed access routes will be jointly undertaken by the forestry harvesting Site Manager and the ECoW. This will identify all '[4]aquatic zones' and 'relevant watercourses' / drains (as specified in the Felling Standards (DAFM (2019)). Areas of very wet ground ("hotspots") will also be earmarked as exclusion zones as these could become damaged by machine tracking and/or become preferential surface run-off conduits following the felling. The audit will establish where silt traps and/or flow control measures will be placed to maximise on-site attenuation of sediment.

Water exclusion zones (Section 6.1 DAFM (2019)):

- Before operations commence, a 10 m wide exclusion zone will be identified along the edge of all aquatic zones and hotspots, and this will be marked clearly on a site map.
- All operators will be made aware of the exclusion zone and its purpose, through the pre-commencement awareness process and throughout operations.
- Machine traffic and timber stacking are not permitted within exclusion zones.
- Trees within the reach of the harvester arm will be felled by harvester and stacked outside the exclusion zone.
- Trees outside machine reach will be felled manually by chainsaw operators. Felled trees will be winched out of the exclusion zone where it is appropriate and safe to do so, or removed by extended harvester arm, for subsequent snedding and processing outside the exclusion zone.
- In all cases, trees will be felled away from the water feature.
- Regarding aquatic zones, watercourse banks must not be disturbed. No branches or debris will be allowed to enter the aquatic zone during operations. Any branches that do fall in will immediately and with care be removed.
- The accumulation of brash, logs and debris in on-site drains and any aquatic zones will be prevented.

[4]***Aquatic zone:*** *Any natural river, stream or lake (but not an artificial drain) illustrated on an Ordnance Survey 6 inch map.*
Relevant watercourse: *Any other watercourse that has the potential to act as a pathway for the movement of significant amounts of sediment and/or nutrients from the site to an aquatic zone. Relevant watercourses are existing drains and channels that may contain flowing water during and immediately after rainfall*

	Silt & sediment control (based on Section 7 DAFM (2019)): › Prior to the commencement of operations, silt traps will be installed within existing forest drains that connect with aquatic zones, either directly or indirect via relevant watercourses. › Silt traps will be staggered along the length of the drain, and not only at the lower reaches towards its outflow. › Silt trap designs will include log sections laid lengthways into the drain and/or the use of staked geotextile barriers. › Silt fences will be installed where necessary, to block pathways for silt escapement where overland flow is possible. › Once silt traps and silt fences become functional, they will be checked a minimum of twice weekly and maintained / repaired, as necessary, in order to ensure continued effectiveness throughout felling operations. › Drainage channels which by-pass the vegetated buffer zone and provide direct connection between the felling area and the stream need to be intermittently blocked with staked plastic sheet pile to minimise the risk of silt and nutrient run-off into the receiving waters. › Extraction and haul routes must be confined to the driest areas of the site and routed in order to minimise the amount of trafficking around the site. Wherever possible, low load bearing harvesters and forwarding machinery will be used. Thick brash mats will be used and maintained and will be removed once felling is complete. At no time will brash be allowed to accumulate in drains, no matter how small. If brash has to be stockpiled it will be in dry areas as far from drainage as possible. **Temporary water crossings** (based on Section 8 DAFM (2019)): › Direct crossing over stream beds will not be permitted. › Crossing of on-site forest drains / 'relevant watercourses' and aquatic zones will be avoided. › The crossing of drains during felling and extraction will be minimised, and machine activity will be restricted to brashed extraction racks and haulage routes. › Where a drain crossing is needed, a method will be selected that prevents the breakdown and erosion of drain sides. › For larger drain crossings, i.e., those with standing water or obvious water flow, a heavy-duty plastic culvert will be deployed lengthways into the channel and covered with brash material. › For smaller drain crossings, i.e., those that have no standing water and are generally dry, log sections will be temporarily laid lengthways into the channel and overlaid with brash. › When installing and removing the temporary crossings, it will be ensured that no additional work is carried out within the aquatic zone, and that the upstream and downstream stream bed and bankside remain undisturbed.
Residual Effect following Mitigation in the Construction Phase	*Roughty sub-catchment*: Localised, **Not Significant**, short-term, reversible negative effect on macroinvertebrate diversity in upper headwater areas for a short distance downstream of connected forest drains. **Not Significant**, imperceptible effect on salmonid nursery areas in the lower reaches of Lettercannon and Glanlee tributaries. **Not Significant,** neutral effects on salmonid fish populations and pearl mussel habitat in the Roughty main channel.

	Flesk Sub-catchment: Localised, **Not Significant**, short-term, reversible negative effect on macroinvertebrate diversity in Cloonkeen (near N22 tributaries (F4, F5) for a short distance downstream of the linear felling areas and connected forest drains, but salmonids are absent in these streams. **Not Significant,** imperceptible negative reversible effect on Flesk River salmonid fish populations and neutral effect on pearl mussel habitat (located at nearest c.5km downstream.

7.5.3.2 Earthworks

Table 7-19 Earthworks – Construction Phase Effects

Description of Potential Effect	Degradation of water quality and aquatic habitats associated with suspended solids wash out to drains and watercourses during earthworks activities (access track upgrades / widening of sections of new internal access track, hardstanding construction, drainage upgrade and installation, cable trenching) causing direct and/or indirect effects on downstream aquatic IEFs.
Watercourses Potentially Affected	Proposed Development – Wind Farm: › Thureehouma Tributary › Lettercannon Tributary › Glanlee Tributary › Roughty River - main channel downstream of tributaries Proposed Development - Site Access Road: › Flesk – Cloonkeen N22 tributaries (F4, F5) › Flesk – Owgarriv Tributary (sites F7 to F14) › Flesk River - main channel downstream of tributaries (F2, F3) › Upper Sullane (S1, S2)
Construction Phase Characterisation of Unmitigated Effect	Uncontrolled solids wash-out is the primary concern in association with earthworks and excavations. Suspended solids sources include road surfacing materials (crushed stone); watercourse crossings, emissions from temporary site compounds and material stockpile areas, earth excavations for new internal roads, hardstands and cable trenches, soil stockpiles and tracking by construction machinery / vehicles over roads and newly excavated terrain. The Proposed Development site topography is generally steep: the receiving streams being swift and turbulent during spates. Any escaped solids in the upper headwaters will be rapidly exported downstream. Water chemistry sampling which targeted a rainfall event for this EIAR (9 May 2022) showed that suspended solids concentrations clearly drop off rapidly following a spate, but temporary turbidity can affect macroinvertebrate drift and fish behaviour. Sediment will settle as the hydrograph recedes after an event, more likely further downstream in lower gradient reaches of the tributaries and the Roughty itself, where salmonid and pearl mussel habitat could be adversely affected. New excavations into upland blanket peatland soils also carry slight risk of temporary increases in nutrient run-off, primarily nitrogen compounds which are affected by changes in aerobic conditions when peat is exposed, giving rise to soluble N-loss as a result of nitrification processes (e.g., Nieminen,

	2003). This could have temporary localised adverse effects noticeable as ephemeral filamentous algal growths in the headwaters of the upper Thureehouma, Glanlee and Lettercannon streams, but the effect would diminish with distance downstream as nutrient uptake occurs and dilution increases. **Hardstandings:** The proposal is to upgrade 4 no. existing hardstandings for use in the Proposed Development and 1 no. existing hardstand for use as a temporary construction compound, as well as construct 7 no. new turbine hardstands, with potential effects as described above. The remaining existing hardstand areas will be allowed to naturally revegetate with no effects on aquatic ecological receptors compared to current baseline. **Access roads and drainage upgrades and construction:** The majority of the wind farm internal access roads will be reused but will be upgraded and resurfaced with crushed rock/gravel. Apart from soil excavations and earth movement, the newly laid track surface material is primarily a source of suspended solids wash out with salmonids in the lower reaches of tributaries being susceptible to sediment effects. **Borrow Pit:** The proposed borrow pit is on the site of the existing borrow pit that was utilised for the Existing Kilgarvan Wind Farm. Topography is relatively flat on the hill brow where the existing borrow pit is located, with drainage directed via the swale alongside the existing access road, and ultimately overland through bog and heath to a headwater of Thureehouma tributary. The separation distance between existing borrow pit and stream is c.420m at nearest which provides scope for sediment controls at source and along the pathway. **Cable Trenching:** Cable trenching for ducting will be installed alongside access roads joining turbines to the existing on-site Coomagearlahy 110kV substation. Cabling will be installed within each of the three Roughty River tributary catchment areas, although it is noted that there are only 3 no. direct watercourse crossings on the proposed cabling routes. Each occur in the (ephemeral) upper reaches of a headwater stream: one on the upper Glanlee Tributary (370m upstream from K14), one on the upper Lettercannon Tributary (800m upstream from K25) and one on the Thureehouma Tributary (1.2km upstream from K3). These are small channels with no fisheries significance near the crossing reaches, but they flow to salmonid habitats located c.1.6km, respectively, from each crossing point. Apart from these crossing points, the hydrological connectivity between cable trenching activity and the upper headwater streams will be via road drains, forestry drains and overland flow-pathways through the heath and bog. Potential wash out of (mainly) inorganic sediment and some organic particulate matter (peatsoil derived) may arise in association with cabling along access roads and at the 3 no. crossing points, with consequent effects on macroinvertebrates and downstream fisheries habitats of each tributary and the Roughty River. Widening of the access road near the entrance from the N22 will temporarily generate suspended solids washout to the Flesk tributaries represented by sites F4 and F5, until the upgraded road surface has bedded in. These channels connect to the Flesk River ~250m downstream. The existing culvert at Site F4 may require extension to accommodate access track widening. The watercourse has numerous natural and artificial barriers to fish passage and has no significant fisheries value. A culvert extension in

	this location does not represent potential for significant effects. Minor repairs are likely to be made to the road surface in the upper Owgarriv (Flesk) catchment, but there is no widening proposed and the scale of works required is small. The potential for generation of excessive levels of suspended solids to the Owgarriv tributaries of the Flesk sub-catchment is considered minimal. *Effect Description in Roughty Sub-catchment:* The upper headwaters of the Roughty tributaries each lack fisheries significance. Localised effects are therefore likely to be a short-term disturbance to macroinvertebrates linked to turbidity and short-term sediment deposition. Some localised filamentous algal growth may be expected, linked with nutrient loss from peat soil disturbance. These effects may cause temporary or short-term reduction in overall sensitivity (diversity / abundance) of the macroinvertebrate community for a short distance downstream of the access road crossing points. The effects will reverse within 1-2 years, returning to baseline condition, as the headwater streams flush out with inevitable spates. Depending on the amounts involved, un-controlled solids export may endanger salmonid spawning grounds in the short-term by clogging redds and reducing hatching success of deposited eggs plus survival of emerging fry, primarily in the lower reaches of the Lettercannon and Glanlee, and to a lesser extent the Thureehouma tributaries (although the latter has higher gradient and less significance in salmonid habitats). Salmonids in the Roughty main channel, for a short distance downstream of the tributary confluences may be subject to intermittent sediment effects that cause reduced feeding success and subsequent temporary avoidance behaviour - mainly linked to temporary bouts of slightly elevated turbidity during the early construction period, until such time as road surface has bedded in and over-the-edge drainage swales have revegetated. *Effect Description in Flesk Sub-catchment:* Road widening and resurfacing, with associated over the edge swales, will form conduits for solids contaminated run off to the headwater streams of the Owgarriv (Flesk) and the Cloonkeen tributaries near the N22 (Sites F4, F5., F6). Localised effects are likely to be a short-term disturbance to macroinvertebrates linked to turbidity and perhaps some level of fine sediment deposition locally for a short distance downstream of the access road. The Owgarriv (Flesk tributary represented by Site F9 has potential for trout downstream of the access road crossing, but this is very remote possibility owing to severe barriers further downstream on the watercourse. Any localised sediment effects would reverse within 1-2 years, returning to baseline condition, as the road surface beds in and the streams flush out with inevitable spates. *Sullane Sub-catchment:* The existing watercourse crossing and drainage infrastructure on the site access road will not be significantly altered but drains and swales along the localised road widening route are conduits to the upper headwater stream that flows to the upper Sullane River. The headwater lacks significant fisheries significance and localised effects are likely to be a short-term disturbance to macroinvertebrates linked to turbidity and perhaps some level of fine sediment deposition locally, which may cause temporary or short-term reduction in overall sensitivity (diversity / abundance) of the macroinvertebrate community near the crossing point. This would be expected to reverse within 1-2 years, returning to baseline condition, as the road surface beds in and the stream flushes out with inevitable spates. Depending on the amounts involved, un-controlled solids

	export may endanger salmonids (mainly trout) spawning grounds of the lower Barr Duinse tributary of the Sullane.
Construction Phase Assessment of Significance prior to Mitigation	*Roughty Sub-catchment*: Whilst the scale of earthworks is less than what would be required for a greenfield development (i.e., presence of long-standing existing infrastructure: access roads, substation) it cannot be ruled out that in a worst case scenario (e.g., prolonged heavy rainfall during earthworks, unexpected peat slippage) and in the absence of mitigation measures there is potential for **significant negative short-term reversible** effects on salmonid spawning and nursery habitats of the lower Glanlee, Lettercannon and Thureehouma tributaries and the Roughty River. Absence of fish in the upper headwaters of the Lettercannon, Glanlee and Thureehouma tributaries means that direct fisheries impact is neutral at locations in closest proximity to proposed roading activities. However, the combined effect of all earthworks and excavation activities has potential for **significant negative, temporary to short-term, reversible** effects in the lower reaches of Lettercannon, Glanlee and Thureehouma tributaries linked to sedimentation and turbidity. This could cause a decrease in density of salmonids and affect local recruitment success in these tributaries for at least the period that the construction phase takes place. Salmonids in the Roughty River near tributary confluences may exhibit avoidance behaviours in the case that intermittent silt plumes flowed down from the construction site and in a worst-case scenario there may be a localised decrease in salmon and trout density and recruitment which is also deemed a **significant negative, temporary to short-term** effect as this is a high-status objective waterbody with excellent salmonid habitats. Given (i) the volume and turbulent nature of the Roughty River, (ii) distance downstream to significant remnant clusters of pearl mussels (i.e., 3.3km downstream of Thureehouma tributary), and (iii) lack of suitable pearl mussel habitat on the Roughty near the affected tributary confluences, any additional turbidity in the water column of the Roughty River as a result of combined earthworks activities on the Proposed Development site would likely be not significant-to-slightly negative, but the worst case scenario must be considered, e.g., that excessive combined uncontrolled sediment wash-out or peat slip could occur, causing a s**ignificant negative** effect (though unlikely) on the nearest remnant pearl mussel population (pockets of large adults) of the Roughty River and smother any potential juvenile habitat (although the species does not appear to currently be recruiting in the Roughty). *Flesk Sub-catchment*: Moderate, short term, reversible negative impact on macroinvertebrate abundance and diversity in the small tributaries crossed by the access track, enduring until such time as road surfacing material has bedded in and over-the-edge drainage swales have revegetated. The Flesk sub-catchment tributaries have low or no fisheries significance, then confluence in fast-flowing or torrential, bedrock dominated, gorged reaches of the Flesk River with little salmonid spawning and limited nursery habitat or nursery for at least ~400m downstream. At the separation distances involved it is considered that any effects linked to temporary bouts of elevated turbidity during the construction period would cause slightly negative, temporary to short term reversible effects in terms of temporary avoidance behaviours by fish in the Flesk main channel. Given (1) the volume and turbulent nature of the Flesk River, (2) distance downstream to any remnant clusters of pearl mussels (c.5km downstream of Cloonkeen tributary confluence at nearest) and (3) lack of suitable pearl mussel habitat on the Flesk anywhere near the affected tributary confluences - any slight

	additional turbidity in the water column of the Flesk River as a result of access road upgrades would likely be imperceptible, not causing additional stress to adult pearl mussels over existing baseline levels and therefore Not Significant impact on this species as a result of this project. *Sullane Sub-catchment*: Moderate, Temporary-to-short term, reversible negative impact on macroinvertebrate abundance and diversity in very upper headwater reach of the Barr Duinse tributary. Absence of fish locally in the upper headwater area meaning fisheries impact is neutral there, but there may be intermittent, temporary, slight, negative, reversible effects on salmonids in the Sullane River main channel further downstream, linked to temporary bouts of elevated turbidity and possibly sedimentation during the early construction period. Given (1) the distance downstream to any significant remnant clusters of pearl mussels (c.8km downstream of the access road activity), (2) lack of suitable pearl mussel habitat within at least 5km of the access road crossing point, and (3) small scale od works in this catchment as a whole - any slight increases in turbidity in the water column of the Sullane River as a result of access road upgrade would likely be imperceptible (by 8 km downstream) and not cause additional stress to adult pearl mussels, therefore no significant effects are likely on Sullane River pearl mussels as a result of this project.
Potential for Cumulative Effect	In the absence of mitigations, there is potential for **likely significant negative** cumulative effects on aquatic receptors arising from earthworks and excavations in combination with felling operations and culvert replacements that also have potential to generate suspended solids wash out to drains and watercourses. Combined suspended solids sources / pathways from the Proposed Development site have potential to cause damage to salmonid habitats of the lower Thureehouma, Lettercannon and Glanlee tributaries as well as sensitive fisheries and pearl mussel habitats of the Roughty River. Combined earthworks and forestry felling involved with access road widening in the Flesk sub-catchment has potential for at least **moderate negative** cumulative effects locally on the Flesk River, but this is less likely owing to the smaller overall magnitude and scale of works in this catchment. See **Section 7.5.6**, below, for details of wider catchment scale cumulative effects.
Construction Phase Mitigation	The following Guidelines apply and will be complied with during all construction activities involving excavation and earthworks: › Guidelines for the crossing of Watercourses During Construction of National Road Schemes (NRA, 2008). › IFI (2016) Guidelines on protection of fisheries during construction works in and adjacent to waters. › Control of water pollution from linear construction projects. CIRIA C648 (2006) **General Sediment Control Measures:** › Overarching water quality protection measures and site-specific drainage design will be adhered to, as detailed in **Chapter 9: Water, Section 9.5** and amalgamated into the CEMP. › Before operations commence, a 10m wide 'Water Exclusion Zone' will be identified along the edge of all watercourses and active drains on

access track upgrade routes. There will be no stockpiling of excavated earth and/or road / hardstand surfacing materials in this zone.
- Tracking or fording across the exclusion zone or watercourse streambeds is prohibited – the existing crossing points on access roads will be used.
- Topsoil stripping in proximity to any watercourses will be undertaken in dry weather conditions and any spoil stockpiles must be located greater than 50m from a watercourse, and/or at least 10m away from a non-flowing drain, surrounded with double lines of geotextile silt fencing to prevent escapement of suspended solids.
- Prior to the commencement of operations, silt traps and check-dams will be installed within existing swales / drains that connect with watercourses, either directly or indirectly via other drains.
- Silt traps will be staggered along the length of swales / drains, and not only at the lower reaches towards the outflow to watercourses.
- Silt fences will be installed where necessary, to intercept pathways for silt runoff where overland flow towards watercourses is possible.
- Attenuation / settlement ponds will be installed as specified in the site drainage plan on downslopes of new internal access track constructions in areas where it is difficult to control run-off, i.e., where there is steep topography.
- Once check-dams, attenuation / settlement ponds, silt traps and silt fences are installed and works commence, they will be checked a minimum of twice weekly and maintained as necessary, in order to ensure continued effectiveness throughout earthworks and excavation operations.
- Crushed rock for track resurfacing should be locally sourced with low limestone content to limit potential for pH changes linked to sediment washout to watercourses and downstream fisheries habitats.

The qualified, experienced Environmental Clerk of Works (ECoW) (see CEMP Section 4.1.2) will be responsible for daily, weekly and monthly checks that ensure all water quality protection measures and guidelines are complied with during the pre-commencement and active earthworks / excavations period of the construction phase. The ECoW will carry out daily visual checks of all measures employed to control, avoid or reduce export of suspended solids and sediment from active earthworks areas.

A detailed and comprehensive pre-commencement confirmatory audit of the existing road drainage features will be undertaken by the contractor and ECoW to identify areas where existing and additional run-off control features will be installed and/or improved in compliance with the detailed drainage design accompanying this application. This applies to the Proposed Development site and the site access road. There are numerous unmapped, small forestry and existing roadside drains that will require sediment run-off control features during the construction phase and these will all be subject to run-off control features including cut-off drains, check-dams, silt fencing and settlement pond installation.

New and Upgraded Access Roads:

Regarding internal access track upgrades, there will be limited, if any "cleaning" of existing vegetation of any existing drains, swales or ponds, as their vegetated state reduces run-off velocity and prevents scour / erosion, contributing to avoidance and reduction of solids export through scour protection, retention and attenuation function. In place where it's not

possible to retain full lengths of existing swale / drain vegetation – then intermittent lengths of existing vegetation will be marked out and retained, supplemented by check dams, until after the bulk of access track upgrade works are complete. Freshly "cleaned" or excavated swales / drains will have intermittent, well-constructed check-dams installed along the length - comprised of gravel mounds and staked geotextile dams. Check-dams will then become permanent features of the swale, helping to manage run-off velocities during the operation phase.

Extension to Existing Borrow Pit:

See detailed mitigation for silt and sediment loss relating to borrow pit excavations in **Chapter 9: Water, Section 9.5.2.2**. The relatively low gradient topography and contained nature of the proposed extension to the existing borrow pit location (set into the hillside) means there is good opportunity to implement silt and sediment controls on hydrological pathways that will avoid and minimise potential for excessive suspended solids loads to reach the Thureehouma stream in the first place. The approach to dirty water management at the borrow pit will be through a series of gravel and/or staked geotextile check dams will be installed along the main preferential flow path exiting the borrow pit area. Temporary attenuation/settlement ponds will be installed downslope from the borrow pit on surface water run-off flow paths.

Cable Trenching:

- All trenching works will be undertaken using a cut and fill procedure to ensure that only short sections of the trench (≤50m) are open at any time. The trench construction reaches will be limited to lengths that can be trenched, ducted and back-filled within the same work day.
- There will be no discharge of silt contaminated pump-out water directly to on-site drains or watercourses. Any silt contaminated water which gathers in an excavated trench will be collected and treated appropriately using Best Practice methods (e.g., silt bags, settlement systems) before being discharged. Treated water will be discharged across vegetated land to drain slowly into any nearby drain or watercourse.
- Any freshly excavated spoil will be retained in an area over 10m away from any drain or watercourse until such time as the trench is refilled. The spoil heap will be located on either a well vegetated area surrounded by silt fencing or with the use of containment measures (geotextile mat or bag) and covered to reduce potential for sediment wash out. A ready supply of these materials will be onsite to deal with such eventualities. Spoil heaps are unlikely to accumulate because trenches will be immediately back filled following ducting installation.
- At the watercourse crossings, a method of water management such as dam and pump over will be used to create a short, dry working area for cable-trenching. There is no fisheries significance at these upper headwater locations and hence no requirement for fish removal. Stony stream bed substrates will be removed and stockpiled immediately nearby, and these will be reused for reinstatement of streambed and banks to pre-existing condition once the trench is backfilled. Any additional stony streambed reinstatement material will be of a locally sourced type (e.g., from the borrow pit).

Construction Phase Residual Effects following Mitigation	*Roughty sub-catchment*: Localised, **Not Significant**, short-term, reversible negative effect on macroinvertebrate diversity in upper headwater areas for a short distance downstream of the Proposed Development site mainly limited to a few areas where the existing roads cross upper reaches of headwater catchments. **Not Significant** (imperceptible) effect on salmonid nursery areas in the lower reaches of Lettercannon and Glanlee tributaries. **Not Significant** (neutral) effects on salmonid fish populations and remnant pearl mussel clusters in the Roughty main channel. *Sullane and Flesk Sub-catchments*: **Not Significant** temporary, reversible negative effect on macroinvertebrate diversity in the Cloonkeen tributary of the Flesk River for a short distance downstream of the road widening. **Not Significant** (neutral) effects on macroinvertebrates and salmonid fish populations of the lower Owgarriv tributary of the Flesk. **Not Significant** (neutral) effect on macroinvertebrates, salmonids and remnant pearl mussels of the Flesk and Sullane rivers.

7.5.3.3 Watercourse Crossings

Table 7-20 Watercourse Crossings – Construction Phase Effects

Description of Potential Effect	Degradation of water quality and aquatic habitats associated with potential pollutant wash out (mainly sediment) during culvert upgrades causing indirect effects on downstream aquatic IEFs. Potential fragmentation of aquatic habitat as a result of culvert installation.
Watercourses Potentially Affected	Proposed Development - Wind Farm: › Thureehouma Tributary › Lettercannon Tributary › Glanlee Tributary › Roughty River - main channel downstream of tributaries Proposed Development - Site Access Road: › Flesk – Cloonkeen N22 tributaries (F4, F5) › Flesk – Owgarriv Tributary (sites F7-F14) › Flesk River - main channel downstream of tributaries (F2, F3) › Upper Sullane (S1, S2)
Construction Phase Characterisation of Unmitigated Effect	*Roughty Sub-catchment (Internal access track crossings):* One new crossing (embedded pipe culvert) will be installed over an ephemeral, upper headwater reach of the **Lettercannon** tributary to facilitate the proposed new access track between proposed T8 and T11. There is no significant fisheries habitat in the proposed crossing reach, nor for at least 800m downstream. The nearest salmonid habitats are in the lower Lettercannon (good numbers of juvenile salmon and trout at K23), c.1.6km downstream of the proposed crossing. No direct effects on salmonid habitat are possible and fragmentation will not occur from the new culvert. Existing culverts occur in the upper **Thureehouma** system in headwater reaches with no fisheries significance. There were no fish at K5, which is ~1km downstream of the respective crossings. No fish were recorded in the upper catchment likely owing to natural barriers (rock waterfalls). Low numbers of salmonids occur >2.5km downstream in the lower Thureehouma tributary near the Roughty confluence. Existing culverts in the upper **Glanlee** system occur on small

	headwaters that have no fisheries significance. Fish are precluded from the upper headwater areas owing to barriers (vertical rock waterfalls) and ephemeral flow. Fish were not recorded until ~1km downstream (K18) of the EIAR Site Boundary on the main Glanlee channel. No direct effects on salmonid habitat are possible as a result of continued use of existing culverts. Indirect effects relating to turbidity and sedimentation arising from instream works during culvert installation between proposed T8 and T11 could damage salmonid habitat and cause short-term reduction in fish density in the lower Lettercannon tributary if not mitigated during construction. *Flesk and Sullane Sub-catchments (Site access track crossing):* One culvert upgrade on a small tributary of the Flesk River near the Cloonkeen substation / N22 access gate (Site F4) involves a steep stream that lacks fisheries significance owing to natural (rock faces) and artificial (N22 culvert) barriers. There are no direct effects possible on fisheries values in the stream. There is potential for export of suspended solids to the Flesk a short distance downstream (~250m) if instream culvert upgrade works are not mitigated. The stream does not have sufficient habitat for a viable trout population between barriers and no direct connectivity to the Flesk River owing to a perched culvert under the existing N22 road. It flows to the Flesk River entering the gorge above Poulgorm Bridge where flows are torrential for at least the next 1.2km downstream. The very turbulent nature of the Flesk gorge would assimilate suspended solids very rapidly and would transport them downstream to habitats that support salmonids. Thereafter sediment may deposit in slow flowing reaches or margins, if excessive amounts escaped the culverting and road widening works. Another small un-mapped tributary (site F5) with no fisheries significance is not directly impacted by the road widening but forms a potential conduit to sensitive habitats and high-status waters of the Flesk River. Existing culverts on the access track show no requirement for upgrade and will not be subject to instream works as part of the Proposed Development. There is some potential for indirect effects on salmonids on the lower tributary reaches of the Owgarriv (Flesk sub-catchment) and Barr Duinse (Sullane sub-catchment) as a result of suspended solids washout associated with minor road surface repairs in the construction phase.
Construction Phase Assessment of Significance prior to Mitigation	*Roughty Sub-catchment*: There is no fisheries significance at the watercourse crossings themselves, but in the absence of mitigation measures around sediment washout control during instream culvert upgrade works there is potential for moderate negative short-term reversible effects on salmonid spawning and nursery habitats of the lower Lettercannon tributary. *Flesk Sub-catchment:* There is no fisheries significance at the Flesk tributary culvert extension (Site F4), but in the absence of mitigation measures around pollutant washout control during instream culvert upgrade works there is potential for slight negative short-term reversible effects on macroinvertebrate and (potentially) salmonid habitats of the Flesk River.
Potential for Cumulative Effect	In the absence of mitigations, there is potential for **likely significant negative** cumulative effects on aquatic receptors arising from the combination of instream works, earthworks and forestry felling operations and that also have potential to generate suspended solids wash out to drains and watercourses. Combined suspended solids sources / pathways from the Proposed Development site have potential to cause damage to salmonid

	habitats of the lower Thureehouma, Lettercannon and Glanlee tributaries as well as sensitive fisheries and pearl mussel habitats of the Roughty River. Combined culvert upgrades, earthworks and forestry felling involved with access road widening in the Flesk sub-catchment has potential for at least **moderate negative** cumulative effects locally on the Flesk River, but this is less likely owing to the smaller overall magnitude and scale of works in this catchment. See Section 7.5.6, below, for details of wider catchment scale cumulative effects.
Mitigation	The following Guidelines apply and will be complied with during all construction activities involving watercourse crossings: › Guidelines for the crossing of Watercourses During Construction of National Road Schemes (NRA, 2008). › IFI (2016) Guidelines on protection of fisheries during construction works in and adjacent to waters. › Control of water pollution from linear construction projects. CIRIA C648 (2006) **General Sediment Control Measures:** › Overarching water quality protection measures and site-specific drainage design will be adhered to, as detailed in **Chapter 9: Water, Section 9.5** and amalgamated into the CEMP. › All general sediment control measures set out in Table 7-19, above will be adhered to, as well as specific measures set out below. **Measures relating to Culvert Upgrades - Instream Works:** › Instream works may only occur during the period July to September (of any year). › Culverts will be subject to Section 50 consent (Arterial Drainage Act 10945), being no less than 900mm in diameter, allowing for a minimum 300mm embed below existing bed level and meeting hydraulic design standards, i.e., capable of passing a fluvial flood flow with a 1% annual exceedance probability (AEP) or 1 in 100-year flow without significantly changing the hydraulic characteristics of the watercourse. › Culvert upgrades will utilise pre-cast concrete components to eliminate risk of wet cement wash-out. › Although there is no fisheries significance in the upper Roughty or Flesk tributaries, IFI must be provided with details of the construction methodology (following planning permission) for the 1no. culvert installation in the Lettercannon headwater and the culvert extension at the Flesk tributary (Site F4). Following agreement of the construction method, IFI must also be notified prior to instream works commencing. › A method of water management such as dam and pump over will be used to create a dry working area for instream culvert installation or upgrade work. › Pumps will remain on-hand to remove ingress water through dams and from groundwater sources. Pump-out water will be extracted from a sunken, gravelled sump area within the 'dry' work area and discharged over 20m away from the stream onto an area of low gradient, rough vegetation surrounded with a double line of silt fencing.

	› There is no fisheries significance at the upper headwater culvert locations in the Roughty or the Flesk sub-catchment and hence no requirement for fish removal. › The ECoW must be on hand when each channel is dewatered to ensure that all water management, pump-over, pump-out and sediment containment measures are operating effectively to prevent export of solids (and other pollutants) from the works area. › Stony stream bed substrates will be removed locally and stockpiled immediately nearby, and these will be reused for reinstatement of streambed and banks to pre-existing condition once the trench is backfilled. Additional stony streambed reinstatement material will be of a locally sourced type (e.g., from the borrow pit). › Stream bed and banks will have rock armour installed to prevent scour upstream and downstream ends of the upgraded culverts. These are steep, step-pool type watercourses and rock armour will be installed as appropriate to restore the pre-existing channel gradient.
Residual Effect following Mitigation	*Roughty sub-catchment*: **Not Significant,** imperceptible short-term indirect effects on fisheries habitats located downstream of culvert upgrades on the affected tributary headwaters.

7.5.3.4 Concrete and Hydrocarbons

Cement: Relatively small amounts of liquid cement usage will be required during the construction phase, i.e., turbine foundations. Concrete pours, if not carefully managed, can give rise to spills that may wash out to drains and watercourses. Owing to its highly alkaline and corrosive nature, cement is potentially toxic to instream fauna, and if present in high concentrations can cause fish and invertebrate kills. It is noted in this regard that the upper headwaters of the 3 no. Roughty Sub-catchment tributaries have no fisheries significance, but concrete spills could result in localised mortality of instream macroinvertebrates and could reach salmonid (mainly trout) habitats in the lower Glanlee, Lettercannon and Thureehouma tributary reaches, if large enough. The considerable volume of the main channel of the Roughty River means that risk of cement spill effects (after dilution) on the main channel downstream is very low. The possibility of spillage can be mitigated largely through avoidance using the best practice in construction management, noting that all major infrastructure, e.g., proposed new foundations/ hardstandings, are located a minimum of 50m from watercourses, hence the overall risk of cement toxicity to downstream salmonids and pearl mussel is very low. See **Chapter 9: Water, Section 9.5.2.5** for specific mitigations relating to protection of water quality (and hence aquatic ecology) through avoidance and prevention of concrete loss from the Proposed Development site during the construction phase.

Hydrocarbons: Hydrocarbon spills and leakages can result in oil slicks and tainting of fish, or (if large enough) fish and invertebrate kills. They can be detrimental to salmonid eggs and young fry in spawning areas of the lower tributaries and main channels. Sources include poorly secured or non-bunded fuel storage areas; spills during re-fuelling; leaks from on-site vehicles, plant and equipment. Loss of hydrocarbons during the construction phase can be avoided and prevented by best practice in terms of site layout including fuel storage and best practice construction management. All of these possibilities can and will be mitigated primarily by avoidance using the best practice in construction site layout and construction management meaning the overall risk is very low. See **Chapter 9: Water, Section 9.5.2.4** for specific mitigations relating to protection of water quality (and hence aquatic ecology) through avoidance and prevention of hydrocarbon loss from the Proposed Development site during the construction phase.

7.5.4 Potential Operational Phase Effects

Table 7-21 - Aquatic Ecology _ Operational Phase Effects

Description of Potential Effect	Degradation of water quality and aquatic habitats associated with potential leaching of suspended solids from internal access roads into drains and nearby watercourses during the 35-year operational phase, causing potential indirect effects on downstream aquatic IEFs.
Watercourses Potentially Affected	Proposed Development - Wind Farm: › Lettercannon Tributary (T11) – sites K25, K23 › Glanlee Tributary (T8) – sites K18B, K19 › Glanlee Tributary (T2, T3) – sites K16, K18, K19 › Roughty River - main channel downstream of tributaries Proposed Development - Site Access Road: › Cloonkeen Tributaries – sites F4, F5 › Owgarriv Tributary – sites F7, F8 and F9-14 › Flesk River - main channel downstream of tributaries › Upper Sullane – sites S2, S1
Characterisation of Unmitigated Effect	Once the construction is complete, road surfaces will bed in and exposed roadside swales, with inbuilt check dams (installed as per the drainage plan) will revegetate, likely within 1 or 2 summer seasons. This will greatly reduce the risk of sediment wash out to watercourses, but there may be intermittent low levels of sediment contaminated run-off from gravel road surfaces to drains and water courses over the 35-year operational period. It would be expected that any measurable impact on aquatic receptors would be very localised to the very upper reaches of the headwater streams, evident as a very slight disturbance in macroinvertebrate communities compared to unaffected reaches. Heavy rainfall events may, over time, cause erosion of gravel road surfaces, which would slightly increase the potential for localised impacts on instream macroinvertebrate fauna. The upper headwaters of each sub-catchment have no fisheries significance, meaning there will be a neutral effect on fisheries habitats and/or migration (i.e., through piped culverts along access roads). Infrequent, light vehicle and very occasional heavy vehicle tracking over the site access road and internal roading will be required as part of routine maintenance. This may contribute to road erosion in the long-term but there are no associated likely or significant effects on aquatic receptors. It is noted that after 16 years of operation, the existing wind farm clearly has little, if any, negative effect on downstream water quality and aquatic habitat, evidenced by instream macroinvertebrate communities that are 'high' status in the adjoined lower tributaries and main river channels of Roughty, Flesk and Sullane.
Assessment of Significance prior to Mitigation	**Slight, long-term, reversible negative** effect on macroinvertebrate diversity in upper headwater areas for a short distance downstream of small upper headwater channels – affecting only those that are crossed by site access and internal access roads. **Imperceptible** effect on

	salmonid nursery areas in the lower reaches of the 3 no. Roughty River tributaries (Thureehouma, Lettercannon and Glanlee) tributaries. **Neutral** effects on salmonid populations and remnant pearl mussel clusters in the Roughty, Flesk and Sullane rivers.
Mitigation	› The site-specific drainage design as described in **Chapter 9: Water, Section 9.5.3.1**, will be implemented in full. This has been designed to significantly increase the level of on-site attenuation to what currently exists including the use of new silt traps, settlement ponds and vegetated buffer areas prior to discharge to the existing site drainage network. › During the operational phase, access roads will be inspected routinely to ensure no significant rutting or erosion is occurring. Such inspections will be carried out a minimum of twice per annum, timed to allow for any repairs prior to the winter season (e.g., August/September) and again in the spring (e.g., March/April) to repair any winter period damage. › Culverts will be inspected on the same schedule as roads and cleared of any debris that could cause blockage and localised erosion. › Any areas of obvious road erosion / rutting that are potential sediment loss sources will be repaired as soon as they are identified using clean, locally sourced hardcore with a low fine content. These can be recorded during routine site visits over the operational phase. › Track-side drains will be allowed to retain re-grown wet grassland / heath vegetation and aquatic macrophytes throughout the operational phase, as these naturally contribute to on-site attenuation by slowing water velocity and trapping/filtering sediment within roadside drainage in advance of entry to watercourses. › No refuelling or other hydrocarbon related usage will be undertaken within 50m of any watercourse in relation to maintenance vehicles, plant or machinery.
Residual Effect following Mitigation	**Imperceptible -to-Neutral Effect**
Potential for Cumulative Operational Effects	There are other operational wind farms and ongoing forestry and agricultural activities in the relevant sub-catchments which are outside the control of the Proposed Development. There is potential for in-combination operational effects which are detailed and addressed at a catchment scale in **Section 7.5.6.2**, below.

7.5.5 Potential Decommissioning Effects

Table 7-22 Aquatic Ecology - Decommissioning Phase Effects

Description of Potential Effect	Degradation of water quality and aquatic habitats associated with suspended solids export from the site linked to heavy plant tracking to remove turbines and possible reinstatement (topsoiling, reseeding) of obsolete hardstands with indirect effects on downstream aquatic IEFs.
Watercourses Potentially Affected	Proposed Development site: › Thureehouma Tributary

	› Lettercannon Tributary › Glanlee Tributary › Roughty River - main channel downstream of tributaries
Decommissioning Characterisation of Unmitigated Effect	Effects would be similar to those described in **Table 7-19**, above relating to earthworks and the potential for sediment loss effects on downstream aquatic IEFs in the Roughty sub-catchment. The primary source areas for sediment loss to drains and watercourses would be associated with reinstatement (if any) of hardstanding areas (topsoiling, reseeding), although these can potentially be left to revegetate naturally.
Decommissioning Assessment of Significance prior to Mitigation	As described in **Table 7-19, Section 7.5.3.2**, above.
Decommissioning Mitigation	Mitigation as set out in **Table 7-19, Section 7.5.3.2**, above.
Decommissioning Residual Effect following Mitigation	*Roughty sub-catchment*: **Slight, short-term, reversible negative** effect on macroinvertebrate diversity in upper headwater areas of the tributaries for a short distance downstream of any drains that connect works areas to watercourses. **Imperceptible** effect on salmonid nursery areas in the lower reaches of Lettercannon and Glanlee tributaries. **Neutral** effects on salmonid fish populations and remnant pearl mussel clusters and habitats in the Roughty main channel.
Potential for Cumulative Effect	With all mitigation measures implemented, primarily around silt and sediment control at source, the decommissioning impact is predicted to be localised **short-term, slight, reversible negative** for Glanlee, Lettercannon and Thureehouma tributaries, and **Not Significant** for the Roughty River.

7.5.6 Potential Cumulative Effects

7.5.6.1 Within Project Cumulative Effects

7.5.6.1.1 *Roughty River Catchment*

In the absence of mitigations and measures to prevent and control sediment source production and losses to watercourses, the cumulative construction phase impact on downstream IEFs of the three tributaries (trout, salmon, macroinvertebrates) and the Roughty River (salmonids, pearl mussel, macroinvertebrates at high status) may be **short-term, significant negative,** although it is noted that the possibility of this occurring from a well-managed site where there is existing infrastructure (i.e., internal access roads and substation in-situ) is not likely. Without robust sediment control measures however, cumulative effects on downstream aquatic IEFs may include short-term decline in densities or loss of salmonids in the lower tributary reaches. There may be intermittent temporary avoidance behaviour of fish in the Roughty River near the tributary confluences affecting distribution and feeding success linked with intermittent turbidity spikes arising from the tributaries. The turbulent nature of the

Roughty at the tributary confluences and for at least 2km downstream would not facilitate sediment deposition in the important spawning and nursery habitats of the main channel.

The key to prevention of any of significant cumulative effects on aquatic receptors and IEFs is to avoid and prevent contaminated run-off levels at source through implementation of site-specific control measures, which are clearly set out in Section 7.5.3, above; in Chapter 9: Water and amalgamated in the CEMP (Appendix 4-3). Considering the worst-case scenario of unexpected peat slippage, it is noted that the peat stability risk assessment for the Proposed Development site (Appendix 8-1), concluded that with the implementation of the proposed mitigation measures that the risk of a peat failure is negligible/none.

With mitigation measures implemented as prescribed it is not expected that project related suspended solids concentrations would be perceptible at over 5km downstream where the nearest significant pearl mussel cluster occurs and therefore turbidity -related effects on this species is not considered to be a significant risk.

Residual cumulative effects are predicted to diminish following the early construction period as the development infrastructure settles into the landscape and ceases to give rise to potentially damaging levels of solids export to watercourses. With the implementation of the prescribed mitigation measures around sediment loss prevention and control during the construction phase, adverse in-combination effects on aquatic receptors / IEFs of the Roughty River are not likely and **Not Significant**.

7.5.6.1.2 *Flesk and Sullane River Catchments*

In the absence of mitigations, the cumulative sediment loss impact on downstream IEFs of the Flesk River and Sullane (salmonids, pearl mussel, high status water quality) may be **short-term**, **slight, reversible negative** given the relatively low level of proposed interventions in relation to the wider sub-catchment pressures and activities. With implementation of prescribed mitigation measures around silt and sediment loss prevention and control during the construction phase, adverse in-combination effects on aquatic receptors / IEFs of the Flesk and Sullane rivers are not likely and **Not Significant**.

7.5.6.2 Catchment Scale Cumulative Effects

7.5.6.2.1 *In-combination with Other Wind Farms*

There are five other operational windfarms in the Roughty River catchment, as set out in **Table 7-23.** The largest is Grousemount Wind Farm, covering a substantial proportion of the upper Roughty River catchment area (1,465 ha). It was the most recent wind development in the catchment, largely completed and commissioned by 2020. The bulk of construction works occurred during 2018-2020, inclusive. The other wind farms in the catchment were constructed prior to the 2007 and 2009 periods.

The principal construction periods are noted with respect to EPA water quality monitoring (see Section 7.4.2, above) which demonstrates that water quality on the basis of Q-values has been maintained at high status on the Roughty River main channel since 2003, i.e., throughout all of these other wind farm construction and operation periods and including the construction / operation period of the Existing Kilgarvan Wind Farm (commissioned since 2007).

From that it can be summarised that there were no significant residual effects on aquatic habitats arising from these wind farm developments, of which notably Grousemount Wind Farm broke new ground (i.e., considerably greater risk of sediment loss during construction) and was over double the land area and triple the turbine numbers as the currently Proposed Development. It is considered with a high degree of confidence that with implementation of mitigation measures prescribed in **Sections 7.5.3, 7.5.4 and 7.5.5** in the area of sediment loss avoidance, prevention and control during the lifetime of the Proposed Development, adverse in-combination effects on aquatic ecological receptors / IEFs of the Roughty River are not likely and **Not Significant.**

Table 7-23 Other Wind Farms in the Roughty River Sub-catchment

Wind Farm	Status	Year Commissioned	No. Turbines	Relationship to Proposed Development
Inchee / Coolkoohil	Constructed	2007	6	Drains to the Inchee branch of the Glanlee tributary of the Roughty
Midas / Coolknoohil (Everwind)	Constructed	2007	11	Drains via tributary to Roughty River (c.2.3km upstream of site)
Foilgreana / Coolknoohil	Constructed	2007	6	Drains overland to Roughty River (c.1.4km upstream of site)
Sillahertane / Coomagearlaghy II	Constructed	2009	10	Drains via tributary to Roughty River (c.2.3km upstream of site)
Grousemount	Constructed	2020+	38	Drains to Roughty River (c3.7km upstream of site at nearest)

7.5.6.2.2 *In-combination with Catchment Forestry Felling*

The Proposed Development sits within the Roughty_030 sub-basin. Upstream lies the Roughty_020 (20.52 km^2) and Roughty_010 (14.28 km^2). The combined catchment land area draining to the Roughty River upstream of the Thureehouma tributary confluence is 50.42 km^2. Corine landcover mapping, corroborated by aerial imagery (EPA maps) shows that total forestry cover of the Roughty catchment upstream of the Proposed Development is in the region of 5.67km^2, equating to 11.25% of the upstream catchment area. To place the Proposed Development felling level in context, the area of proposed felling is very low (5.75ha / 0.0575km^2), made up of 5 no. smaller plots on different branches of the Glanlee and Lettercannon tributaries, representing just 0.1% of the total catchment area upstream of the project influence. It is generally accepted that the smaller the portion of the catchment to be felled at any one time, the lesser the risk of sediment and nutrient loss (Hutton et al, 2008; Kelly Quinn et al., 2016). Furthermore, keyhole felling of small areas (as is proposed) presents even less risk in terms of sediment and nutrient loss compared to clearfelling. In the case of felling small coupes of trees, significant physico-chemical and biotic effects do not occur in the receiving waters of the larger channel downstream (Rodgers et al, 2010; O'Driscoll et al, 2013). With mitigation implemented as prescribed in **Section 7.5.3.1**, above, there is a low risk of project related felling effects, which (as supported by the literature) also translates to there being minimal, if any, risk of cumulative forestry effects on the sensitive salmonid habitats of the upper Roughty River. The residual cumulative forestry felling effects are predicted to be **Imperceptible indirect negative, short term, reversible**.

7.5.6.2.3 *In-combination with Agriculture*

There are low levels of intensified agricultural activity in the Roughty River catchment within the combined project and upstream catchment area. Agricultural activities are sources of nutrient and suspended solids to watercourses. The Proposed Development does not give rise to significant sources of nutrient, but in the absence of mitigation in the area of sediment loss control, the Proposed Development could cumulatively add to agriculturally derived sources of suspended solids loss to surface waters. With mitigation measures implemented as prescribed in **Sections 7.5.3, 7.5.4 and 7.5.5** above, the cumulative effect with agriculture on aquatic ecological receptors is **Not Significant**.

7.5.6.2.4 *In-combination with Rural Housing and Other Projects*

One-off rural housing is scarce in this quite remote mountain valley. Kerry County Council's online Planning Enquiry webtool was searched, revealing no recently permitted (or previously permitted and unbuilt) one-off housing or farm construction developments that could have in-combination effects with the Proposed Development.

7.5.7 Monitoring

7.5.7.1 Construction Phase

7.5.7.1.1 *Responsibilities*

As part of this EIAR, as transposed to the CEMP for the Proposed Scheme, surface water quality monitoring procedures are proposed during construction works.

An appointed, qualified, experienced Environmental Clerk of Works (ECoW) (see CEMP Section 4.1.2) will be responsible for daily checks and monthly water sampling described below that ensures water quality protection measures and guidelines are complied with during the pre-commencement and active construction phase.

The ECoW will also attend stakeholder meetings with relevance to aquatic ecology and fisheries throughout the construction (i.e., IFI). The finalised designs of the new culvert in the upper Lettercannon tributary and the culvert extension (as a result of Section 50 consent) plus their Construction Method Statements (CMS) will be provided to IFI no later than 6 weeks in advance of proposed works. The finalised CMS will include any additional measures conditioned within a planning permission. The ECoW, in conjunction with the Site Manager will ensure that IFI are then notified well in advance of instream works commencing.

The contractor will employ a professional company with experience in continuous turbidity monitoring to carry out the monitoring set out in **Section 7.5.7.4**, below.

7.5.7.1.2 *Daily Site Monitoring Procedure*

The following daily environmental monitoring procedure will be carried out to ensure that environmental management requirements that protect aquatic ecological receptors are being implemented and are meeting their objectives:

General Procedures

- Water quality protection mitigation/ control measures shall be inspected daily by the ECoW during working days where there are active earthworks/ excavations / culvert upgrades occurring
- Any maintenance and repairs required relating to construction related drainage management, e.g., silt fences, settlement ponds, check-dams, will be actioned immediately.
- Environmental monitoring and checklists shall be recorded and added to the CEMP on a daily basis.

Weather Forecasts

- Chapter 9: Water, Section 9.5.2.1 sets out the protocol surrounding programming of construction works in relation to weather forecasts. This protocol will be adhered and ensured by the ECoW.

- Prior and following heavy rainfall, the ECoW will ensure that all sediment loss prevention measures and environmental controls are functioning correctly.
- During and immediately after heavy periods of rain, earthmoving activities will be reviewed with temporary restrictions where necessary.

Visual Checks

- Underpinning the monitoring approach will be daily visual checks on the construction site, conducted by the ECoW, to ensure all mitigation measures are implemented as set out in the CEMP. These visual checks will include checks on integrity of all on-site mitigation infrastructure, e.g. silt fencing, attenuation / treatment ponds, on-site drainage flow paths etc. Any required maintenance will be actioned immediately.
- Daily visual checks for evidence of silt plumes and oil slicks will also be carried out at watercourses and drainage ditches surrounding works areas.
- During daily checks, the ECoW will have powers to stop works if there are obvious sediment plumes observed in watercourses/drains or obvious erodible sediment sources along any pathways from construction areas to drains and/or watercourses. In the instance that works must stop, the source(s) and/or reasons for observed sediment loss will be identified and controls will be bolstered through additional silt fencing and check-dams or pump-out and treatment via settlement systems.

7.5.7.1.3 *Surface Water Monitoring*

In addition to the daily on-site visual checks set out above and within the CEMP, a dedicated water sampling programme will be implemented focusing mainly on suspended solids and turbidity on the Roughty River. It is not practicable to carry out upstream/downstream monitoring on the tributaries in relation to the construction works because of the headwater location of the Proposed Development. Hence, the water sampling monitoring programme will focus on the lower tributary (Thureehouma, Lettercannon and Glanlee) sites and the Roughty River where the main aquatic ecological sensitivities are located.

Water Sample Procedure and Analysis Parameters

- Continuous turbidity sondes will be deployed at Sites R1 US and R2 DS shown on Figure 7-3.
- Turbidity sonde deployment, maintenance and data management will be carried out by a professional, experienced company that specialises in continuous turbidity monitoring.
- Turbidity recording will start 6 months prior to commencement of active on-site construction works (earthworks, excavations, drainage installations and felling). This will establish an up-to-date baseline for comparison during the construction phase. Continuous turbidity monitoring will thereafter continue throughout the main earthworks and forestry felling activities of the construction phase and cease 3 months after their completion.
- During the pre-commencement phase the correlation between suspended solids and turbidity will be calculated. This relationship is site-specific (based on geology / soil type) and will be carried out by a qualified, professional company that specialises in turbidity / suspended solids correlation.
- In addition, the ECoW will collect monthly discrete grab samples from sites on the tributaries K16, K18, K17A, K23 and K27 as shown in Figure 7-3. The tributary sites will be analysed for the following parameters: Total Suspended Solids (mg/l), Turbidity (NTU), Ortho Phosphorus (mg/l P), Ammonia (mg/l N), Total Oxidised Nitrogen (TON) (mg/l N) and pH.
- Monthly sampling on the tributary sites will be pre-scheduled (e.g., first Tuesday of each month) and not altered according to weather conditions. This will avoid “fair weather” sampling, therefore ensuring a broad representation of flow conditions and potential pollutant loss from the site.

- Water samples will be analysed at an ISO Accredited or EPA Approved water laboratory.
- The date, time and flow conditions and the broad antecedent dry period (approximate days / hours since last significant rainfall) will be recorded during each water sample collection at each site. Water flow condition recording (e.g., "below average", "average", "above average", "well above average / flood flow") is crucial to interpretation of the data as pollutant export depends on flow and the data will help determine whether strengthening of on-site mitigation measures is required.
- Water samples once collected will be stored in cooler boxes with ice packs and delivered to the laboratory on the day of sampling or kept refrigerated overnight and delivered the following morning.
- Water sample results will be added to a continually updated spreadsheet that provided calculation of rolling averages.

7.5.7.1.4 *Water Quality Sampling – Action Trigger Points*

Based on the literature (Kerr 1995, Newcombe and Jensen 1996) and water quality criteria for salmonid waters the following applies:

- Once the turbidity / Total Suspended Solids (TSS) correlation has been professionally calculated for the main channel of the Roughty River, then, based on the conversion from realtime turbidity records, the daily mean suspended solids concentration at Site R2 DS must not exceed 5% over the upstream (R1 US) TSS level.
- If the threshold is exceeded on the Roughty main channel, the ECoW will investigate any potential source areas of high suspended solids on the construction site using a hand-held turbidity meter to first check Sites K19, K23 and K27 to determine if there is an obvious source from one or more of the tributaries, then work back upstream from the 'problem' tributary confluence(s) to key junctions in the tributary system to locate any potential construction related source of TSS. Once the source area is identified, the ECoW will instruct additional efforts be made to strengthen sediment control measures as set out in the CEMP and **Section 7.5.3**, above.
- If either once off and/or rolling average SS concentration on the tributary stream sites K19, K23 and K27 (Fig 7-3) exceeds 25mg/l suspended solids at any time, then any source of potential sediment run-off from the active construction site will be investigated by the ECoW who has the power to stop works and order strengthening of sediment control measures as set out in the CEMP and **Section 7.5.3**, above.

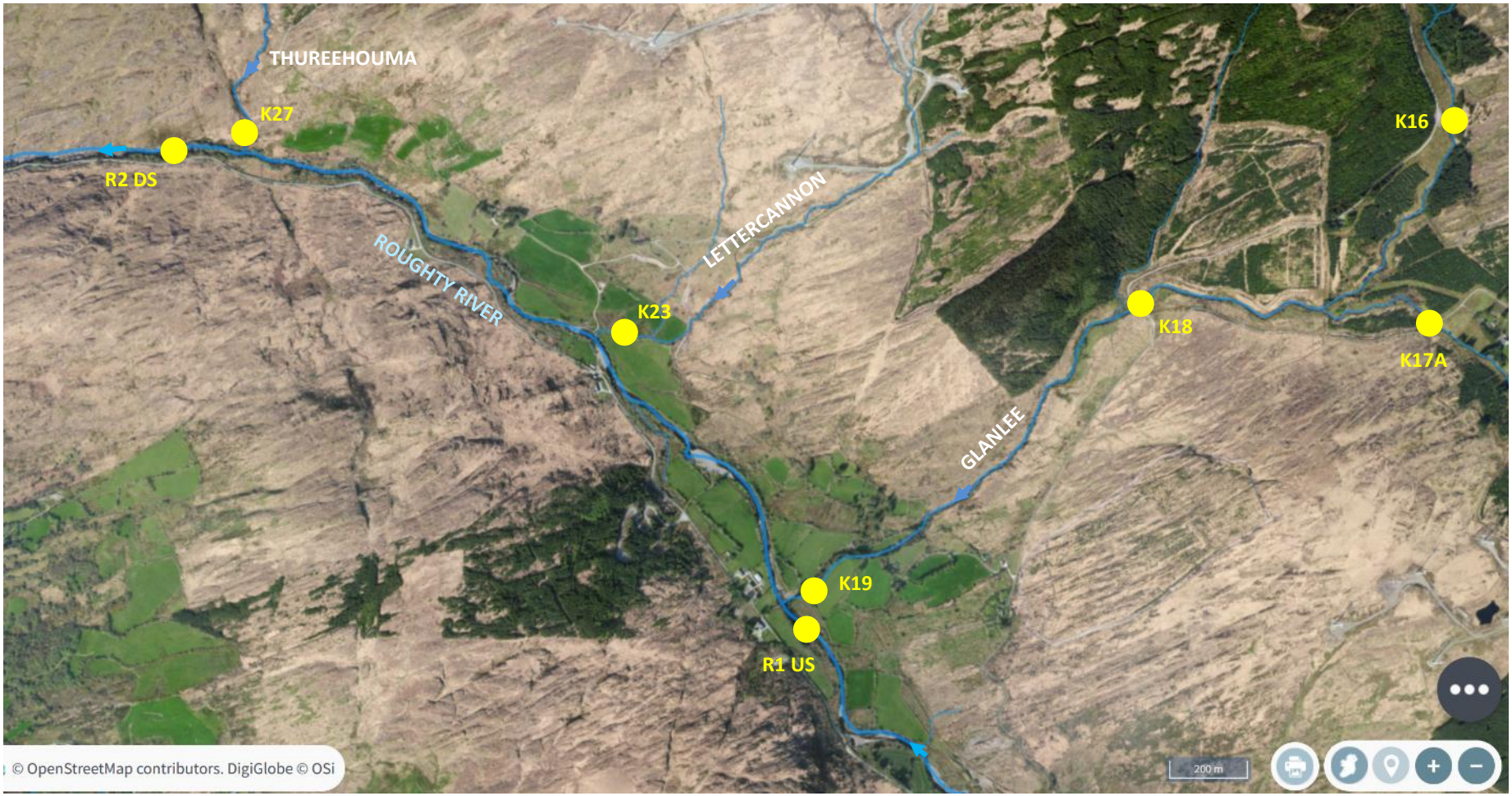

Figure 7-3 Proposed Water Sampling Locations - Construction Phase

7.5.8 WFD Implications

With all specific construction phase mitigation measures in **Sections 7.5.3, 7.5.4 and 7.5.5** above, which includes the detailed drainage design and overarching mitigation, monitoring and compliance measures as amalgamated in the CEMP, the Proposed Development will not give rise to changes to hydromorphology or water quality that could cause deterioration of the biological quality element (Macroinvertebrate Q-value) or supporting physico-chemical conditions that underpin WFD ecological status classifications of the following River Water Bodies (RWBs):

- Roughty 030 (IE_SW_21R010250) (High Status Objective RWB)
- Flesk (Kerry)_040 (IE_SW_22F020100)
- Flesk (Kerry)_030 (IE_SW_22F020060) (High Status Objective RWB)
- Sullane _010 (IE_SW_19S020100)

The Proposed Development, therefore, does not give rise to potential for deterioration in RWB status for these, or any downstream connecting RWB, nor will attainment of good or high status (in the case of Roughty_030 and Flesk (Kerry)_030 RWBs) be jeopardised, hence the Proposed Development is compliant with core objectives of the WFD. A full Water Framework Directive Compliance Assessment has been completed for the Proposed Development as detailed in Appendix 9-3.

7.6 Conclusion

This chapter assesses the effects that the Proposed Development may have on aquatic ecological receptors and sets out the mitigation measures proposed to avoid or reduce any potential likely significant effects that were identified.

The Proposed Development comprises the wind farm site and its associated access track. The wind farm repower element of the Proposed Development is in the upper reaches of three small tributaries of the Roughty River (Thureehouma, Lettercannon and Glanlee). The access track traverses several small headwater tributaries of sub-catchments of the River Flesk (Laune) and Sullane (Lee).

A large portion of the wind farm site infrastructure is already in-situ, notably the internal roading, drainage network and existing culverts. As such, there is no requirement for large-scale earthworks that would otherwise be associated with a new wind farm development. Earthworks are limited to a small number of new hardstands, cable ducting, drainage upgrades and a short section of new internal track between proposed T8 and T11. One new culvert crossing will be required on a small, ephemeral watercourse in the upper reaches of the Lettercannon tributary.

A comprehensive suite of field surveys was carried out to inform the aquatic ecological impact assessment, including electrofishing, macroinvertebrate sampling (Q-value analysis), freshwater pearl mussel survey, water chemistry sampling and aquatic habitat assessments.

Electrofishing at sites on the three tributaries and on the Roughty main channel showed (1) upper reaches of the tributaries within the Proposed Development site have no salmonid value and are generally of low local ecological value owing to ephemeral flows, small size and steep topography, (2) lower reaches of each of the three tributaries have small populations of salmon and trout, (3) mid-reaches of the Glanlee tributary (outside the site boundary) have small numbers of trout only, and (4) Roughty River comprises excellent salmonid habitats (spawning, nursery and holding) with high densities of juvenile salmon and trout of various size classes.

Freshwater pearl mussel survey on the Roughty River covered a total of 9km downstream of the tributary confluences, revealing low numbers and a very patchy distribution related to limited habitat

availability. Mussels were large, aged adults with no obvious evidence of recruitment. Over 70% of the channel was completely unsuitable for mussels in terms of substrate (bedrock, unstable cobble) and hydrological nature. The remaining 30% of habitat had very limited habitat suitability owing to scouring during high flow. A few scattered adults (n=4) were located 900m downstream of the wind farm site boundary, with the nearest significant cluster of large adults located a further 3.2km downstream. Water and macroinvertebrate sampling showed the Roughty River and the three affected tributaries to be "unpolluted" with waters indicative of 'high' status according to Surface Water Regulations and aligning with 'good' to 'high' ecological status according to macroinvertebrate communities under the Water Framework Directive (WFD).

Watercourses crossed by the existing access track are small headwater tributaries of the River Flesk, with one small headwater crossing of the Sullane sub-catchment. Each of the crossings within the Proposed Development area are culverted, with no requirement for further instream works. The access track itself will be subject to superficial repairs (minor resurfacing) where necessary.

The access track tributaries drain to the River Flesk within a reach that is mainly torrential and gorge-like with bare bedrock and boulder chutes and pools. There is little or no salmonid spawning or nursery habitat. Holding pools are common for migrating salmon and older residential trout. The Flesk tributary streams themselves have no fisheries significance in the already culverted reaches, but trout cannot be ruled out in the lower reaches of the Owgarriv Stream that drains to the Flesk. Freshwater pearl mussels were not detected downstream of the Owgarriv tributary as far as the Loo River confluence (1.2km). No significant

A section of the access track nearer the N22 road may require minor levels of widening, involving a small amount of linear forestry felling and one culvert upgrade. The culvert upgrade is on a minor, non-fisheries channel. These works are outside the EIAR Site Boundary but, for completeness, were assessed in combination, as part of this Chapter.

In the absence of mitigations and measures to prevent and control sediment sources and pollutant losses to watercourses, the cumulative construction phase impact on downstream aquatic receptor the three tributaries (trout, salmon, macroinvertebrates) and the Roughty River (salmonids, pearl mussel, macroinvertebrates at high status) may be short-term, significant negative, although it is noted that the possibility of this occurring from a well-managed site where there is existing infrastructure (i.e., internal access roads and sub-station in-situ) is not likely.

On the access track, the combination of felling and road widening in the Flesk sub-catchment has potential for at least short-term, moderate, negative reversible effects on the Flesk tributaries and the Flesk River, localised to a short distance downstream of the tributary confluences.

A wide range of mitigation measures have been prescribed as part of the Proposed Development to prevent contamination of surface waters during the construction phase; detailed in this chapter, in Chapter 9 (Water) and amalgamated in the CEMP. The existing drainage network will be upgraded to improve on-site attenuation and concomitant treatment. The construction phase discharges will be limited to greenfield run-off rates with measures employed to limit sediment sources and control pathways to prevent suspended solids wash-out. The implementation and efficacy of all mitigation measures will be overseen and monitored by a dedicated Ecological Clerk of Works during the construction phase.

Residual effects are predicted to diminish following the early construction period as the development infrastructure settles into the landscape and ceases to give rise to potentially damaging levels of solids export to watercourses. With the implementation of the prescribed mitigation measures around sediment loss prevention and control during the construction phase, adverse in-combination effects on aquatic receptors of the Roughty River, plus the Flesk and Sullane Rivers (access track) are not likely and Not Significant.