FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 2

Aquatic Ecology

1 Methodology

1.1 Selection of watercourses for assessment

All freshwater watercourses which could be affected directly or indirectly by the proposed project were considered as part of the current assessment. This included watercourses draining the proposed wind farm site as well as those crossed by the proposed grid connection route and turbine delivery route (where any works had potential to cause impacts). A total of *n*=40 locations were selected for detailed aquatic assessment (see Table 1 and Figure 1 below). Sites were grouped according to survey clusters, i.e. A (north of proposed project), B (within project site) and C (downstream of project site). An additional *n*=5 surveys locations (i.e., sites N1, N2, N3, N4 & N5) were surveyed in June 2021 to reflect the updated site infrastructural layout. The nomenclature for the watercourses surveyed is as per the Environmental Protection Agency's (EPA) online map viewer.

A fisheries assessment (including electro-fishing and fisheries habitat appraisal) and white-clawed crayfish survey was undertaken at *n*=35 sites in June-July 2020 (Table 1 and Figure 1). A fisheries appraisal (no electro-fishing) was undertaken at an additional *n*=5 locations in June 2021 to reflect the updated site infrastructural layout (i.e., sites N1, N2, N3 & N4 and N5).

A freshwater pearl mussel survey was conducted at seven locations along the River Laney and Awboy River (Table 2 and Figure 2).

Biological water quality sampling (Q-sampling) was undertaken at a representative sub-set of these sites (i.e., *n*=21 sites; A1, A2, A5, B6, B7, B8, B9, B10, B11, C3, C5, C7, C11, C12, C13, C17, N1, N2, N3, N4 & N5) (Figure 3).

Physiochemical water quality samples were taken from a total of *n*=15 sites (i.e., A1, A2, A5, B6, B7, B8, B9, B10, C7, C13, C17, N1, N2, N3 & N4).

This holistic approach informed the overall aquatic ecological evaluation of each site in context of the proposed wind farm project.

More specific aquatic methodology is outlined below and in the appendices of this report.

Table 1 : *n*=40 aquatic survey locations for the proposed Ballinagree wind farm project, Co. Cork (watercourse names are according to the EPA)

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1	Nadanuller Beg Stream	18N05	Carrigagulla	536890	587246
A2	Nadanuller Beg Stream	18N05	Carrigagulla	537742	587571
A3	Unnamed stream	n/a	Crinnaloo South	538409	587668
A4	Unnamed stream	n/a	Crinnaloo South	538946	587720
A5	Glen River	18G04	Inchamay South	540517	587756
B1	Carrigagulla Stream	19C22	Carrigagulla	536626	585034
B2	Unnamed stream	n/a	Knocknagappal	534010	584604
B3	West Ballinagree Stream	19W12	Knocknagappal	534023	583798
B4	Knocknagappal 19 Stream	19K04	Knocknagappal	534644	583730
B5	River Laney	19L01	Ballynagree West	535126	584076

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
B6	River Laney	19L01	Ballynagree West	535248	583913
B7[5]	Unnamed stream	n/a	Ballynagree East	535968	584267
B8	River Laney	19L01	Ballynagree East	536600	583906
B9	Unnamed stream	n/a	Carrigagulla	538378	584701
B10	Ballynagree East Stream	19B21	Ballynagree East	536999	581849
B11	River Laney	19L01	Annagannihy	539060	582814
C1	Carrigthomas Stream	19C48	Knocknagappul	534443	582576
C2	Maulnahorna Stream	19M10	Rahalisk	533717	582074
C3	Carrigthomas Stream	19C48	Horsemount Bridge	534597	581268
C4	Rahalisk Stream	19R08	Knocknagappul	535030	580521
C5	Carrigthomas Stream	19C48	Coppeleenbawn Bridge	535286	579818
C6	Unnamed stream	n/a	Knocknagappul	536028	580673
C7	River Laney	19L01	Ballynagree West	536793	580028
C8	Lacknahaghny Stream	19L21	Lacknahaghny	536625	579348
C9	Unnamed stream	n/a	Carrigthomas	536313	579387
C10	Unnamed stream	n/a	Carrigthomas	535957	579674
C11	River Laney	19L01	Knocknagappul Bridge	535409	579769
C12	Awboy River	19A03	Awboy Bridge	534960	579216
C13	River Laney	19L01	Clonavrick Bridge	534605	578297
C14	Clonavrick Stream	19C74	Clonavrick	535048	577820
C15	Coolaniddane River	19C67	Caherbaroul	536466	577955
C16	Kilberrihert Stream	19K24	Derryroe	536269	577345
C17	Coolaniddane River	19C67	Caherbaroul	536005	577472
C18	Caherbaroul Stream	19C76	Caherbaroul	535712	577653
C19	Bealick Stream	19B45	Rockville	536620	577111
N1	West Ballynagree Stream	19W12	Knocknagappul	534473	583824
N2	River Laney	19L01	Knocknagappul	534962	584267
N3	Unnamed stream	n/a	Ballynagree East	535352	585631
N4	River Laney	19L01	d/s ford crossing at Carrigagulla	536666	583905
N5	Unnamed stream	n/a	Knocknagappul	534809	581860

[5] Biological and physiochemical water quality sampling at this site was undertaken in May 2021

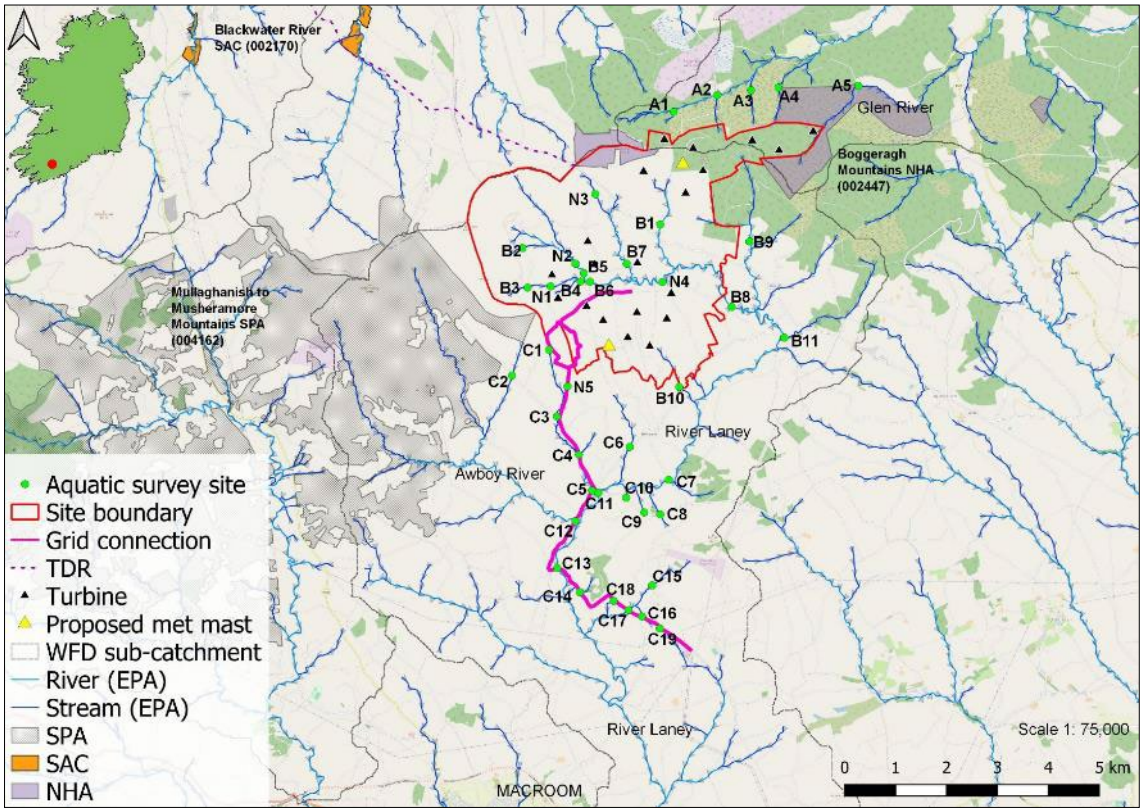

Figure 1: **Overview of the *n*=40 aquatic survey locations for the proposed Ballinagree wind farm project, Co. Cork.**

1.2 Desk Study

A sensitive species data request was submitted (9th November 2020) to the National Parks and Wildlife Service for the 10km grid squares containing and adjoining the proposed wind farm project (i.e., W28, W37, W38, W48 & W49) and was received on the 12th November 2020. Data held by the National Biodiversity Data Centre (NDBC) was also reviewed. Records for a number of rare or protected species were available although none overlapped directly with the wind farm boundary. However, several records overlapped with or shared hydrological connectivity with associated infrastructure (i.e., grid connection route, turbine delivery route).

1.3 Field Assessment

Surveys of the aquatic sites within the vicinity of the proposed project were conducted in June-July 2020, June 2021 and December 2021 (total of *n*=40 survey locations). Survey effort focused on both instream and riparian habitats approx. 150m upstream and 150m downstream of each sampling point (see Figure 1 above). The watercourses at each survey location were described in terms of the important aquatic habitats and species.

This helped to evaluate species and habitats of ecological value in the vicinity of each site. The aquatic baseline prepared informs mitigation for the proposed project.

A broad aquatic habitat assessment was conducted utilising elements of the methodology given in the Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003' (EA, 2003) and the Irish Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000). All sites were assessed in terms of:

- Physical watercourse/waterbody characteristics (i.e., width, depth etc.);
- Substrate type, listing substrate fractions in order of dominance (i.e., bedrock, boulder, cobble, gravel, sand, silt etc.);
- Flow type, listing percentage of riffle, glide and pool in the sampling area;
- An appraisal of the macrophyte and aquatic bryophyte community at each site;
- Riparian vegetation composition.

1.3.1 Otter signs

The presence of otter (*Lutra lutra*) at each of the *n*=40 aquatic survey locations was determined through the recording of otter signs within 150m of the survey area. The survey broadly followed the best practice survey methodology for otter as recommended by Lenton et al. (1980), Chanin (2003), Bailey & Rochford (2006) and CIEEM (2013). Otter signs included holts, couches, spraints, latrines, slides and prints, which are useful determinants of otter utilisation of watercourses. The location of signs was recorded via handheld GPS.

1.3.2 Catchment-wide electro-fishing and fisheries appraisal

A catchment-wide electro-fishing (CWEF) survey of the watercourses within the vicinity of the proposed wind farm (*n*=35 of 39 sites, Table 1, and Figure 1) was conducted in July 2020, following notification to Inland Fisheries Ireland (Macroom) and under the conditions of a Department of Communications, Climate Action & Environment (DCCAE) licence. The survey was undertaken in accordance with best practice and Section 14 licencing requirements.

Furthermore, a fisheries habitat appraisal of all *n*=40 aquatic survey sites was undertaken to establish their importance for salmonid, lamprey, European eel and other fish species. The baseline assessment considered the quality of spawning, nursery and holding habitat within the vicinity of the survey sites using Life Cycle Unit (salmonids) and Lamprey Habitat Quality Index scores (lamprey).

1.3.3 Fish stock assessment (electro-fishing)

A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish sites on both named and unnamed watercourses in the vicinity of the proposed Ballinagree wind farm during July 2020, following notification to Inland Fisheries Ireland (Macroom) and under the conditions of a Department of Communications, Climate Action & Environment (DCCAE) license. Both river and holding tank water temperature was monitored continually throughout the survey to ensure temperatures of 20°C were not exceeded, thus minimising stress to the captured fish due to low dissolved oxygen levels. A portable battery-powered aerator was also used to further reduce stress to any captured fish contained in the holding tank.
Salmonids, European eel and other captured fish species were transferred to a holding container with oxygenated fresh river water following capture.

To reduce fish stress levels, anaesthesia was not applied to captured fish. All fish were measured to the nearest millimetre and released in-situ following a suitable recovery period.

As three primary species groups were targeted during the survey, i.e., salmonids, lamprey, and eel, the electro-fishing settings were tailored for each species. By undertaking electro-fishing using the rapid electro-fishing technique (see methodology below), the broad characterisation of the fish community at each sampling reach could be determined as a longer representative length of channel can be surveyed. Electro-fishing methodology followed accepted European standards (CEN, 2003) and adhered to best practice (e.g., CFB, 2008).

1.3.3.1 Salmonids and European eel

For salmonid species and European eel, as well as other incidental species, electro-fishing was carried out in an upstream direction for a 10-minute CPUE, an increasingly common standard approach for wadable streams (Matson et al., 2018). A total of approx. ≥75-100m channel length was surveyed at each site, where feasible, in order to gain a better representation of fish stock assemblages. At certain, more minor watercourse sites or sites with limited access, it was more feasible to undertake electro-fishing for a 5-minute CPUE. Discrepancies in fishing effort (CPUE) between sites are accounted for in the subsequent results section.
Relative conductivity of the water at each site was checked in-situ with a conductivity meter and the electro-fishing backpack was energised with the appropriate voltage and frequency to provide enough draw to attract salmonids and European eel to the anode without harm. For the low to moderate conductivity waters of the sites (most draining upland/sandstone areas) a voltage of 250-300V, frequency of 40-45Hz and pulse duration of 3.5ms was utilised to draw fish to the anode without causing physical damage.

1.3.3.2 Lamprey

Electro-fishing for lamprey ammocoetes was conducted using targeted box quadrat-based electro-fishing (as per Harvey & Cowx, 2003) in objectively suitable areas of sand/silt, where encountered. As lamprey take longer to emerge from silts and require a more persistent approach, they were targeted at a lower frequency (30Hz) burst DC pulse setting which also allowed detection of European eel in sediment, if present. Settings for lamprey followed those recommended and used by Harvey & Cowx (2003), APEM (2004) and Niven & McAuley (2013). Using this approach, the anode was placed under the water's surface, approx. 10–15 cm above the sediment, to prevent immobilising lamprey ammocoetes within the sediment. The anode was energised with 100V of pulsed DC for 15-20 seconds and then turned off for approximately five seconds to allow ammocoetes to emerge from their burrows. The anode was switched on and off in this way for approximately two minutes. Immobilised ammocoetes were collected by a second operator using a fine-mesh hand net as they emerged.

Lamprey species were identified to species level, where possible, with the assistance of a hand lens, through external pigmentation patterns and trunk myomere counts as described by Potter & Osborne (1975) and Gardiner (2003).

1.3.4 Fisheries habitat

1.3.4.1 Salmonids

Fisheries habitat quality for salmonids was assessed using the Life Cycle Unit method (Kennedy, 1984; O'Connor & Kennedy, 2002) to map the *n*=37 riverine sites as nursery, spawning and holding habitat, by assigning quality scores to each type of habitat.

Those habitats with poor quality substrata, shallow depth and a poorly defined river profile receive a higher score. Higher scores in the Life Cycle Unit method of fisheries quantification are representative of poorer value, with lower scores being more optimal despite this appearing counter-intuitive.

Table 2: Life Cycle Unit scoring system for salmonid nursery, spawning and holding habitat value (as per Kennedy, 1984 & O'Connor & Kennedy, 2002)

Habitat quality	Habitat score	Total score (three components)
Poor	4	12
Moderate	3	9-11
Good	2	6-8
Excellent	1	3-5

1.3.4.2 Lamprey

Lamprey habitat evaluation for each survey site was undertaken using the Lamprey Habitat Quality Index (LHQI) scoring system, as devised by Macklin et al. (2018). The LHQI broadly follows a similar rationale as the Life Cycle Unit score for salmonids. Those habitats with a lack of soft, largely organic sediment areas for ammocoete burrowing, shallow sediment depth (<10cm) or compacted sediment nature receive a higher score. Higher scores in this index are thus of poorer value (in a similar fashion to the salmonid Life Cycle Unit Index), with lower scores being more optimal. Overall scores are calculated as a simple function of the sum of individual habitat scores.

Larval lamprey habitat quality as well as the suitability of adult spawning habitat is assessed based on the information provided in Maitland (2003) and other relevant literature (e.g., Gardiner, 2003). Unlike the salmonid Life Cycle Unit index, holding habitat for adult lamprey is not assessed owing to their different migratory and life history strategies, and that electro-fishing surveys routinely only sample larval lamprey.

The LHQI scoring system provides additional information compared to the habitat classification based on the observations of Applegate (1950) and Slade et al. (2003), which deals specifically with larval (sea) lamprey settlement habitat. Under this scheme, habitat is classified into three different types: preferred (Type 1), acceptable (Type 2), and not acceptable for larvae (Type 3) (Slade et al. 2003). Type 1 habitat is characterized by soft substrate materials usually consisting of a mixture of sand and fine organic matter, often with some cover over the top such as detritus or twigs in areas of deposition. Type 2 habitat is characterized by substrates consisting of shifting sand with little if any organic matter and may also contain some gravel and cobble (lamprey may be present but at much lower densities than Type 1). Type 3 habitat consists of materials too hard for larvae to burrow including bedrock and highly compacted sediment. This classification can also be broadly applied to other lamprey species ammocoetes, including *Lampetra* species.

Table 3: Lamprey Habitat Quality Index (LHQI) scoring system for lamprey spawning and nursery habitat value (Macklin et al., 2018).

Habitat quality	Habitat score	Total score (two components)
Poor	4	8
Moderate	3	6-7
Good	2	3-5
Excellent	1	2

1.3.4.3 General fisheries habitat

A broad appraisal / overview of the upstream and downstream habitat at each site was also undertaken to evaluate the wider contribution to salmonid and lamprey spawning and general fisheries habitat. River habitat surveys and fisheries assessments were also carried out utilising elements of the approaches in the River Habitat Survey Methodology (Environment Agency, 2003) and Fishery Assessment Methodology (O'Grady, 2006) to broadly characterise the river sites (i.e., channel profiles, substrata etc.).

1.3.5 Freshwater pearl mussel survey

A freshwater pearl mussel survey was undertaken on sections of the River Laney and Awboy River in June 2020 by Sweeny Consultancy under NPWS licence C15/2020. Methodology followed NPWS guidance (Anon, 2004).

Assessments were made of the habitat suitability for freshwater pearl mussels, based on the criteria of Hastie et al. (2000) and Skinner et al. (2003).

Outside of these targeted survey areas on the River Laney, a broad appraisal of pearl mussel habitat was undertaken at each of the *n*=40 aquatic survey locations.

Table 4: Freshwater Pearl Mussel Survey Sites

River Name	Site Code	Site Name	Grid Ref. upstream end (ITM)	Stretch Surveyed
Laney	FPM1	Windfarm Site downstream of turbines	538025 583419	Ford to 200m downstream
Laney	FPM2	Lacknahaghny Br.	536896 579983	Bridge to 100m upstream and downstream
Laney	FPM3	Knocknagappul Br.	535467 579825	Bridge to 200m downstream
Awboy	FPM4	Awboy Br.	534902 579260	Laney confluence to 100m upstream

River Name	Site Code	Site Name	Grid Ref. upstream end (ITM)	Stretch Surveyed	
Laney	FPM5	Clonavrick Br.	534592 578381	100m upstream to downstream of bridge.	100m
Laney	FPM6	Morris's Br.	535701 575743	100m upstream to downstream of bridge.	100m
Laney	FPM7	Downstream of Clashavoon Stream confluence	536731 573787	Stream confluence to downstream.	200m

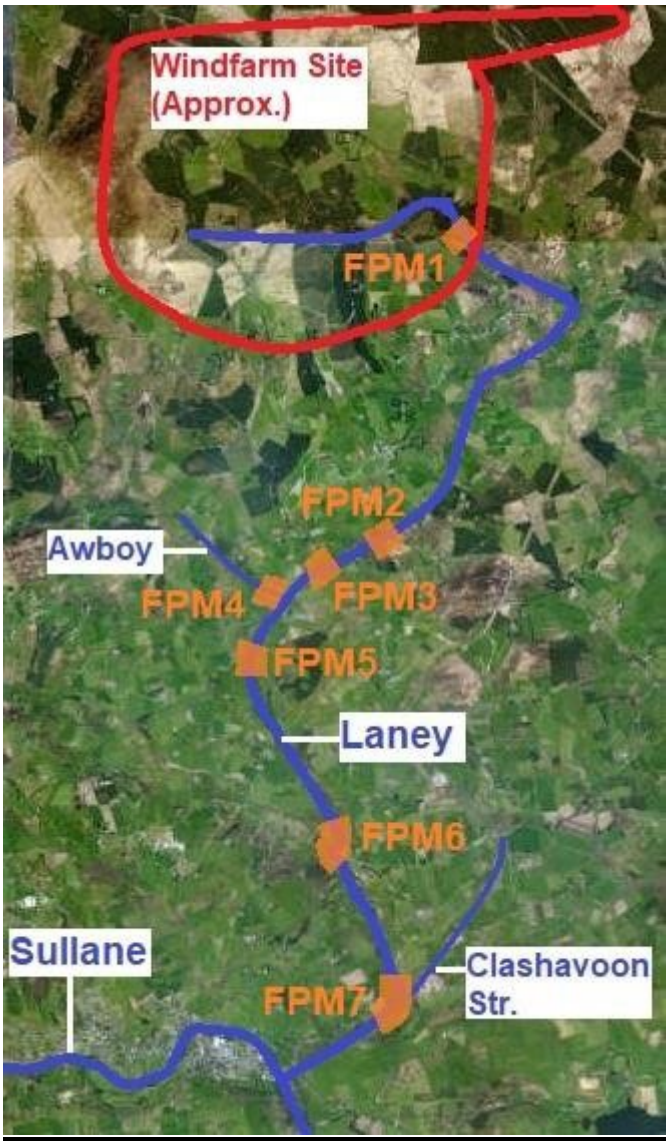

Figure 2: Freshwater Pearl Mussel Survey Sites

1.4 White-clawed crayfish survey

White-clawed crayfish (*Austropotamobius pallipes*) surveys were undertaken at the aquatic survey locations under a National Parks and Wildlife (NPWS) open licence (no. C79/2020), as prescribed by Sections 9, 23 and 34 of the Wildlife Act (1976-2021), to capture and release crayfish to their site of capture, under condition no. 5 of the licence. As per Inland Fisheries Ireland recommendations, the crayfish licence sampling started at the uppermost site(s) of the wind farm catchment/sub-catchments in the survey area to minimise the risk of transfer invasive propagules (including crayfish plague) in an upstream direction. Hand-searching of instream refugia and sweep netting was undertaken according to Reynolds et al. (2010). Trapping of crayfish was not feasible given the small nature of most aquatic survey locations sampled. An appraisal of white-clawed crayfish habitat at each location was also carried out based on physical channel attributes, water chemistry and incidental records in mustelid spraint. Additionally, a desktop review of crayfish records within the wider Ballinagree catchment was undertaken.

1.4.1 Biological water quality (Q-sampling)

Biological water quality sampling (Q-sampling) was undertaken at a representative sub-set of aquatic survey locations in July 2020, June 2021 and December 2021 (i.e., *n*=21 sites; A1, A2, A5, B6, B7, B8, B9, B10, B11, C3, C5, C7, C11, C12, C13, C17, N1, N2, N3, N4 & N5) (Figure 3). Macro-invertebrate samples were converted to Q-ratings as per Toner et al. (2005). All riverine samples were taken with a standard kick sampling hand net (250mm width, 500µm mesh size) from areas of riffle/glide utilising a three-minute sample. Large cobble was also washed at each site where present and samples were elutriated and fixed in 70% ethanol for subsequent laboratory identification. Any rare invertebrate species were identified from the NPWS Red List publications for beetles (Foster et al., 2009), mayflies (Kelly-Quinn & Regan, 2012), stoneflies (Feeley et al., 2020) and other relevant taxa (i.e., Byrne et al., 2009; Nelson et al., 2011).

Table 5: Reference categories for EPA Q ratings (Q1 to Q5)

Q Value	WFD Status	Pollution status	Condition
Q5 or Q4-5	High status	Unpolluted	Satisfactory
Q4	Good status	Unpolluted	Satisfactory
Q3-4	Moderate status	Slightly polluted	Unsatisfactory
Q3 or Q2-3	Poor status	Moderately polluted	Unsatisfactory
Q2, Q1-2 or Q1	Bad status	Seriously polluted	Unsatisfactory

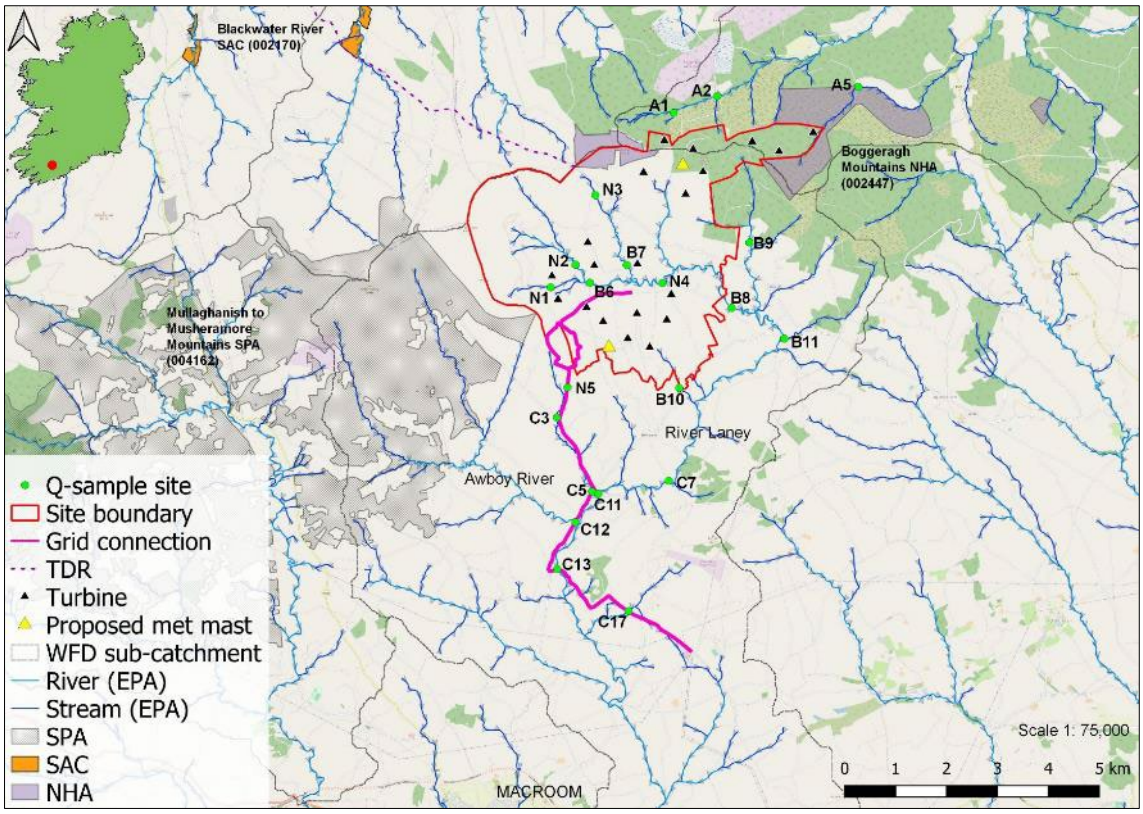

Figure 3: **Overview of the *n*=21 Q-sampling locations for the proposed Ballinagree wind farm project, Co. Cork**

1.5 Physiochemical water quality

Physiochemical water quality samples were collected from a total of *n*=15 aquatic survey locations (Figure 4) on 18th June 2020, 1st July 2020 or 1st June 2021 (i.e., A1, A2, A5, B6, B7, B8, B9, B10, C7, C13, C17, N1, N2, N3 & N4).

Samples were cooled and delivered to the laboratory on the same day for analysis. In order to collate a broad water quality baseline for the study area, a range of physio-chemical parameters for each site were laboratory-tested, namely;

- pH
- Alkalinity (mg $CaCO_3$/l)
- Total Ammonia (mg N/l)
- Molybdate Reactive Phosphorus (MRP) (mg P/l)
- Total Oxidised Nitrogen (TON) (mg N/l)
- Dissolved Organic Carbon (DOC) (mg C/l)
- Biochemical Oxygen Demand (BOD) (mg O_2/l)
- Chemical Oxygen Demand (COD) (mg O_2/l)
- Suspended solids (mg/L)

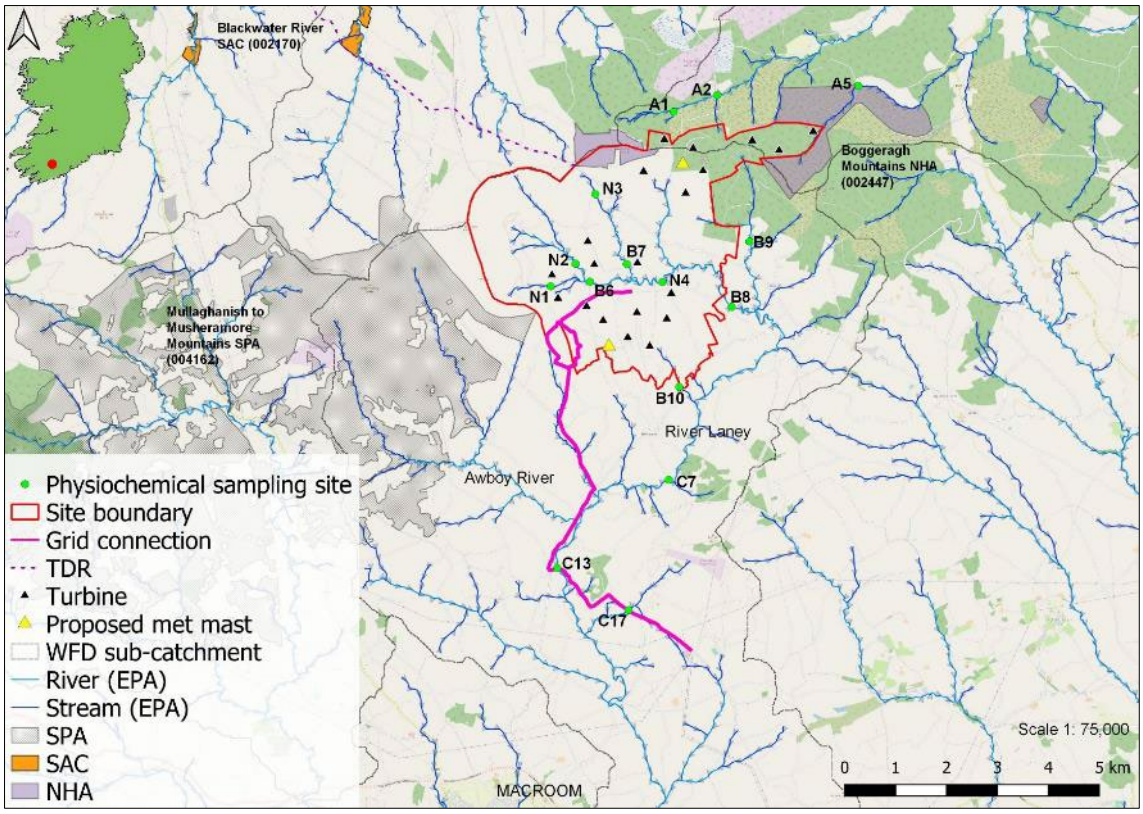

Figure 4: **Overview of the *n*=15 physiochemical water quality sampling locations for the proposed Ballinagree wind farm project, Co. Cork**

1.6 Aquatic ecological evaluation

The evaluation of aquatic ecological receptors contained within this report uses the geographic scale and criteria defined in the 'Guidelines for Assessment of Ecological Impacts of National Road Schemes' (NRA, 2009).

1.7 Biosecurity

A strict biosecurity protocol including the Check-Clean-Dry approach was adhered to during surveys for all equipment and PPE used. Disinfection of all equipment and PPE before and after use with Virkon™ was conducted to prevent the transfer of pathogens or invasive propagules between survey sites. Surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation. Any aquatic invasive species or pathogens recorded within or adjoining the survey areas were geo-referenced

2 Desk Study Results

2.1 Sensitive species data

A total of n=6 records for freshwater pearl mussel *(Margaritifera margaritifera)* were available for the River Laney (locally pronounced 'Lane'), with multiple records also available for the River Blackwater downstream of Banteer (Figure 8B.3.1). A single record overlapped with proposed wind farm infrastructure (grid connection route crossing) at survey site C13 at Clonavrick Bridge on the River Laney (record from 2007). Aside from this record, several other potential hydrological source-receptor pathways to known pearl mussel populations were identified (see Figure 5 below).

Common frog *(Rana temporaria)* were widespread throughout 10km grid squares W28, W37, W38, W48 & W49 although none overlapped with the proposed wind farm footprint.

Otter *(lutra lutra)* records were also widespread throughout the relevant grid squares. Otter records were available for the upper Awboy River, Carrigthomas Stream at Horsemount Bridge (survey site C3), Glen River at Glencaum Bridge and the Nad River in several locations. Otter were also previously recorded on the River Laney at Carrigagulla Bridge (near survey site B11), Clonavrick Bridge (survey site C11) and Morris's Bridge. The species is widespread on the River Blackwater. No otter records overlapped within the wind farm boundary.

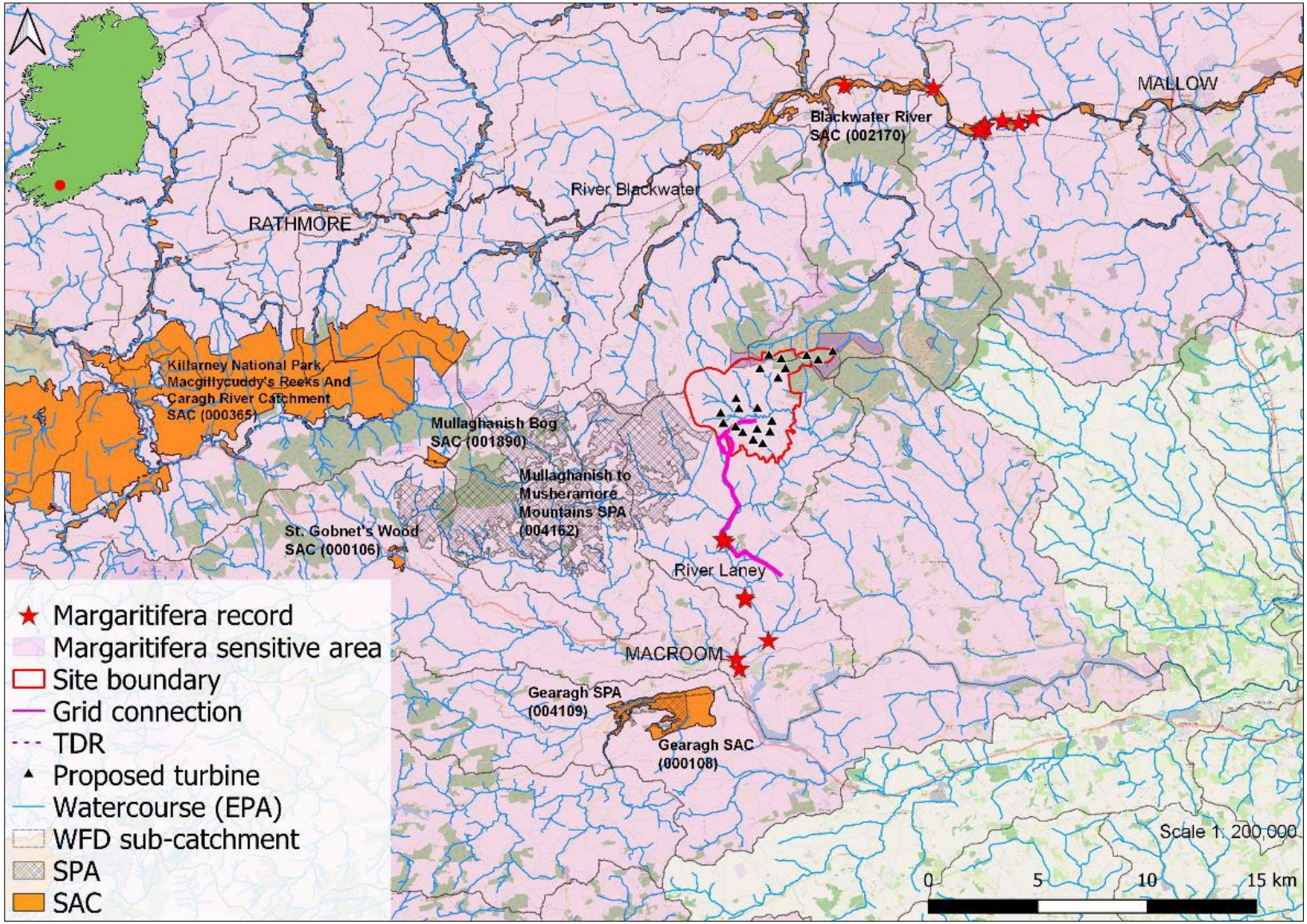

Figure 5: Distribution of freshwater pearl mussel (*Margaritifera margaritifera*) in the vicinity of the proposed project

2.2 EPA water quality data (existing data)

The following outlines the available water quality data for the watercourses in context of the proposed project. Only recent water quality (i.e., since 2018) is summarised below. EPA biological monitoring data was only available for the larger watercourses within the vicinity of the proposed wind farm project (i.e., River Laney, Awboy River and Glen River), with no data available for the smaller watercourses surveyed. Whilst there was no water quality data available for the Nadanuller Beg Stream draining to the north-east of the wind farm site, the downstream-connecting Nad River (18N01) achieved Q4-5 (high status) at station RS18N010400 in 2019.

Please note that biological water quality analysis was undertaken as part of this study, with the results presented in the Section 3.2.

2.2.1 River Laney

The River Laney (EPA code: 21F02, locally pronounced 'Lane') was the most significant watercourse draining the wind farm site, flowing in a loosely southerly direction before adjoining the River Sullane near Ford's Mill, Macroom. A number of survey watercourses adjoined the Laney (**Figure 1**). There was a total of four EPA biological monitoring stations which have been recently monitored on the river (i.e., since 2017). The uppermost of these (station code: RS19L010100) was located at Carrigagulla Bridge, approx. 0.35km upstream of survey site B11, and achieved Q4-5 (high status) water quality in 2019. Station RS19L010200 at Knocknagappul Bridge (aquatic survey site C11) also achieved Q4-5 (high status) water quality in 2017. Downstream of the survey area, stations RS12C030100 and RS19L010500, also achieved Q4-5 (high status) water quality in 2019. The River Waterbodies Risk for the River Laney was 'not at risk' according to the EPA (although it was considered 'at risk' in the lower reaches, near Macroom).

2.2.2 Awboy River

One of the larger Laney tributaries, the Awboy River (19A03) joined the Laney approx. 75m downstream of Awboy Bridge on the L3418 road. There was a single EPA biological monitoring station on the river, which achieved Q5 (high status) water quality at Awboy Bridge (station RS19A030200) in 2019. This equates to the highest possible water quality standard under the Water Framework Directive (i.e., pristine water quality). The River Waterbodies Risk for the Awboy River was 'at risk' according to the EPA.

2.2.3 Glen River

The Glen River (18G04) drained to the north of the wind farm boundary and adjoined the River Blackwater near Banteer. There were four biological monitoring stations with recent data on the river and all achieved Q4-5 (high status) in 2018 (the nearest of which was at Glencaum Bridge approx. 2.5km downstream of survey site A5).

3 Results of aquatic surveys

The following section summarises each survey site in terms of aquatic habitats, physical characteristics and overall value for fish, freshwater pearl mussel, white-clawed crayfish and macrophyte communities. Biological water quality (Q-sample) and physiochemical water quality results are also summarised for each site, where applicable. Habitat codes are according to Fossitt (2000). Scientific names are provided at first mention only. Most sites were surveyed in July 2020 with a low number (N1-N4) surveyed in June 2021. An evaluation of the aquatic ecological importance of each survey location based on these aquatic surveys is provided and summarised in Table 10.

No significant constraints were noted in terms of data collection to inform the aquatic and fisheries surveys.

3.1 Aquatic survey location results

3.1.1 Site A1 – Nadanuller Beg Stream, Carrigagulla

Site A1 was located on the uppermost reaches of the Nadanuller Beg Stream (EPA code: 18N05, also known locally as the Owenaluggin River). The upland eroding watercourse (FW1) was characterised by glide and riffle sequences with localised pool habitat over boulder cascades. The channel was approximately 1m wide and 0.2m deep with peat-stained water at the time of survey. The deep U-shaped channel graded into a valley with shallow slopes adjoining upland conifer plantations (WD4, 10-15 years old). The substrata were dominated by bedrock (20%), boulder (30%), large cobble (20%) and peat, with only localised coarse and medium gravels. The substrata were moderately silted and featured a very high coverage of filamentous algae at the time of survey. The adjoining lands comprised of wet grassland (GS4), blanket bog and pockets of heath, with purple moor grass (*Molinia caerulea*), *Juncus* sp. rushes and marsh bedstraw (*Galium palustre*) dominating. Macrophytes were absent due to the high energy of the site. However, aquatic bryophyte coverage was high locally, with *Fontinalis squamosa* and common earwort (*Scapania undulata)* present on boulder tops.

No fish were recorded from site A1 via electro-fishing. The site was considered a poor salmonid habitat overall, with poor nursery, spawning and holding areas present. The small, high-energy stream was not considered of value to European eel and was unsuitable for lamprey. Fisheries potential improved further down the watercourse (i.e., site A2.). There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 6). Molybdate reactive phosphorus (MRP) (0.043mg P/l) and total ammonia (0.094mg N/l) concentrations were high and, thus, the site failed meet the good status thresholds as set out under S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (Table 9).

Plate 1: Representative image of site A1 on the Nadanuller Beg Stream, June 2020 (facing upstream)

3.1.2 Site A2 – Nadanuller Beg Stream, Carrigagulla

Site A2 was located on the upper reaches of the Nadanuller Beg Stream, approx. 1km downstream from site A1. The upland eroding watercourse (FW1) averaged 1.5-2m wide and 0.2-0.3m deep. Characteristic of a high-energy, upland site, the profile was dominated by shallow riffle and glide sequences over boulder/bedrock cascades with localised pool. Bank heights were 1.5m, with a U-shaped channel. The bed was dominated by small boulder and cobble with bars of bedrock, with gravel pockets interstitially. The substrata were clean and unbedded with very limited algae growth. The site was located in upland blanket bog (PB2) and localised wet grassland (GS4), with scattered grey willow scrub (*Salix cinerea*). Macrophytes were absent but instream moss cover was high, being represented by localised *Fontinalis squamosa* and common earwort.

Brown trout (*Salmo trutta*) was the only fish species recorded from site A2 via electro-fishing. The site was considered an excellent trout nursery, with the population dominated by juveniles. Spawning habitat was good, locally, although deeper holding habitat for adults was sparse (as were adult fish themselves). The small, high-energy stream was considered of low value to European eel and was unsuitable for lamprey. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 6).

Plate 2: Representative image of site A2 on the Nadanuller Beg Stream, July 2020

3.1.3 Site A3 – unnamed stream, Crinaloo South

Site A3 was located on an unnamed stream at Crinaloo South, approx. 180m upstream of the Nadanuller Beg Stream confluence. The upland eroding watercourse (FW1) averaged just 0.5-1m wide and <0.2m deep. Characteristic of a high-energy, upland site, the profile was dominated by shallow riffle and glide sequences over boulder cascades with localised deeper pools. Bank heights were 1m, with a V-shaped channel. The riparian zone was colonised by bracken (*Pteridium aquilinum*) scrub (WS1). The substrata were dominated by large boulder and cobble with small pockets of coarse gravel interstitially. Siltation was moderate. Macrophytes were absent but bryophytes were present in the form of *Fontinalis squamosa* and common earwort, with pinnate scalewort (*Porella pinnata*) and yellow fringe moss (*Racomitrium aciculare*) also present.

Brown trout was the only fish species recorded from site A3 via electro-fishing. Low numbers of adult trout were recorded, with an absence of juveniles. The site was considered of moderate value for salmonids, overall. The small, high-energy stream was considered of low value to European eel (none recorded) and was unsuitable for lamprey. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality was not assessed at this site.

Plate 3: Representative image of site A3 on an unnamed stream at Crinaloo South, July 2020

3.1.4 Site A4 – unnamed stream, Crinaloo South

Site A4 was located on a second unnamed stream at Crinaloo South, approx. 1.2km upstream of the Nadanuller Beg Stream confluence. The upland eroding watercourse (FW1) averaged 2-2.5m wide and 0.2m deep. Characteristic of a high-energy, upland site, the profile was dominated by shallow riffle and glide sequences over boulder cascades with localised deeper pools. Bank heights were 1.5m, with a U-shaped channel. The site was situated in an upland area bordering mature Sitka spruce (*Picea sitchensis*) plantations (WD4) with riparian areas of blanket bog. The substrata were dominated by large boulder and cobble with small pockets of coarse gravel interstitially. Siltation was moderate. Macrophytes were absent but bryophytes were present in the form of *Fontinalis squamosa* and common earwort on instream boulders.

Brown trout and European eel (*Anguilla anguilla*) were the only two fish species recorded from site A4 via electro-fishing. Trout were present in moderate numbers, with both adults and a low number of juveniles present. A single adult eel was also recorded. The river was considered a moderate nursery with moderate quality spawning locally. Holding habitat was also considered moderate. Eel habitat was moderate overall but the high-energy site was considered unsuitable for lamprey. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality was not assessed at this site.

Plate 4: Representative image of site A4 on an unnamed stream at Crinaloo South, July 2020

3.1.5 Site A5 – Glen River, Inchamay South

Site A5 on the upper reaches of the Glen River (EPA code: 18G04) (bridge crossing CC-L95791-005.00) was an upland eroding watercourse (FW1) characterised by glide and riffle sequences with localised pool habitat over boulder cascades. The channel averaged 2m wide and 0.3m deep with peat-stained water at the time of survey. The shallow U-shaped channel was cut into a shallow sloping valley. The site drained an upland area which featured frequent coniferous afforestation (WD4). The adjoining lands comprised heath (south bank)) and wet grassland with pockets of heath to the north. The riparian zone featured open banks with low lying cover of soft rush (*Juncus effusus*), ferns, common sorrel (*Rumex acetosa*), bramble (*Rubus fruticosus* agg.), foxglove (*Digitalis purpurea*), heather (*Calluna vulgaris*), purple moor grass, rank grasses and occasional willow and rowan (*Sorbus aucuparia*). The substrata were dominated by boulder (30%), large cobble (40%) with coarse and medium gravels (20%). The remaining proportions comprised silt and small pockets of finer gravel in interstitial spaces, with a concrete apron near the bridge. The substrata were heavily covered with floc and filamentous algae. Macrophytes were not present upstream but downstream slower glide supported small beds of water crowfoot vegetation (*Ranunculus* sp.). The site had a high coverage of *Fontinalis squamosa* and *Chiloscyphus polyanthos,* with common earwort and yellow fringe moss also present. The presence of more than three indicator macrophyte/bryophyte species means the site's aquatic vegetative community was representative of the Annex I habitat 'Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation and aquatic mosses [3260]'.

Brown trout was the only fish species recorded from site A5 via electro-fishing. Trout were present in high numbers, with a high proportion of juveniles and a low number of adults present. The site was considered a very good nursery with locally good quality salmonid spawning habitat Holding habitat was also considered good in frequent, small deeper pools. Eel habitat was moderate overall but the high-energy site was considered unsuitable for lamprey. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 6).

Site A5 was located within the Boggeragh Mountains NHA (0002447), a site designated for peatlands. This site was therefore considered of national importance. The site also supported good-quality salmonid habitat, the presence of Annex I 'floating river vegetation' habitat and good status (Q4) water quality.

Plate 5: Representative image of site A5 on the Glen River (facing downstream from bridge)

3.1.6 Site B1 – Carrigagulla Stream, Carrigagulla

Site B1 was located on the Carrigagulla Stream (EPA code: 19C22) approx. 270m upstream of the L2758 road crossing. The semi-natural, upland eroding watercourse (FW1) featured roughly equal proportions of riffle, glide and pool habitat with no evident channel modifications. The stream averaged 1.5m wide and 0.2-0.3m deep with a strong flow at the time of survey. The profile was characteristic of high energy site (i.e., boulder cascade). The bed was dominated by small boulder and cobble with well-rounded coarse gravel. The substrata had light siltation and were unbedded and well-rounded indicating prevalent higher energy conditions. The V-shaped channel was bordered by semi-improved grassland (GA1, wet in nature) with the immediate riparian areas characterised by patches of gorse (*Ulex europaeus*) and bramble scrub (WS1) with localised willow. Bank heights were shallow and graded into the river valley at a low angle. Macrophytes were absent but some *Fontinalis squamosa* and common earwort was present.

Brown trout was the only fish species recorded from site B1 via electro-fishing. Trout were present in low numbers, with only small adults recorded. Despite this, nursery habitat was moderate overall, with locally good spawning habitat present, However, the high-energy, steep-gradient of the site reduced the fisheries value considerably. The site was of limited value for eel and considered unsuitable for lamprey. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality was not assessed at this site.

Plate 6: Representative image of site B1 on the Carrigagulla Stream, July 2020

3.1.7 Site B2 – unnamed stream, Knocknagappal

Site B2 was located on an unnamed stream in an upland area to the western boundary of the wind farm site. The channel represented an upland eroding watercourse (FW1) although it was 100% dry at the time of survey. However, the channel likely conveyed significant water flows following rainfall (i.e., non-perennial stream). Situated in a steep V-shaped channel, the dry stream averaged 1.5-2m wide in a 2-4m wide channel. The stream fell over a moderate gradient downstream of the road crossing, with a bed dominated by cobble and coarse gravels (both 35%), with occasional boulder and high fractions of sand. The bankfull height ranged from 3-4m and graded into (low intensity) improved agricultural pasture (GA1) downstream of the road culvert. The riparian zone featured sparse growth of nettle (*Urtica dioica*), soft rush, foxglove, marsh bedstraw, common sorrel and marsh thistle (*Cirsium palustre*) with scattered scrub patches of bramble, grey willow, gorse and fuchsia (*Fuchsia magellanica*). Rank grasses grew along the channel bed. The stream drained coniferous afforestation (WD4) and clear-fell (WD5) upstream, with agricultural pasture and coniferous afforestation (WD4) dominating downstream. Due to the dry channel, no macrophyte or aquatic bryophyte growth was present.

The stream offered no fisheries value at the time of survey (100% dry) and was considered to offer little if any fisheries value when conveying water given its small, high-gradient, high-energy upland nature. The site had no potential for freshwater pearl mussel or white-clawed crayfish given the seasonal, upland nature of the stream. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality was not assessed at this site.

Plate 7: **Representative image of site B2 on the upper reaches of an unnamed stream at Knocknagappul (site 100% dry during the survey period)**

3.1.8 Site B3 – West Ballinagree Stream, Knocknagappul

Site B3 was located in the uppermost reaches of the West Ballinagree Stream (EPA code: 19W12) at a local road crossing. The channel represented an upland eroding watercourses (FW1) although it was 100% dry at the time of survey. However, the channel likely conveyed significant water flows following rainfall (i.e., non-perennial stream). Situated in a deep U-shaped channel, the dry stream averaged <1m wide in a 1.5-2m wide channel with bankfull heights averaging 1m. The stream fell over a moderate gradient downstream of the road crossing, with a bed comprising 20% small boulder, 30% cobble, 20% medium gravel, 20% fine gravel and 10% sand. Silt or mud accumulations were absent. The site was situated in an upland area dominated by coniferous afforestation (Sitka spruce, WD4). Upstream of the site, the channel was situated in a mature block of Sitka spruce, with maturing coniferous plantation downstream. The riparian zone was heavily scrubbed (shading >95%) with a typical upland plant composition dominated by abundant grey willow and bramble (WS1). Nettle, foxglove, bilberry (*Vaccinium myrtillus*), common sorrel, marsh thistle, soft rush, bittercress (*Cardamine* sp.), rank grasses and terrestrial moss species such as big shaggy moss (*Rhytidiadelphus triquetrus*) were common. Due to the dry channel, no macrophyte or aquatic bryophyte growth was present.

The stream offered no fisheries value at the time of survey (100% dry) and was considered to offer little if any fisheries value when conveying water given its small, high-gradient, high-energy upland nature. The site had no potential for freshwater pearl mussel, white-clawed crayfish or otter given the seasonal, upland nature of the stream.

It was not possible to assess biological water quality at this site given a lack of water and flow.

Plate 8: **Representative image of site B3 on the West Ballynagree Stream (100% dry during the survey period)**

3.1.9 Site B4 – Knocknagappal Stream, Knocknagappal

Site B4 was located on the lower reaches of the Knocknagappul Stream (EPA code: 19K04, approx. 50m upstream of the confluence with the River Laney. The natural upland eroding watercourse (FW1) averaged 1-1.5m wide and 0.1-0.2m deep in a deeply cut (near vertical-sided) U-shaped channel. Shallow glide and riffle dominated the site (40% each) with only localised plunge pools, some to 1m in depth but mostly shallower. Bankfull heights were 1.5-2m and the channel evidently conveyed significantly more water during spate conditions. Natural bank scouring was frequent, particularly on the many meanders at the site. The substrata were dominated by small cobble (40%) with occasional small boulder (5%). Fine to medium gravels were frequent (30% overall), with sand also present (10%). Some exposed peat was present locally. Although some silt plumes were present underfoot, overall siltation levels were low in this high-energy channel. The stream meandered through a valley floor with mosaics of lowland blanket bog (PB4) and degraded raised bog (PB1). Common plant species included purple moor grass, soft rush, heath milkwort (*Polygala serpyllifolia*), marsh lousewort (*Pedicularis palustris*), tormentil (*Potentilla erecta)* bog myrtle (*Myrica gale*) and localised bog cotton (*Eriophorum angustifolium*). The area was exposed to low intensity sheep grazing and the bank of the stream were open, with low-height scrub and rank grasses. There was no instream macrophyte growth given the typically high energy of the site (spate channel). The bryophyte community was also poorly represented with only very limited drab brook moss (*Hygrohypnum luridum*) on instream boulders.

Brown trout was the only fish species recorded from site B4 via electro-fishing. Only a low number of juveniles were recorded. However, the site was of good value overall for salmonids given good nursery habitat, moderate spawning and moderate holding areas. Salmonid habitat improved in the downstream-connecting River Laney. The site was of moderate value for eel (albeit none recorded) but was considered unsuitable for lamprey (i.e., high-energy, upland eroding spate channel). There was no suitability for freshwater pearl mussel. No white-clawed crayfish were not recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality was not assessed at this site.

Plate 9: **Representative image of site B4 on the Knocknagappul Stream (facing upstream from near River Laney confluence).**

3.1.10 Site B5 – River Laney, Ballynagree West

Site B5 on the upper reaches of the River Laney (EPA code: 19L01) was located approx. 0.1km upstream of the Knocknagappul Stream confluence. The upland eroding watercourse (FW1) averaged 2-2.5m wide in a 3m wide channel with a shallow U-shaped profile. The depth averaged 0.2-0.4m in a shallow glide dominated habitat (60%). Riffles were frequent (30%) as the river flowed over a moderate gradient, with occasional small pools locally to 0.7m. The substrata typified a higher-energy site and was dominated by cobble (40%) and small boulder (20%), with good fractions of fine to medium gravels (30% overall). Sand was present, particularly in marginal areas. Some of these areas featured soft sediment but accumulations were sand-dominated, shallow (<2cm) and relatively compacted. Exposed clay/peat was present in some areas. The substrata were unbedded. Bankfull heights averaged 1-2m (lower on the eastern bank). Natural scouring was frequent at the site (i.e., undercut banks, frequent meanders). The site was bordered by a mature coniferous plantation (WD4) to the east, with a narrow border of alder (*Alnus glutinosa*) and grey willow alongside a riparian strip of wet grassland (GS4). The west bank featured lowland blanket bog/grassland habitat supporting purple moor grass, marsh thistle, gorse (low-lying), soft rush and common lowland blanket bog species such as common sorrel, marsh lousewort, heath milkwort and common catsear (*Hypochaeris radicata*). The banks were low and open with little to no shading of the river channel. There was no instream macrophyte growth in the high energy channel. However, a range of aquatic bryophytes were present locally including drab brook moss, *Hygroamblystegium tenax*, *Chiloscyphus polyanthos and Racomitrium aciculare*. *Lemanea* sp. algae was also present locally. Filamentous algae coverage was low (<1%) but indicated a source of enrichment.

Brown trout was the only fish species recorded from site B5 via electro-fishing, with a moderate number of juveniles and adults captured. Nursery habitat was considered good with locally good spawning habitat also present given the unbedded, clean nature of the smaller substrata. Holding habitat was limited but good nonetheless where present in localised deeper pools. European eel habitat was moderate but the value was reduced given the paucity of larger boulder refugia and deep pools.

The Laney at site B5 was not considered of any value to lamprey given the high-energy nature. There was low suitability for freshwater pearl mussel and none are known from the River Laney. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its upland nature.

Biological water quality was not assessed at this site.

Plate 10: Representative image of site B5 on the River Laney (facing downstream)

3.1.11 Site B6 – River Laney, Ballynagree West

Site B6 on the upper reaches of the River Laney (EPA code: 19L01) was located approx. 0.3km downstream from site B5. The upland eroding watercourse (FW1) averaged 2-2.5m wide in a 3m wide channel with a shallow U-shaped profile. The depth averaged 0.2-0.4m in a shallow glide dominated habitat (70%). Riffles were frequent as the river flowed over a moderate gradient, with occasional small pools to 0.6m. The substrata typified a higher-energy, spate site; cobble dominated (40%) with occasional boulder (10%), both of which retained some mobility. The site featured relatively high fractions of fine (20%) and medium gravels (20%) with sand in interstitial spaces and in slacker areas of flow. Bedrock was present but rare. There were no accumulations of fine sediment and overall levels of siltation were low with generally clean, unbedded substrata. Bankfull heights were invariably 1m. The site was situated between dense blocks mature coniferous afforestation (WD4, sitka spruce). The river was bound by very dense scrub (WS1) dominated by gorse, grey willow and bramble. Fuchsia was common throughout with frequent great woodrush (*Luzula sylvatica*), bugle (*Ajuga reptans*), marsh bedstraw and fern species spurge (get species). Riparian fringes were often wet along both banks and dominated by a mossy understory in addition to the aforementioned scrub species.

Shading was high (>90%) with tunnelling frequent. Given this, macrophyte growth was absent although there was localised *Racomitrium aciculare*, *Hygroamblystegium tenax* and claw brook moss (*Hygrohypnum ochraceum*) on the topside of boulder/cobble with occasional *Chiloscyphus polyanthos* on submerged substrata. The liverwort *Pellia epiphylla* was frequent on the river banks.

Brown trout was the only fish species recorded from site B6 via electro-fishing, with adults and a low number of juveniles present.

The site was considered a good salmonid habitat overall, with good quality spawning and moderate nursery habitat present, although deeper holding areas were scarce. European eel habitat was considered moderate (none recorded) but the value was reduced given the paucity of larger boulder refugia and deep pools. The high-energy upland site was unsuitable for lamprey. There was low suitability for freshwater pearl mussel and none are known from the River Laney. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its upland nature.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 6).

Plate 11: Representative image of site B6 on the River Laney (facing downstream)

3.1.12 Site B7 – unnamed stream, Ballynagree East (WF-HF9)

Site B7 (watercourse crossing WF-HF9) was located on a semi-natural unnamed stream at Ballynagree East at the site of a forestry access ford crossing, approx. 0.6km upstream from the River Laney confluence. The site was also the location of a proposed watercourse crossing (pre-cast box culvert). The upland eroding watercourse (FW1) averaged 2-2.5m wide (narrowed upstream) and 0.1-0.3m deep. The shallow U-shaped profile was dominated by shallow glide habitat (60%) with frequent riffles (30%) and only localised pool (10%). Bankfull height ranged from 0.5-1m. The stream flowed over a slight gradient and adjoined the River Laney approx. 0.4km downstream.

The stream was of moderate energy with a bed dominated by cobble (40%) and boulder (30%) substrata, which were moderately compacted. Fine to medium gravels and sands were present locally in interstitial spaces and on the channel margins (30% overall). Siltation was moderate with plumes visible underfoot. The site was bordered to the west by mature coniferous plantations (WD4), with an area of replanted clear-fell located upstream and downstream on the east bank. Improved agricultural pasture (GA1) bordered the stream further downstream on the east bank. Riparian shading was high (>90%) with tunnelling frequent throughout the site, particularly upstream. Dense scrub of grey willow, gorse, fuchsia, bramble and scattered mature sitka spruce bordered the channel. Given the high shading, macrophyte growth was not present.

However, there was relatively high cover (50%) of aquatic bryophytes with species *Hygrohypnum ochraceum*, *Chiloscyphus polyanthos* and *Fontinalis squamosa* dominating. Water-forget-me-not (*Myosotis scorpioides*) was present locally in more open marginal areas of damp ground. Crescent cup liverwort (*Lunularia cruciata*) was present on muddy banks and on the topside of larger instream boulders. Filamentous algae coverage was low (<1%) but indicated a source of enrichment.

Brown trout was the only fish species recorded from site B7 via electro-fishing, with a low number of adults and juveniles present. The site was considered to have moderate nursery and spawning value for salmonids that would have been higher if not bordered by conifers (abundant pine needle deposition on bed and sedimentation visible). Holding habitat was moderate at best. European eel habitat was considered moderate but none were recorded. The high-energy upland site was unsuitable for lamprey. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its upland nature.

Biological water quality, based on Q-sampling (June 2021), was calculated as Q4-5 (high status) (Table 8).

Plate 12: Representative image of site B7 on an unnamed stream at Ballynagree East (at forestry track ford crossing and watercourse crossing WF-HF9)

3.1.13 Site B8 – River Laney, Ballynagree East

Site B8 on the upper reaches of the River Laney (EPA code: 19L01) was located approx. 4.7km downstream from site B6, at a forestry track ford crossing and 0.3km downstream of the wind farm boundary. The upland eroding river (although more depositing than upstream) averaged 4-5m in width and 0.2-0.6m in depth. The shallow U-shaped channel (bankfull height 1-2m) was dominated by slow flowing, relatively deep glide >0.5m (50%) and pool habitat (30%), with occasional riffles. Some pools were >1m deep, locally. The substrata were comprised primarily of relatively clean, unbedded cobble and medium to coarse gravels (50%) overall, with occasional larger boulder (20%, particularly upstream).

Significant amounts of sands were also present (20%), particularly in association with macrophyte beds downstream of the ford. Overall, siltation was light but present. The site was adjoined by maturing coniferous afforestation (WD4) on all sides. The banks were heavily scrubbed although the channel suffered only light shading. Scrub composed of grey willow, gorse, bramble dominated the riparian zone, with other common species including foxglove, soft rush, meadowsweet (*Filipendula ulmaria*), agrimony (*Eupatorium cannabinum*), fuchsia and fern species. Instream macrophytes were frequent upstream and downstream of the ford, with water crowfoot (*Ranunculus* sp.) dominating (20% cover overall) – this provided some good salmonid nursery areas. Hemlock water dropwort was occasional on exposed gravel shoals and along the margins. The aquatic bryophyte community consisted of common *Fontinalis squamosa* with more occasional *Hygroamblystegium tenax* and *Chiloscyphus polyanthos*. The presence of more than three indicator macrophyte/bryophyte species means the site's aquatic vegetative community was representative of the Annex I habitat 'Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation and aquatic mosses [3260]'.

Brown trout and European eel were the only fish species recorded from site B8 via electro-fishing. The trout population was dominated by adults although smaller numbers of juveniles were present also. A single adult eel was also captured. The site was considered a very good nursery and spawning area. It was also a very good holding habitat given the presence of deeper glide and pool. Despite a moderate value for lamprey (localised sediment accumulations) none were recorded. Despite good suitability for freshwater pearl mussel, none were recorded at this site. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its upland nature.

Biological water quality was not assessed at this site. Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 6).

Plate 13: Representative image of site B8 on the River Laney (facing downstream from ford crossing)

3.1.14 Site B9 – unnamed stream, Carrigagulla

Site B9 was located on the upper reaches of an unnamed stream at a farm access bridge crossing. The stream was a largely natural, upland eroding watercourse (FW1) which averaged 2.5m wide and 0.2-0.4m in depth. The channel featured a shallow U-shaped profile and was comprised primarily of shallow glide and riffle with occasional pools, especially on frequent meanders. Bankfull height was generally 1-1.5m. The substrata were dominated by cobble (40%) and boulder (20%) with occasional patches of fine to medium gravels. Siltation was moderate throughout slower-flowing areas of channel, with silt plumes present underfoot. The margins occasionally featured sand-silt accumulations. The site drained upland coniferous afforestation (WD4) and was bordered by mosaics of agricultural pasture (GA1) and species-poor wet grassland (GS4), dominated by soft rush with frequent willow and gorse scrub. The channel was heavily scrubbed in the vicinity of the survey site, with dense grey willow, bramble and gorse-dominated scrub lining both banks. Riparian shading was high (>75%), with few open areas of channel present (i.e., tunnelling). Localised marsh horsetail (*Equisetum palustre*) and coltsfoot (*Tussilago farfara*) were present upstream pf the bridge. Given the high shading, macrophyte growth was not present. However, *Fontinalis squamosa*, *Hygroamblystegium tenax* and *Chiloscyphus polyanthos* were common on instream substrata, with occasional *Scapania undulata* also recorded.

Brown trout and European eel were the only fish species recorded from site B9 via electro-fishing. The trout population was dominated by juveniles. A single juvenile eel was also captured. The site was considered a good salmonid nursery with moderate quality spawning (diminished because of heavily bedded substrata). Holding habitat also considered moderate locally (a small number of deeper pools present). Eel habitat was of moderate quality. The high-energy upland site was unsuitable for lamprey. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality, based on Q-sampling, was calculated as **Q4-5 (high status)** (**Table 6**).

Plate 14: Representative image of site B9 on an unnamed stream at Carrigagulla

3.1.15 Site B10 - Ballynagree East Stream, Ballynagree East

Site B10 was located upstream of the L3418 road crossing on the upper reaches of the Ballynagree East Stream (EPA code: 19B21). The small, shallow, high-energy stream was an upland eroding watercourse (FW1) and averaged <1m in width and 0.05-0.15m deep. The channel was situated in a 6-7m wide steep incised V-shaped valley with bankfull heights of 3-4m. The stream flowed over a moderate to steep gradient and, resultingly, the profile was dominated by riffle (40%) with fast glide (40%). Pool habitat, although frequent, was limited in extent. The substrata were dominated by cobble (40%) and small boulder (30%) which were heavily silted in many areas (clay deposits, large silt plumes underfoot). Sand (20%) and clay-dominated silt accumulations were present, mostly in channel margins. Medium to coarse gravels were present locally. Both upstream and downstream of the survey site, the gradient decreased. The site was adjoined by improved agricultural grassland (GA1) both upstream and downstream of the bridge. The valley through which the stream flowed upstream of the bridge was steep and well-developed, with the rocky escarpment supporting mature sycamore (*Acer psuedoplatanus*), oak (*Quercus* sp.), blackthorn (*Prunus spinosa*) and sitka spruce. The understory comprised bilberry, opposite-leaved golden saxifrage (*Chrysosplenium oppositifolium*), creeping jenny (*Lysimachia nummularia*), ground elder (*Aegopodium podagraria*), wood sorrel (*Oxalis acetosella*) and fern species. Riparian shading was high and this precluded macrophyte growth, with none recorded present. The bryophyte community was poorly represented with local *Hygroamblystegium tenax*.

A single juvenile brown trout was the only fish recorded from site B10 via electro-fishing. The small, shallow high gradient stream (with heavy siltation) provided poor spawning, nursery or holding habitat and also offered little value for European eel. The upland eroding site was unsuitable for lamprey. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 6). The site failed to meet the EPA nitrate threshold for good status water quality (i.e., very high TON of 2.299mg N/l) (Table 9).

Plate 15: Representative image of site B10 on the Ballynagree East Stream

3.1.16 Site B11 – River Laney, Annagannihy

Site B11 on the River Laney (EPA code: 19L01) was located downstream of the confluence with the Annaginnihy Stream, approx. 0.3km downstream of Carrigagulla Bridge. The medium-sized, high-energy river was an upland eroding watercourse (FW1) which averaged 5-6m wide and 0.2-0.5m deep. The river flowed through a shallow U-shaped channel in an agricultural landscape (GA1) although maintained good riparian buffers of scrub. Characteristically, the profile was comprised primarily of riffle and fast glide (40% each) with frequent small pools, some of which were 1m in depth. The river was evidently exposed to high flow rates seasonally (i.e., spate channel) and the banks were frequently scoured and undercut locally. The substrata were dominated by boulder (40%) and large cobble (30%) with frequent bedrock (10%). Slack areas comprised smaller hard substrata (fine to coarse gravels). Sand was present locally in deeper pools (especially near the confluence). Siltation was light. A large pool located near the confluence was dominated by small cobble, finer gravels and sands. The site was adjoined by improved agricultural grassland (GA1) on both banks both upstream and downstream. The riparian buffers were dominated by grey willow and bramble/gorse scrub. Hawthorn was occasional. Non-native montbretia (*Crocosmia* x *crocosmiiflora*) was common throughout. Riparian shading was low. In terms of macrophytes, water crowfoot predominated (20% cover overall) with occasional water dropwort on gravel shoals and in channel margins. *Fontinalis squamosa* was abundant instream (30% cover) with frequent *Hygrohypnum ochraceum*, *Chiloscyphus polyanthos* and *Racomitrium aciculare*. The presence of more than three indicator macrophyte/bryophyte species means the site's aquatic vegetative community was representative of the Annex I habitat 'Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation and aquatic mosses [3260]'.

Brown trout was the only fish species recorded from site B11 via electro-fishing, with juveniles and adults present in moderate numbers. The site was a very good brown trout nursery, with moderate (locally good) spawning and some good (locally excellent) holding habitat. Instream macrophyte beds bolstered the nursery value of the site. European eel habitat was considered good throughout given undercut banks, ample boulder refugia and frequent pools although none were recorded. The high energy nature of the site precluded the presence of lamprey. There was low suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey but the site was considered of moderate suitability.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 6).

Plate 16: **Representative image of site B11 on the River Laney (facing downstream from Annaginnihy Stream confluence)**

3.1.17 Site C1 – Carrigthomas Stream, Knocknagappul

Site C1 was located in the upper reaches of the Carrigthomas Stream (EPA code: 19C48). The site was represented by a small upland eroding watercourse (FW1) averaging 1m wide and 0.05-0.1m deep. The stream was considered likely non-perennial at this location. The channel flowed over a moderate gradient and the profile was dominated by shallow riffle (50%) with occasional riffle and limited shallow pool (10%). The stream flowed through a deeply cut, semi-natural deep U-shaped channel with frequent scouring indicative of spate tendencies. The substrata comprised cobble (40%), small boulder (30%), coarse gravel (10%), medium gravels (10%) and coarse sands (10%). Soft sediment accumulations were not present given the high energy of the site. The channel bankfull height was 1.1.2m and graded into heavily scrubbed riparian areas of grey willow, gorse, bracken and bramble, with a treeline of mature sitka spruce along the east bank. Riparian shading was very high (>90%) although the stream was more open further downstream. The riparian composition immediately bordering the stream on both the east and west banks comprised mostly mature shrubby grey willow with bracken foxglove bilberry, bramble, soft shield fern (*Polystichum setiferum*) and a well-developed terrestrial moss layer in the treeline understory. The site drained coniferous plantations (WD4) upstream, with improved pasture (GA1) downstream. The stream contained no macrophytes given the heavily shaded nature, high energy nature and very shallow water. However, *Chiloscyphus polyanthos* was present locally on instream cobble and boulder.

No fish species were recorded from site C1 via electro-fishing. The small, shallow possible seasonal site offered poor fisheries habitat overall, for both salmonids and eel. However, fisheries value improved significantly downstream (i.e., site C3). There was no suitability for lamprey, freshwater pearl mussel or otter given the site characteristics. No white-clawed crayfish were recorded and there were no records for the species within the catchment.

Biological water quality was not assessed at this site.

Plate 17: Representative image of site C1 on the Carrigthomas Stream, Knocknagappul

3.1.18 Site C2 – Maulnahorna Stream, Rahalisk

Site C2 on the Maulnahorna Stream (EPA code: 19M10) was a small, semi-natural upland eroding stream (FW1), averaging 0.75-1.5m wide and 0.1-0.15m deep. Located at a road crossing, the stream flowed over a moderate gradient upstream of the bridge before grading out and meandering downstream. The water level was low at the time of survey although the stream had capacity to convey significantly more water during higher flow periods (i.e., spate channel but likely non-perennial). The profile was dominated by shallow glide (50%) and frequent riffle (40%) with only localised pool to 0.2m max. Bankfull height varied from 0.5-1.5m in a shallow U-shaped channel (more V-shaped upstream). Given the high energy nature of the site, the substrata were moderately compacted. The substrata comprised 50% cobble, 20% boulder, 10% 20% medium gravel and 10% fine gravel/sand. Although some silt had accumulated underneath the bridge structure in association with an instream blockage (debris and livestock gate), siltation was light overall (i.e., clean substrata). Downstream of the bridge, the site was bordered by improved agricultural pasture (GA1) to the west with an immature sitka spruce plantation (WD4) and scrub border to the east. The riparian zone was exposed to low intensity sheep grazing and was typified by often dense patches of gorse, bramble and grey willow scrub. The channel was moderately shaded by riparian species. Macrophyte growth was largely absent although hemlock water dropwort was abundant along stream margins and on exposed gravel/cobble shoals instream. The bryophyte community was poorly represented, with only very localised *Hygroamblystegium tenax* present in the vicinity of the bridge.

No fish species were recorded from site C2 via electro-fishing. The narrow, shallow site was considered likely non-perennial which, despite some suitability as a salmonid nursery, precluded resident fish. There was no suitability for freshwater pearl mussel given the site characteristics. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality was not assessed at this site.

Plate 18: Representative image of site C2 on the Maulnahorna Stream (downstream of bridge)

3.1.19 Site C3 – Carrigthomas Stream, Horsemount Bridge

Site C3 on the Carrigthomas Stream (EPA code: 19C48, also known as the Glashreagh River) was located Horsemount Bridge, approx. 1.5km downstream from site C1. The stream was a semi-natural, upland eroding channel (FW1) draining both afforested (WD4) and agricultural pasture (GA1) areas upstream. The stream had been straightened locally near the bridge (30m section, downstream of concrete/cobble bridge apron) but retained a good natural, meandering profile further downstream. The channel averaged 2-2.5m wide but narrowed to <2m further downstream, with an average depth of just 0.1-0.15m in a shallow, U-shaped channel. Shallow glide (60%) and riffle (20%) dominated with occasional small pools, particularly downstream of the straightened section. The substrata were comprised predominantly of boulder (20%) and cobble (50%), although interstitial spaces featured medium and fine gravels (20% overall), with sand in channel margins (10%). The substrata were moderately compacted. Silt accumulations were not present although the site was suffering from moderate siltation overall (high clay-fraction silt plumes underfoot, evident agricultural impacts from livestock poaching upstream). The site was bordered by agricultural pasture on both banks (GA1), with WD4 sitka upstream in addition to more pasture. In the open section of channel in the vicinity of the bridge, the riparian zone was poorly developed (recovering from previous works) although further downstream the stream was bound by often dense scrub of grey willow, gorse and bramble. Tunneling was frequent. Macrophyte growth was sparse with only very limited water starwort (*Callitriche* sp.) and water mint (*Mentha aquatica*) present. A single small patch of round-leaved crowfoot (*Ranunculus omiophyllus*) was recorded immediately upstream of the bridge in the muddy paludal. The bryophyte community was poorly represented although some limited *Chiloscyphus polyanthos* was present locally on the topside of small boulders. *Lemanea* sp. algae was present occasionally on larger instream cobble and boulder.

Brown trout was the only fish species recorded from site C3 via electro-fishing, with juveniles predominating in relatively high numbers. A small number of small adults were also recorded, mostly confined to deeper pool areas near the bridge. The site was evidently a very good brown trout nursery, although this was compromised somewhat by virtue of evident siltation and substrata compaction. Nevertheless, some limited spawning habitat was present, along with localised holding areas (more so downstream). European eel habitat was moderate give the shallow nature of the site (none recorded).

The high energy nature of the site precluded the presence of lamprey. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 7).

Plate 19: Representative image of site C3 on the Carrigthomas Stream (facing downstream from Horsemount Bridge)

3.1.20 Site C4 – Rahalisk Stream, Knocknagappul (GCR-WCC15)

Site C4 on the Rahalisk Stream (EPA code: 19R08) was located immediately upstream of the confluence with the Carrigthomas Stream (pipe culvert, fish passable) at a proposed grid connection crossing (GCR-WCC15). The small, moderate-gradient upland eroding stream channel (FW1) averaged 0.5-0.75m wide and ≤0.05m deep. The water level was very low at the time of survey and the risk of the stream drying up was considered high during drier periods. The stream flowed in a steep, deep V-shaped channel with bankfull heights of 2-3m. Fast shallow glide and riffle dominated with no pool habitat apart from in association with the road culvert (0.2m max. depth). The substrata were composed predominantly of loose fine to medium gravel (40%) with frequent small cobble (35%) and small boulder (20%). Sand was occasional (10%), with localised shallow silt. The stream adjoined agricultural grassland (GA1) to the east and a small block of scrubby willow woodland (WD1) to the west. The riparian zone was very heavily scrubbed with dense (impenetrable) growth of bramble, nettle, gorse and bracken. Shading from terrestrial species was extremely high (>95%) and, as a result, there was no instream macrophyte growth. Some limited *Chiloscyphus polyanthos* was present on small cobble and boulder.

No fish were recorded via electro-fishing. Overall, the stream offered little fisheries value given the extremely shallow and overgrown nature of the channel. However, fisheries habitat improved in the downstream-connecting Carrigthomas Stream, underneath the local road crossing. There was no suitability for freshwater pearl mussel or otter given the site characteristics. No white-clawed crayfish were recorded and there were no records for the species within the catchment.

Biological water quality was not assessed at this site.

Plate 20: **Representative image of site C4 on the Rahalisk Stream, Knocknagappul (heavily bound in scrub)**

3.1.21 Site C5 – Carrigthomas Stream, Coppeleenbawn Bridge (GCR-WCC9)

Site C5 on the Carrigthomas Stream (EPA code: 19C48) was located downstream of the L3418 road and proposed grid connection crossing (GCR-WCC9), approx. 100m upstream from the River Laney confluence. Here, the stream was a semi-natural, upland eroding channel (FW1) which averaged 2-2.5m wide in a shallow U-shaped channel, with an average depth of 0.2-0.3m. Shallow glide dominated (60%) with frequent riffle areas (30%) and localised pool (10%) to a maximum of 0.3m. Bankfull height varied from 1.5-2m with frequent undercut banks throughout. Livestock poaching was prevalent along the southern bank (no riparian fencing) although siltation levels were light. The substrata were comprised predominantly of well-sorted gravels (50%) with frequent small cobble (30%) and localised boulder (20%). Sand and silt were present in marginal slacks (5% each). Silt was flocculent, where present. The substrata were loose and mobile throughout most of the survey section.

The site was bordered by agricultural pasture on both banks (GA1), with a scattered treeline and scrub mosaic on the north bank supporting grey willow and hawthorn with occasional osier (*Salix viminalis*), ash and alder. The scrub was dominated by bramble and gorse. Riparian shading was low overall, although high locally in more vegetated sections. Macrophyte growth was sparse with only localised hemlock water dropwort. The bryophyte community was poorly represented (low cover given mobile substrata) although some limited *Hygroamblystegium tenax* and *Hygrohypnum ochraceum* was present locally on the topside of small boulders. Filamentous algal cover was moderate locally (10% overall), although large sections of channel were free from algal impacts.

Brown trout was the dominant species recorded from site C5 via electro-fishing, with juveniles predominating in relatively high numbers. A small number of adults were also present in addition to a low number of *Lampetra* sp. ammocoetes.

The site was considered an excellent salmonid nursery (brown trout only), supporting mixed cohorts. Spawning habitat was good (locally very good, particularly near the Laney confluence in lower reaches) with holding habitat limited (moderate value). European eel habitat was moderate, at best, and none were recorded during electro-fishing. Two *Lampetra* sp. ammocoetes were recorded (likely brook lamprey given catchment migration barriers) – these were present in sub-optimal sand-flocculent silt heavily covered filamentous algae. Lamprey habitat was considered good given the presence of good spawning substrata although the lack of optimal soft sediment accumulations reduced the site's value overall. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey but the site was considered of moderate suitability.

Biological water quality, based on Q-sampling, was calculated as Q3-4 (moderate status) (Table 7).

Plate 21: Representative image of site C5 on the Carrigthomas Stream downstream of Coppeleenbawn Bridge

3.1.22 Site C6 – Unnamed stream, Knocknagappul

Site C6 on an unnamed stream was located downstream of the L3418 road and proposed grid connection crossing (pipe culvert), approx. 0.75km upstream of the River Laney crossing. The small upland eroding watercourse (FW1) averaged 1-1.5m in width and just 0.05-0.1m in depth in a deep U-shaped channel. The moderate-energy stream had been straightened and deepened historically with old embankments present on the south bank. Roadside retaining walls were present upstream of the culvert. The profile was dominated by shallow glide with occasional riffle and very localised shallow pool to a maximum depth of 0.25m. The substrata were characterised by mixed gravels (more so medium and coarse) (40%) with frequent small cobble and boulder (40%). The substrata were both bedded and moderately silted throughout (heavy locally). The site was intermittently exposed to livestock poaching on both banks. Having flowed alongside the L3418 road (channel straightened), the stream flowed through intensive agricultural grassland (GA1) downstream of the road crossing. Here the channel was heavily bound in scrub (invariably impenetrable) dominated by bramble, nettle, gorse and grey willow. Mature ash and hawthorn were present intermittently along the channel.

Riparian shading was extremely high in most areas, with frequent tunnelling. Instream macrophytes were limited to very localised common water starwort (*Callitriche stagnalis*) and brooklime (*Veronica beccabunga*) in open areas of channel. *Scapania undulata* was occasional instream, in more open areas.

Brown trout was the only fish species recorded from site C6 via electro-fishing, with two small individuals captured. The site offered only moderate quality salmonid habitat, with a lack of deeper holding areas and only moderate quality nursery and spawning (siltation). European eel habitat was poor with none recorded via electro-fishing. Potential for lamprey existed but was low, with poor quality spawning substrata present (silted, bedded) and a lack of suitable sediment accumulations for larval burial. There was no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and shallow, high-energy nature.

Biological water quality was not assessed at this site.

Plate 22: Representative image of site C6 on an unnamed stream at Knocknagappul

3.1.23 Site C7 – River Laney, unnamed bridge, Ballynagree West

Site C7 on the River Laney (EPA code: 19L01) was located at a local road crossing (twin arch masonry bridge), approx. 1km south of Ballinagree village. The semi-natural upland eroding watercourse (FW1) featured some more lowland depositing characteristics. The channel averaged 6-8m wide and 0.3-0.5m deep, with frequent pools to >1.2m. Bank height ranged from <1 to 2m, with historical retaining walls on the north bank. The moderate energy site was characterised by deeper glide (50%) with frequent fast riffles (30%) and frequent pool areas (20%). In general, the river slowed and deepened downstream of the bridge (more deeper glide and pool), with faster glide and riffles dominating upstream. The substrata were dominated by clean, unbedded, well-mixed gravels and small cobble (60% overall), with occasional boulder (especially in vicinity of the bridge and downstream of the bridge) and sand (20%) in marginal areas and interstitial spaces. The site featured only light siltation and soft sediment accumulations were dominated by sand, where present. The site was adjoined by low intensity improved agricultural grassland (GA1) and mosaics of wet grassland (often dominated by soft rush but supporting a range of rank grass and herbaceous species also).

The riparian zones were well developed and comprised mature treelines of grey willow, alder, hazel (*Corylus avellana*), hawthorn, osier, sycamore and occasional ash with scattered cypress (*Cupressus* sp.) and sitka spruce. The scrubby understorey supported species including bramble, bracken, meadowsweet, foxglove, montbretia, broom (*Cytisus scoparius*), yellow iris (*Iris psuedacorus*) common valerian (*Valeriana officinalis*), gorse and rank grasses. Riparian shading was relatively low. Instream macrophyte growth was dominated by water crowfoot (20% cover) (especially downstream of bridge) with frequent *Fontinalis squamosa*. Hemlock water dropwort was common on exposed gravel shoals and in channel margins. *Chiloscyphus polyanthos* was frequent on instream cobble and boulder. Occasional *Hygroamblystegium tenax* was present on boulders. The presence of more than three indicator macrophyte/bryophyte species means the site's aquatic vegetative community was representative of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and aquatic mosses [3260]'. A dipper (*Cinclus hibernica*) nest was also recorded under the bridge.

Brown trout was the only fish species recorded from site C7 via electro-fishing. Mixed cohorts of brown trout were present, ranging from juveniles to larger adults. Site C7 offered excellent salmonid habitat overall, with combinations of excellent spawning (clean, unbedded gravels and cobble), excellent nursery habitat (particularly in the vicinity of *Ranunculus* beds and upstream of the bridge) and excellent holding habitat for adults (downstream of the bridge). European eel habitat was considered good given the presence of instream refugia although none were recorded during electro-fishing. Whilst optimal larval lamprey habitat was not present, areas of sub-optimal sand-dominated substrata were present in marginal areas and in association with *Ranunculus* beds. However, no ammocoetes were recorded during electro-fishing. Lamprey spawning habitat was of moderate quality locally, particularly in marginal slacks downstream of the bridge where lower flows were more amenable to the species. There was some suitability for freshwater pearl mussel, although none were recorded in surveys throughout the River Laney. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey but the site was considered of good suitability due to healthy salmonid population and good foraging habitat.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 7).

Plate 23: Representative image of site C7 on the River Laney at an unnamed bridge, Ballynagree West

3.1.24 Site C8 – Lacknahaghny Stream, Lacknahaghny

Site C8 on the Lacknahaghny Stream (EPA code: 19L21) was a small, narrow upland eroding watercourse (FW1) located in the vicinity of a local road crossing (pipe culvert) and proposed grid connection crossing. The stream flowed between blocks of coniferous woodland (WD4) and averaged <0.75m wide and ≤0.05m deep, in a steep V-shaped channel with bankfull heights of 2-3m. Although conveying low volumes of water at the time of survey, the channel was considered non-perennial. The substrata comprised coarse gravels and small cobble with occasional boulder although these were heavily silted and compacted. Water quality issues were evident, with near stagnant conditions and heavy peat staining. The stream meandered through dense scrub dominated by grey willow and bramble, with hogweed, gorse, common polypody, bilberry and fern species. The sitka spruce plantations flanked the channel on both banks, with a narrow alder border. Upstream of the road crossing, the channel drained a wet upland area dominated *Juncus* sp. rushes. The narrow channel featured heavy encroachment of terrestrial species and shading was invariably excessive. Macrophyte species were not present and the only bryophyte recorded was very localised *Scapania undulata* on instream boulders.

No fish were recorded from site C8 via electro-fishing. Site C8 offered no fisheries value at the time of survey and the channel was considered likely seasonal in its upper reaches, thus precluding resident fish. The site had no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality was not assessed at this site.

Plate 24: Representative image of site C8 on the Lacknahaghny Stream

3.1.25 Site C9 – unnamed stream, Carrigthomas

Site C9 was located on an unnamed stream in the vicinity of a local road and proposed grid connection crossing, approx. 0.5km upstream of the River Laney confluence. The stream was a very small, narrow upland eroding watercourse (FW1). The stream had been historically modified downstream of a local road crossing alongside a mature sitka spruce plantation (WD4), with extensive straightening and deepening evident.

The stream flowed in a deep V-shaped channel with bankfull heights of 2.5-3m. The stream averaged <1m wide and <0.05m deep at the time of survey, with a slight flow only. The substrata were dominated by small boulder and cobble (50%) with frequent sand accumulations. Iron oxide (bacterial) deposits were frequent on instream substrata (these are often associated with leachate from afforestation and low dissolved oxygen levels). Siltation was moderate locally. The profile was shallow fast glide dominated with frequent small plunge pools over a moderate gradient. The stream was heavily scrubbed over in the vicinity of the road crossing (impenetrable bramble and gorse scrub), with riparian shading also high as it flowed along the eastern boundary of the coniferous block. The small valley escarpment supported scrubby grey willow and bramble with foxglove, wood sorrel, common polypody, broad buckler fern (*Dryopteris dilatata*) and terrestrial mosses. There were no macrophytes instream given the high shading. *Scapania undulata* was occasional on instream cobbles.

No fish were recorded from site C9 via electro-fishing. Site C9 offered no fisheries value at the time of survey and the channel was considered likely non-perennial in its upper reaches, thus precluding resident fish. The site had no suitability for freshwater pearl mussel or otter. No white-clawed crayfish were recorded and there were no records for the species within the catchment.

Biological water quality was not assessed at this site.

Plate 25: Representative image of site C9 on an unnamed stream at Carrigthomas

3.1.26 Site C10 – unnamed stream, Carrigthomas

Site C10 was located on an unnamed stream in the vicinity of a local road and proposed grid connection crossing, approx. 185m upstream of the River Laney confluence. The small, shallow upland eroding watercourse (FW1) emanated from a pipe culvert pipe associated with the local road and joined a small unnamed stream which flow parallel to said road. The water level was low at the time of survey, with only low flows present and depths of 0.05-0.1m. The stream featured 1.5 to 2m bank heights in an often-steep, deeply-cut, V-shaped channel. Natural scouring was evident throughout the site (i.e., spate channel). The profile was featured slow-flowing glide over a moderate gradient with occasional riffle (10%) and frequent pool (70%). The substrata were dominated by a mix of bedrock (10%), small boulder (20%), cobble (40%), mixed gravels (20%) and sand (5%). The substrata were moderately silted (high clay fractions, 5%) given the low flows at the time of survey (i.e., deposition of sediment).

The site was adjoined by improved agricultural grassland (GA1) to the west and an alder plantation to the east (GA1 upstream). The riparian zone was heavily scrubbed by grey willow, bramble, foxglove, wild angelica (*Angelica sylvestris*), wood sorrel, hogweed, hedge bindweed (*Calystegia sepium*), ivy and fern species. Shading of the channel was high (>75%). Instream macrophyte growth was, thus, absent. However, some limited *Hygroamblystegium tenax* was present on the topside of instream boulders with occasional *Chiloscyphus polyanthos* on larger boulders.

No fish were recorded from site C10 via electro-fishing. Site C10 offered very low fisheries value at the time of survey and the channel was considered likely non-perennial, thus precluding resident fish. However, some limited, sub-optimal habitat was present for salmonids and European eel further downstream nearer to the Laney confluence (more deeper pools). The upland eroding site was unsuitable for lamprey. The site had no suitability for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality was not assessed at this site.

Plate 26: Representative image of site C10 on an unnamed stream at Carrigthomas, immediately downstream of the road culvert

3.1.27 Site C11 – River Laney, Knocknagappul Bridge

Site C11 on the River Laney (EPA code: 19L01) was located at Knocknagappul Bridge, a proposed grid connection crossing point. Downstream of Knocknagappul Bridge (a 3-arch structure), the swift-flowing river (FW1) averaged 6-8m in width and 0.2-0.4m deep, with locally deeper pools to 1.5m. The channel was considered semi-natural with a well-defined thalweg and bankfull heights of 1-1.5m. The profile was dominated by riffle and shallow, fast glide near the bridge with more predominant deeper glide habitat approx. 40m downstream. The riverbed comprised mostly mobile, unbedded cobble (40%) with frequent small boulder (30%) and medium to coarse gravels in the interstitial spaces and in marginal areas (20%). Sand was occasional (10%) and small accumulations were present in association with the bridge structure, instream macrophyte beds and further downstream in slacker areas of channel (i.e., pool). Siltation was light overall given the swift flows.

The site was adjoined by mosaics of agricultural grassland (GA1) and species-poor wet grassland (GS4), with soft rush frequent. Wetter areas along the riparian zone supported yellow iris and meadowsweet. The channel was flanked by treelines of mature grey willow with occasional ash, hawthorn and alder. Non-native montbretia was scattered throughout. Hemlock water dropwort was abundant along riparian areas and also common instream, with water crowfoot frequent (20% cover), particularly upstream of the bridge and downstream in deeper, slower glide habitat. Coverage of bryophytes was relatively high with frequent *Fontinalis squamosa*, *Chiloscyphus polyanthos* and *Hygroamblystegium tenax* on cobble and boulders. *Fontinalis antipyretica* was occasional. The presence of more than three indicator macrophyte/bryophyte species means the site's aquatic vegetation community was considered representative of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and aquatic mosses [3260]'. *Lemanea* sp. algae was also occasional throughout faster-flowing areas. Great scented liverwort (*Conocephalum conicum*) was present on muddy banks and the bridge structure.

Brown trout was the dominant fish species recorded from site C11 via electro-fishing. Relatively high numbers of mixed cohort brown trout were present, ranging from juveniles to larger adults. A single Atlantic salmon (*Salmon salar*) parr was also recorded (17.0cm FL). This was the only salmon recorded in the Ballinagree study area. The site was an excellent salmonid habitat, with good spawning substrata present throughout in addition to excellent quality nursery and holding habitat.

The site was considered of good value to European eel given the presence of deeper pool areas, scoured banks and large woody debris/boulder refugia in stream (however, none were recorded). Lamprey spawning habitat was present but localised (site more suited to salmonids) with sand-dominated sediment accumulations present locally in vicinity of the bridge and some instream *Ranunculus* beds (none recorded). There was some suitability for freshwater pearl mussel, although none were recorded in surveys throughout the River Laney. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded in the vicinity of the bridge although the site had high suitability for the species given the presence of a healthy salmonid population and good foraging habitat.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 7).

Plate 27: Representative image of site C11 the River Laney at Knocknagappul Bridge (facing downstream from bridge

3.1.28 Site C12 – Awboy River, Awboy Bridge (GCR-WCC8)

Site C12 on the Awboy River (EPA code: 19A03) was a medium-sized, moderate energy upland eroding watercourse (FW1). Located downstream of Awboy Bridge (proposed grid connection crossing GCR-WCC8) and 70m upstream of the River Laney confluence, the river averaged 4-5m wide and 0.2-0.4m deep. The largely-natural channel (modified upstream of the bridge, straightened through a residential garden) featured a bankfull height of 1-1.5m in a shallow U-shaped channel. Downstream of the bridge, the profile featured a repeating series of riffle-glide-pool sequences. Fast, shallow glide dominated (50%) with frequent riffles (30%) and localised pool, to a maximum depth of 0.8m. The substrata were dominated by cobble (50%) with frequent small boulder (30%) and localised bedrock (5%). Fine to medium gravels were present in interstitial spaces (10%), with occasional coarse gravels. Silt was largely absent given the high-energy nature of the site. The substrata were mostly unbedded and largely free from filamentous algae.

The site was bordered on both banks by agricultural grassland (GA1) with a mature riparian zone on both banks (willow/sycamore treelines with scrub). The mobile nature of the substrata combined with fast flows and shade discouraged macrophyte growth although some water crowfoot was present locally with hemlock water dropwort common in margins and on instream gravel shoals. *Chiloscyphus polyanthos* and *Fontinalis squamosa* dominated the bryophyte community. The presence of three indicator macrophyte/bryophyte species means the site's aquatic vegetation community was considered representative of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and aquatic mosses [3260]'. A single kingfisher was observed in flight near the bridge. No otter signs were recorded during the survey but given the presence of a healthy salmonid population and good foraging habitat

Brown trout was the only fish species recorded from site C12 via electro-fishing. Moderate numbers of mixed cohort brown trout were present, ranging from juveniles to larger adults. The site was evidently a good salmonid habitat, with good quality spawning, nursery and holding habitat present. Despite some good European eel suitability, particularly in vicinity of the bridge and in deeper pools, none were recorded. The high energy of the site and lack of sediment deposition precluded larval lamprey, despite some localised spawning habitat in slacker areas. No freshwater pearl mussels were recorded at this site. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey but the site had high suitability for the species given the presence of a healthy salmonid population and good foraging habitat.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 7).

Plate 28: **Representative image of site C12 the Awboy River at Awboy Bridge (facing downstream from bridge)**

3.1.29 Site C13 – River Laney, Clonavrick Bridge (GCR-WCC7)

Site C13 on the River Laney (EPA code: 19L01) was located at Clonavrick Bridge, a proposed grid connection crossing point (GCR-WCC7). The river at this site was a high-energy large upland eroding watercourse (FW1), which averaged 10-12m wide and 0.6-1m in depth. The site was typified by deep, fast glide (60%) (up to 1.5m in depth upstream of the bridge) with occasional riffles areas and localised small pools.

Downstream of the bridge featured shallower, faster glide and riffles. The substrata were characteristic of a high-energy site with bedrock (10%), boulder (30%) and cobble (40%) dominating although there were good fractions of well-mixed (fine, medium, coarse) gravels in interstitial spaces and slacker areas of flow. Coarse sand was present locally (5%). Silt was absent given the high flow rates. Filamentous algae was very localised (almost absent). The site was flanked on both banks by mature treelines of ash, grey willow and sycamore with bramble-dominated scrub. In terms of macrophytes, water crowfoot was present locally (occasional) with hemlock water dropwort commonly present in margins and on exposed cobble/gravel shoals. *Fontinalis squamosa* was abundant on larger boulder and cobble, with *Chiloscyphus polyanthos* frequent. The presence of three or more indicator macrophyte/bryophyte species means the site's aquatic vegetation community was considered representative of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and aquatic mosses [3260]'. *Conocephalum conicum* was present on the bridge structure. A single otter spraint (old) was recorded underneath the bridge structure (ITM, 534606, 578288).

Brown trout was the only fish species recorded from site C13 via electro-fishing. Moderate numbers of mixed cohort brown trout were present, with juvenile size classes dominating over a smaller number of larger adults. Overall, site C13 was of excellent value to salmonids, with good spawning and nursery habitat in addition to excellent holding habitat (particularly downstream of the bridge) for larger adult trout. Despite good physical habitat for European eel (ample boulder refugia), none were recorded. The high-energy nature of the site precluded the presence of lamprey. No freshwater pearl mussels were recorded at this site, despite some suitability and historical records near the bridge.

No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey but the site had high suitability for the species given the presence of a healthy salmonid population and good foraging habitat.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 7).

Plate 29: **Representative image of site C13 the River Laney at Clonavrick Bridge (facing back upstream towards bridge)**

3.1.30 Site C14 – Clonavrick Stream, Clonavrick (GCR-WCC6)

The Clonavrick Stream (EPA code: 19C74) at site C14 was located at local road and proposed grid connection crossing (GCR-WCC6), approx. 0.4km upstream of the River Laney confluence. The <1m wide stream was semi-dry at the time of survey (0.05m deep max) with localised ponding and an imperceptible flow. The river had been extensively modified in the vicinity of the road crossing with a number of agricultural (pipe) culverts present downstream and recent drainage excavations adjoining the stream. Further downstream, the channel had been historically straightened but not deepened and sat in a shallow U-shaped channel. The substrata were heavily silted (plumes underfoot) and comprised coarse gravels and small cobble, with frequent silt accumulations – these were invariably flocculent. The stream was evidently suffering from enrichment and water quality issues, with a foul odour and discolouration present in addition to excessive siltation (mostly from livestock poaching). The stream flowed through agricultural grassland (GA1) with narrow riparian buffers open to regular livestock poaching. Upstream of the road crossing, the stream emanated in a small area of mixed woodland (WD1) supporting sitka spruce, sycamore and beech (*Fagus sylvatica*). Downstream, the stream was intermittently shaded by willow-dominated treeline with associated bramble and holly (*Ilex aquifolium*) scrub. Terrestrial encroachment of grasses (e.g., soft rush) was common instream. Filamentous algae (*Cladophora* sp.) was present (20% cover in those areas containing water).

No fish were recorded at site C14 via electro-fishing and the site was not of fisheries value at the time of survey given the lack of water and evidently poor water quality (i.e., siltation, enrichment etc.). However, fisheries habitat improved further downstream nearer the Laney confluence. There was no suitability for freshwater pearl mussel or white-clawed crayfish. No otter signs were recorded during the survey and the site was considered of low suitability given its small size.

Biological water quality was not assessed at this site.

Plate 30: Representative image of site C14 the Clonavrick Stream (downstream of road culvert)

3.1.31 Site C15 – Coolaniddane River, Caherbaroul

Site C15 on the upper reaches of the Coolaniddane River (EPA code: 19C67) was located downstream of a local road crossing. The small upland eroding watercourse (FW1) was semi-natural in the vicinity of the road culvert (double 900m pipe culverts), with bankfull heights of 2-2.5m in a historically straightened and deepened V-shaped channel. The river averaged 1.5-2m wide and 0.1-0.2m deep. The profile was dominated by shallow glide (70%) with occasional riffle (20%) and localised shallow pool to a maximum depth of 0.3m. The substrata were comprised of small cobble (50%) with occasional boulder (20%) with localised fine to medium gravels. Smaller substrata predominated upstream of the road crossing. As per upstream, siltation and compaction of the substrata was moderate. The site was bordered by agricultural grassland (GA1) to the north with an area of dense scrubby grey willow-dominated woodland to the south. The channel became heavily overgrown downstream of the road crossing (impenetrable scrub), dominated by bramble and gorse. Sitka spruce bordered the channel upstream of the road crossing. There were no macrophytes given the high riparian shading, with localised *Hygroamblystegium tenax* present. Filamentous algal cover was 20%, thus indicating enrichment.

No fish were recorded at site C15 via electro-fishing, despite some physical habitat suitability. Whilst the foul odour present upstream (agricultural run-off) was not present downstream, enrichment was evident and it appeared upstream agricultural pressures had impacted the fisheries habitat of the river. Thus, the site had very poor fisheries value. Irrespectively, European eel habitat was poor given the small, shallow nature of the site. The higher energy and lack of suitable sediment accumulations precluded the presence of lamprey. There was no suitability for freshwater pearl mussel or white-clawed crayfish given the site characteristics. No otter signs were recorded during the survey and the site was considered of low suitability given its small size.

Biological water quality was not assessed at this site.

Plate 31: Representative image of site C15 on the Coolaniddane River (downstream of road culvert)

3.1.32 Site C16 – Kilberrihert Stream, Derryroe (GCR-WCC3)

Site C16 was located on the uppermost reaches of the Kilberrihert Stream (EPA code: 19K24), downstream of a local road and proposed grid connection crossing (GCR-WCC3), approx. 260m upstream of the Coolaniddane River confluence. The channel, flowing in an east to west direction, represented a dry drainage ditch (FW4) at the time of survey. The non-perennial stream had been historically straightened and deepened in the vicinity of the road crossing and a small coniferous plantation (mature sitka spruce, WD4). The channel featured a shallow, U-shaped channel (bankfull height <0.5m) and evidently only conveyed water during periods of high flow and rainfall. The substrata were 100% silt (wet mud base, with abundant leaf litter). Given the high shading from afforestation, the understorey was poorly developed with bramble scrub dominating. Macrophytes were lacking given the extreme shading and lack of water.

No fish were recorded at site C16 and the site had no fisheries value at the time of survey given the lack of water or flow. Being located in the uppermost reaches, with no connectivity to other watercourses nearby, the site was considered unlikely to serve as a migratory pathway for European eel. There was no suitability for freshwater pearl mussel, otter or white-clawed crayfish given the site characteristics.

It was not possible to assess biological water quality at this site given a lack of water and flow.

Plate 32: Representative image of site C16 on the Kilberrihert Stream (downstream of road culvert)

3.1.33 Site C17 – Coolaniddane River, Caherbaroul (GCR-WCC4)

Site C16 on the Coolaniddane River (EPA code: 19C67) was located downstream of a local road and proposed grid connection crossing (GCR-WCC4), approx. 0.8km downstream from site C15. The small upland eroding watercourse (FW1) averaged 1.5-2m wide and 0.1-0.2m deep, with swift flow. Shallow glide and riffle dominated (both 40%) with only localised shallow pool present. The substrata were comprised of small cobble (40%) with occasional boulder (20%) and 40% fine to medium gravels.

As per site C15 upstream, siltation and compaction of the substrata was moderate. The site was bordered by intensive agricultural grassland (GA1) and coniferous afforestation (WD4), with the stream heavily overgrown by willow and bramble-dominated scrub. There were no macrophytes given the high riparian shading, with localised *Hygroamblystegium tenax* present. Filamentous algal cover was 20%, thus indicating enrichment.

Despite some physical suitability, no fish were recorded at site C17 via electro-fishing. Enrichment was evident and it appeared upstream agricultural pressures had impacted the fisheries habitat of the river. Thus, the site had very poor fisheries value. There was no suitability for freshwater pearl mussel or white-clawed crayfish given the site characteristics. No otter signs were recorded during the survey and the site was considered of low suitability given its small size.

Biological water quality, based on Q-sampling, was calculated as Q3 (poor status) (Table 7). The site failed to meet the EPA nitrate threshold for good status water quality (i.e., very high TON of 2.489mg N/l) (Table 9).

Plate 33: Representative image of site C17 the Coolaniddane River (upstream of road culvert)

3.1.34 Site C18 – Caherbaroul Stream, Caherbaroul (GCR-WCC5)

Site C18 was located on the uppermost reaches of the Caherbaroul Stream (EPA code: 19C76) at a local road and proposed grid connection crossing (GCR-WCC5). The stream was semi-dry at the time of survey, with localised ponding present to a maximum depth of 0.05m. The watercourse was evidently non-perennial at this location. The stream had been extensively straightened but not deepened and sat in a U-shaped channel. Bankfull height was 1-1.5m. A pipe culvert was present 5m downstream of the road culvert. The substrata were dominated by medium to coarse gravels but were compacted with moderate to heavy siltation. The site was bordered by intensive agricultural grassland (GA1), with a small area of grey willow scrub near the road crossing. The channel was heavily scrubbed over by low-lying scrub, dominated by bramble, gorse, nettle, broad-leaved dock (*Rubex obtusifolius*) and rank grasses.

No fish were recorded at site C18 via electro-fishing and site had no fisheries value at the time of survey given the lack of water or flow. Being located in the uppermost reaches, with no connectivity to other watercourses nearby, the site was considered unlikely to serve as a migratory pathway for European eel. There was no suitability for freshwater pearl mussel, otter or white-clawed crayfish given the site characteristics.

Biological water quality was not assessed at this site.

Plate 34: Representative image of site C18 the Caherbaroul Stream (downstream of road culvert, heavily bound in scrub)

3.1.35 Site C19 – Bealick Stream, Rockville

Site C19 was located on the uppermost reaches of the Bealick Stream (EPA code: 19B45) adjacent to a local road and the proposed grid connection. The channel represented a semi-dry drainage ditch (FW4), with very little water (depth <0.01m) at the time of survey. The stream had been historically straightened and deepened. The channel featured a near-vertical, deep U-shaped profile, with a bankfull height of 1m. Only local ponding of water was present and the channel was considered non-perennial at this location. The substrata were dominated by compacted fine to medium gravels with light to moderate siltation. The site was adjoined by species-poor wet grassland (GS4) to the south (*Juncus* sp. dominated) to the south with frequent areas of scrub (WS1) and wet grassland (GS4) adjoining the stream. Upstream, the channel flowed through a small area of willow-dominated mixed broad-leaved woodland. The stream was heavily scrubbed over (near 100% shading), dominated by bramble, grey willow and rank grasses. Macrophytes were lacking given the extreme shading and lack of water.

No fish were recorded at site C19 via electro-fishing and site had no fisheries value at the time of survey given the lack of water. However, the stream likely supports fish populations a considerable distance downstream, nearer the Laney confluence (i.e., >4km downstream).

Being located in the uppermost reaches, with no connectivity to other watercourses nearby, the site was considered unlikely to serve as a migratory pathway for European eel. There was no suitability for freshwater pearl mussel, otter or white-clawed crayfish given the site characteristics.
Biological water quality was not assessed at this site.

Plate 35: **Representative image of site C19 the Bealick Stream (semi-dry channel, localised ponding only)**

3.1.36 Site N1 – West Ballynagree Stream, Knocknagappul (WF-HF5)

Site N1 was located on the West Ballynagree Stream at a proposed pre-cast box culvert crossing (WF-HF5), approx. 0.45km downstream from site B3. The stream was a small upland eroding watercourse (FW1), which averaged <1m wide and <0.1m deep when surveyed (June 2021). The shallow stream cascaded over boulder and localised bedrock and was dominated by a series of riffles and fast glides with localised shallow pools to 0.25m max. The stream flowed over a moderate gradient and was evidently spate in nature, with scouring and undercut banks frequent. The stream was known to be non-perennial (i.e., channel was dry at site B3 in 2020 survey period). The substrata were dominated by very coarse gravels, small cobble and angular boulder, with only very localised finer gravels. Siltation was low overall. The site was bordered by young sitka spruce plantations (WD4) with abundant willow, gorse and bramble scrub (WS1) with wet soft rush-dominated grassland (GS4) adjoining the channel. The narrow channel was often heavily tunnelled by scrub.

This coupled with fast flows, mobile substrata and likely low summer flows resulted in an absence of macrophytes. However, *Scapania undulata* was occasional on instream boulder with *Racomitrium aciculare* also occasional.

An electro-fishing survey was not undertaken at this site (i.e., fisheries appraisal only). Apart from some low seasonal potential for migratory European eel, the small upland stream had no fisheries value given its location in the headwaters of the stream and non-perennial nature. However, fisheries value improved further downstream near the River Laney confluence. The non-perennial, high-energy site was unsuitable for freshwater pearl mussel. No white-clawed crayfish were recorded and there were no records for the species within the catchment. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Whilst a Q-sample was taken in June 2021, the paucity of macro-invertebrates recorded (very low numbers of Tubificidae larvae and *Lumbriculus* sp.) was not sufficient to reliably calculate water quality status (Table 8). This was presumably an artefact of the non-perennial nature of the stream.

Plate 36: **Representative image of site N1 on the West Ballynagree Stream at proposed watercourse crossing WF-HF5**

3.1.37 Site N2 – River Laney, Knocknagappul (WF-HF6)

Site N2 (watercourse crossing WF-HF6) was located on the upper reaches of the River Laney, approx. 0.35km upstream of survey site B5. The upland eroding watercourse (FW1) averaged 3-4m wide and 0.1-0.2m deep, with localised pools to >0.5m locally and (often in association with meanders). The spate channel featured bankfull heights of 1m within a wider channel/shallow valley between coniferous blocks (WD4). Natural scouring and undercutting of banks was frequent. The meandering channel featured occasional plunge pools to 0.7m. The substrata typified an upland river with frequent boulder, cobble and well-sorted gravels interstitially. Coarse sand was also frequent.

Given the site characteristics (moderate gradient, moderate flows), there was little or no siltation of instream substrata and no sediment accumulations. The site was bordered by scrub vegetation supporting abundant gorse, fuchsia, willow and occasional bramble. Tunnelling of the channel was often present. The site was adjoined by mature coniferous afforestation (WD4). Riparian shading and high flows coupled with mobile substrata resulted in a lack of macrophyte growth. However, *Racomitrium aciculare* was common on larger instream boulder.

An electro-fishing survey was not undertaken at this site (i.e., fisheries appraisal only). The River Laney at site N2 (proposed pre-cast box culvert) was a moderate-quality salmonid habitat with some locally good spawning habitat. Holding pools for larger adults was sparse. The site was most of value as a brown trout nursery. European eel habitat was moderate given the site characteristics and their presence would have been inhibited by the presence of downstream hydro-electric dams. There was no potential for white-clawed crayfish. Freshwater pearl mussel were not recorded and the species is not known from the River Laney, despite some physical habitat suitability. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 8).

Plate 37: **Representative image of site N2 on the upper River Laney at proposed watercourse crossing WF-HF6**

3.1.38 Site N3 – Unnamed stream, Ballynagree East (WF-HF8)

Site N3 (watercourse crossing WF-HF8) was located on the uppermost reaches of a small, unnamed tributary of the River Laney at a local road crossing. The upland eroding watercourse (FW1) meandered over a moderate gradient in a natural incised valley. The stream averaged 1-2m wide and 0.1-0.2m deep. The swift-flowing channel was dominated by a series of riffles and fast shallow glide, often cascading over boulder. Occasional deeper pools (0.3m max) were present, particularly in association with meanders.

A single deep plunge pool (1m) was present in association with the existing road box culvert. This also featured a 2m fall and was a barrier to fish migration. Upstream of the bridge, the stream flowed over a steeper gradient, was shallower and narrower. Typical of a small spate channel, the substrata were dominated by angular cobble and boulder with interstitial coarse and medium gravels with some localised coarse sand. Soft sediment accumulations were absent. Overall, siltation was low given high flow rates. The substrata were compacted. The banks were frequently scoured and undercut, especially on meanders. Whilst the channel was open in the vicinity of the crossing (sheep grazing, open banks), macrophyte growth was absent. Localised *Racomitrium aciculare* was present with occasional *Cinclidotus fontinaloides*. Filamentous algae was present but coverage was low. The site was bordered by improved agricultural pasture (wet GA1) adjoined by small coniferous afforestation blocks (WD4) downstream.

An electro-fishing survey was not undertaken at this site (i.e., fisheries appraisal only). Site N3 was located in the headwaters of the small unnamed stream and thus was of low fisheries value. The high-gradient spate channel was considered likely exposed to low flows during summer months and this, coupled with natural and artificial barriers on the watercourse, likely precluded fish presence (however, some low eel potential, in season). The box culvert under road acted as an impassable barrier to fish, with a 2m fall. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and upland nature.

Biological water quality, based on Q-sampling, was calculated as Q4-5 (high status) (Table 8).

Plate 38: **Representative image of site N3 on the upper reaches of a small unnamed River Laney tributary at proposed watercourse crossing WF-HF8 (facing downstream from road crossing)**

3.1.39 Site N4 – River Laney, Carrigagulla (WF-HF4)

Site N4 (watercourse crossing WF-HF4) was located on the upper reaches of the River Laney, approx. 30m downstream of an existing ford crossing and 2km downstream of survey site B6. The upland eroding river (FW1) averaged 5-8m wide and 0.2-0.4m deep in a naturally cut channel with bankfull heights of 1.5-2m. The moderate-flowing river was dominated by deep, slow-flowing glide with frequent pool and occasional riffle areas (diverse range of habitats). The substrata comprised a mix of clean, unbedded (mobile) small cobble and well-sorted gravels, with only very occasional small boulder. Sand was frequent also, with some accumulations in marginal slacks. Siltation was low overall (clean substrata), despite evident spate erosion of muddy banks (often scoured and undercut). The site was bordered by coniferous afforestation (WD4) on both banks with buffers of often mature willow, fuchsia and bramble scrub (WS1/WL2). Riparian shading was moderate but not excessive although some partial tunnelling was present downstream of the proposed singles-span bridge crossing. Instream macrophytes were limited to occasional water crowfoot in more open, swift glide areas (5% cover). The mobile substrata prevented growth of aquatic bryophytes.

An electro-fishing survey was not undertaken at this site (i.e., fisheries appraisal only). Site N4 was evidently of high value to salmonids with excellent quality spawning and nursery habitat present, in addition to some localised deeper holding pools and undercuts for larger adults. European eel habitat, whilst present, was sub-optimal given the general paucity of suitable refugia (e.g., larger boulders). Although some sand accumulations were present marginally, these were unsuitable for larval lamprey and the general upland eroding (higher-energy) nature of the site likely precluded the presence of *Lampetra* sp. The substrata were generally considered to be too mobile for freshwater pearl mussel and, irrespective of some habitat suitability, the species is not known from the River Laney. No otter signs were recorded during the survey but the site was considered of moderate suitability given the presence of a healthy salmonid population.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 8).

Plate 39: **Representative image of site N4 on the upper reaches of the River Laney at proposed watercourse crossing WF-HF4 (facing upstream to existing ford crossing)**

3.1.40 Site N5 – unnamed stream, Knocknagappul (GCR_WCC19)

Site N5 was located on an unnamed, unmapped Carrigthomas Stream tributary (no EPA code) at a local road and proposed grid connection crossing (GCR-WCC19). The small, swift-flowing upland eroding stream (FW1) averaged 2-2.5m wide and 0.1-0.2m deep with localised pool associated with cascades and meanders to 0.4m. The largely natural stream channel flowed over a moderate gradient and had not been historically modified (with the exception of the road box culvert). The shallow stream likely suffered from low flows/water levels during drier periods. The substrata were dominated by moderately-compacted cobble and small boulder, with locally frequent small patches of fine and medium gravels and sand in slacks and in interstitial spaces. Siltation was moderate overall (due to surrounding land uses) but the high-energy of the site precluded sediment deposits. The stream was often heavily shaded by riparian scrub and macrophytes were limited to occasional watercress and water starwort (*Callitriche* sp.) along the margins. The bryophytes *Chiloscyphus polyanthos* and *Fontinalis antipyretica* were occasional on larger instream substrata. Filamentous algae was present (<1% cover), indicating enrichment. Livestock poaching was present in several locations. The site was bordered by sloping, low-intensity wet (*Juncus*-dominated) improved grassland (GA1) with frequent gorse-dominated scrub (WS1). Coniferous plantations (WD4) bordered the site upstream. Gorse, bramble and grey willow scrub tunnelled the stream downstream of the road crossing.

An electro-fishing survey was not undertaken at this site (i.e., fisheries appraisal only). The site was of moderate value as a salmonid nursery and spawning habitat (brown trout only). Holding habitat for adults was (typically for a small stream) present but limited in distribution and extent. Salmonid habitat improved in the downstream-connecting Carrigthomas Stream. Whilst some finer gravels suitable for *Lampetra* sp. spawning were present, there was no suitable ammocoete habitat given the high energy nature of the site. European eel habitat was moderate overall given the high energy of the site and paucity of optimal refugia. The site had low suitability for white-clawed crayfish and none were recorded. There was no suitability for freshwater pearl mussel given the small, shallow size of the stream. No otter signs were recorded during the survey and the site was considered of low suitability given its small size and high-energy nature.

Biological water quality, based on Q-sampling, was calculated as Q4 (good status) (Table 8).

Plate 40: **Representative image of site N5 on an unnamed, unmapped stream at proposed watercourse crossing GCR-WCC19**

3.2 Biological water quality (macro-invertebrates)

With the exception of two sites (C5 and C17), all sampling locations met the good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC). Sites B9 (unnamed stream), N2 (River Laney), and N4 (River Laney) achieved Q4-5 (high status).

Sites C5 (Carrigthomas Stream, Q3-4 moderate status) and C17 (Coolaniddane River, Q3 poor status) failed to meet the good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC).

No rare or protected macro-invertebrate species of conservation status greater than least concern (according to national red lists) were recorded in the biological water quality samples taken from *n*=21 sites (Figure 6, Tables 6,7 and 8). Whilst no red list for caddis species is currently available, there is a paucity of records for the three of the recorded cased caddis species *Drusus annulatus* (sites B6, B7, C17, N2, N4), *Potamophylax cingulatus* (sites A2, A5, B8), *Chaetopteryx villosa* (site A5) in the southwest (O'Connor, 2020).

The majority of samples achieved Q4 or Q4-5 (good status) given the presence of numbers of EPA group A (sensitive) species, such as the mayflies *Ecdyonurus venosus* and *Rhithrogena semicolorata,* and the stonefly *Perla bipunctata*. The samples also contained a good representation of group B (less sensitive) species, such as *Leuctra hippopus* and *Silo pallipes*, and low abundances of group C (tolerant) species aside from the widespread mayfly species *Baetis rhodani*.

Site C5 (Carrigthomas Stream) achieved Q3-4 (moderate status) given the presence of a single group A species, a paucity of group B and dominance of group C species. Site C17 (Coolaniddane River) achieved Q3 (poor status) given the absence of group A species, paucity of group B and the dominance of group D species.

At site N1 on the West Ballynagree Stream (watercourse crossing WF-HF5) a low number of macro-invertebrate individuals and species was recorded (i.e., very low numbers of Tubificidae larvae and *Lumbriculus* sp. were recorded present). This community composition was not sufficient to reliably calculate water quality status and was considered an artefact of the non-perennial nature of the stream.

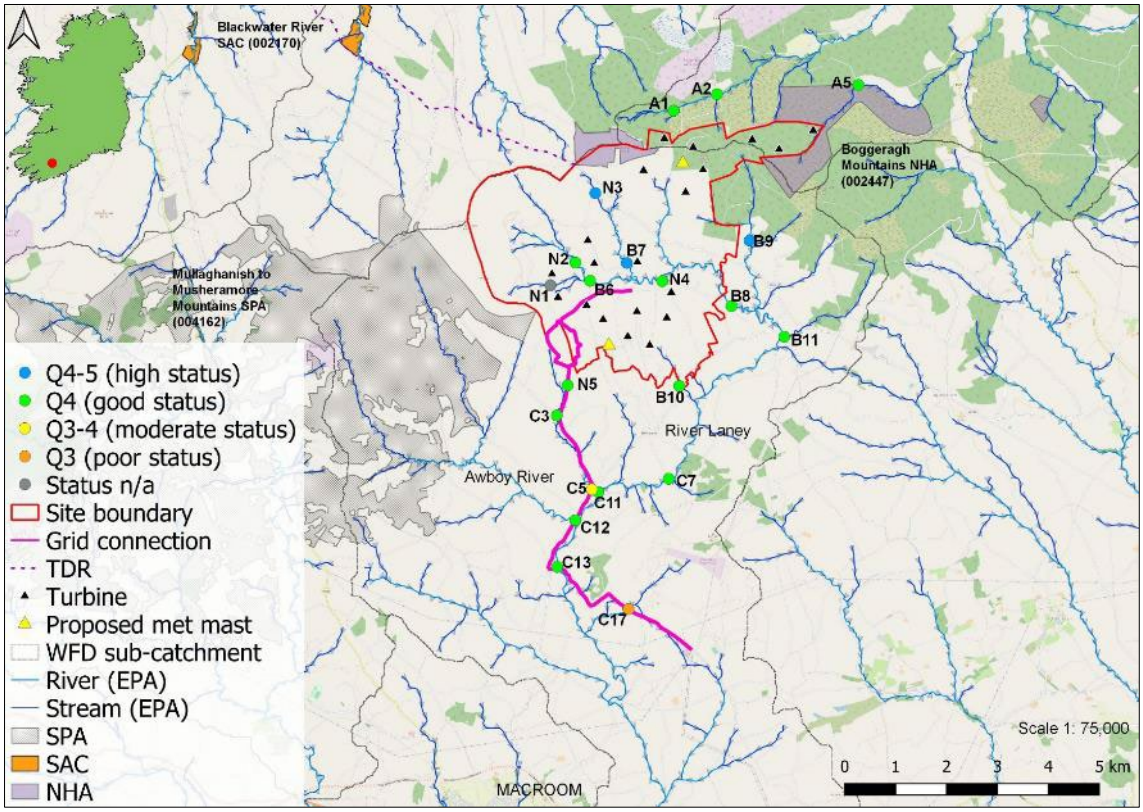

Figure 6: Biological water quality results (Q-ratings) for the *n*=21 sampling locations

Table 6: Macro-invertebrate Q-sampling results for survey sites A1, A2, A5, B6, B8, B9, B10 and B11, July 2020

Group	Family	Species	Site A1	Site A2	Site A5	Site B6	Site B8	Site B9	Site B10	Site B11	EPA class
Ephemeroptera	Heptageniidae	*Ecdyonurus venosus*			2		1		1	1	A
Ephemeroptera	Heptageniidae	*Rhithrogena semicolorata*				10	43	32	2	1	A
Ephemeroptera	Heptageniidae	*Heptagenia sulphurea*				1	2	1	3	1	A
Plecoptera	Chloroperlidae	*Siphonoperla torrentium*	7	8	16			2	1	2	A
Plecoptera	Nemouridae	*Protonemura meyeri*						2		2	A
Plecoptera	Perlodidae	*Isoperla grammatica*	2	3	21	3		7		1	A
Plecoptera	Leuctridae	*Leuctra hippopus*	9	1	4			1		8	B
Trichoptera	Glossosomatidae	*Agapetus fuscipes*						1			B
Trichoptera	Goeridae	*Silo pallipes*				9					B
Trichoptera	Limnephilidae	*Potamophylax cingulatus*		1	1		1				B
Trichoptera	Limnephilidae	*Chaetopteryx villosa*			6						B
Trichoptera	Limnephilidae	*Drusus annulatus*				1					B
Trichoptera	Limnephilidae	*Halesus radiatus*						1			B
Trichoptera	Odontoceridae	*Odontocerum albicorne*				1	1				B
Trichoptera	Sericostomatidae	*Sericostoma personatum*					1	1			B
Ephemeroptera	Baetidae	*Baetis rhodani*	8	68	17	2	13	4		38	C
Ephemeroptera	Caenidae	*Caenis rivulorum*								3	C
Ephemeroptera	Ephemerellidae	*Serratella ignita*			31	6	50	11		19	C
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*			15	2	4	4	1		C
Trichoptera	Philopotamidae	*Wormaldia occipitalis*			28				2		C
Trichoptera	Philopotamidae	*Philopotamus montanus*				3			1	1	C
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*	9	2	3					1	C
Trichoptera	Polycentropodidae	*Plectrocnemia geniculata*			5				1		C
Trichoptera	Polycentropodidae	*Polycentropus kingi*			1						C
Trichoptera	Polycentropodidae	*Polycentropus flavomaculatus*								1	C
Trichoptera	Rhyacophilidae	*Rhyacophila munda*	2	1		2	2				C
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*			3	1		1		1	C

Group	Family	Species	Site A1	Site A2	Site A5	Site B6	Site B8	Site B9	Site B10	Site B11	EPA class
Coleoptera	Dytiscidae	*Oreodytes sanmarkii*	1				2				C
Coleoptera	Elmidae	*Elmis aenea*		2	7		1	3		12	C
Coleoptera	Elmidae	*Limnius volckmari*				2	1	1		1	C
Coleoptera	Hydraenidae	*Hydraena gracilis*	1	2	1	1	1	2		4	C
Coleoptera	Scirtidae	Scirtidae larva						1	1		C
Diptera	Chironomidae	Chironomid larva	2	2	9		5	2		34	C
Diptera	Limoniidae	*Eloeophila* sp. larva								2	C
Diptera	Pediciidae	*Dicranota* sp.	2	2	7		1			6	C
Diptera	Simulidae	*Prosimulium* sp.				1		6	1	2	C
Amphipoda	Gammaridae	*Gammarus duebeni*		5	2	3	4	1	12	7	C
Mollusca	Planorbidae	*Ancylus fluviatilis*		3				2			C
Hemiptera	Veliidae	Veliidae *nymph*			1				1		C
Hemiptera	Veliidae	*Velia caprai*							1		C
Arachnida	Hydrachnidiae	Unidentified species			1					30	C
Annelidae	Oligochaeta	Unidentified species	2	2			1				n/a
Abundance			45	102	181	48	134	86	28	178	
Taxon richness			11	14	18	14	15	19	10	19	
Q-rating			**Q4**	**Q4**	**Q4**	**Q4**	**Q4**	**Q4-5**	**Q4**	**Q4**	
WFD status			**Good**	**Good**	**Good**	**Good**	**Good**	**High**	**Good**	**Good**	

Table 7: Macro-invertebrate Q-sampling results for riverine survey sites C3, C5, C7, C11, C12, C13 and C17, July 2020

Group	Family	Species	Site C3	Site C5	Site C7	Site C11	Site C12	Site C13	Site C17	EPA class
Ephemeroptera	Heptageniidae	*Ecdyonurus venosus*				3	1	3		A
Ephemeroptera	Heptageniidae	*Rhithrogena semicolorata*	7		9	30		6		A
Ephemeroptera	Heptageniidae	*Heptagenia sulphurea*	1	1		1				A
Ephemeroptera	Heptageniidae	*Ecdyonurus insignis*			6					A
Plecoptera	Chloroperlidae	*Siphonoperla torrentium*	1							A
Plecoptera	Chloroperlidae	*Chloroperla tripunctata*					3	2		A
Plecoptera	Nemouridae	*Nemoura cinerea*								A
Plecoptera	Perlidae	*Perla bipunctata*			6	11	6	2		A
Plecoptera	Leuctridae	*Leuctra hippopus*		10	1	1	10			B
Trichoptera	Glossosomatidae	*Agapetus delicatulus*				1				B
Trichoptera	Glossosomatidae	*Glossosoma boltoni*			1					B
Trichoptera	Goeridae	*Silo pallipes*	3			1				B
Trichoptera	Odontoceridae	*Odontocerum albicorne*			3		1			B
Trichoptera	Limnephilidae	*Drusus annulatus*							1	B
Trichoptera	Limnephilidae	*Potamophylax latipennis*			2					B
Trichoptera	Sericostomatidae	*Sericostoma personatum*	1				1			B
Ephemeroptera	Baetidae	*Baetis rhodani*	9	13	19	15	10	17	16	C
Ephemeroptera	Caenidae	*Caenis rivulorum*		2		7	3	9		C
Ephemeroptera	Ephemerellidae	*Serratella ignita*	5	8	57	15		53	1	C
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*				24	3	18	1	C
Trichoptera	Philopotamidae	*Wormaldia occipitalis*								C
Trichoptera	Philopotamidae	*Philopotamus montanus*				1	1		1	C
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*	2							C
Trichoptera	Polycentropodidae	*Plectrocnemia geniculata*		1						C
Trichoptera	Polycentropodidae	*Polycentropus kingi*							2	C
Trichoptera	Polycentropodidae	*Polycentropus flavomaculatus*					1	2		C
Trichoptera	Rhyacophilidae	*Rhyacophila munda*		1		1		1		C

Group	Family	Species	Site C3	Site C5	Site C7	Site C11	Site C12	Site C13	Site C17	EPA class
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*	1		2	1	3	11	3	C
Coleoptera	Dytiscidae	*Oreodytes sanmarkii*	1	2						C
Coleoptera	Dytiscidae	*Hydroporus tessellatus*	1	1						C
Coleoptera	Dytiscidae	*Agabus guttatus*							2	C
Coleoptera	Dytiscidae	*Dytiscidae* larva							2	C
Coleoptera	Elmidae	*Elmis aenea*		7	5		5	4		C
Coleoptera	Elmidae	*Limnius volckmari*		5	1	1		1		C
Coleoptera	Haliplidae	*Haliplus ruficollis* group		1						C
Coleoptera	Hydraenidae	*Hydraena gracilis*		1		1	3			C
Coleoptera	Hydrophilidae	*Helophorus brevipalpis*							2	C
Coleoptera	Scirtidae	*Cyphon* sp. larva						1		C
Diptera	Chironomidae	Chironomid larva		5	4	2	18	5	8	C
Diptera	Limoniidae	*Eloeophila* sp. larva		2		1				C
Diptera	Pediciidae	*Dicranota* sp.	4	7		1	6		36	C
Diptera	Simulidae	Unidentified larva		2	1	8	1	3	6	C
Diptera	Tipuliidae	*Tipula* sp.							1	C
Amphipoda	Gammaridae	*Gammarus duebeni*	15	9	4	3	3	2		C
Mollusca	Planorbidae	*Ancylus fluviatilis*		2		1				C
Arachnida	Hydrachnidiae	Unidentified species		18			12			C
Annelidae	Oligochaeta	Unidentified species		3		1	3	1	8	n/a
Abundance			51	101	121	131	94	141	90	
Taxon richness			11	19	13	20	20	15	14	
Q-rating			**Q4**	**Q3-4**	**Q4**	**Q4**	**Q4**	**Q4**	**Q3**	
WFD status			**Good**	**Mod.**	**Good**	**Good**	**Good**	**Good**	**Poor**	

Table 8: Macro-invertebrate Q-sampling results for riverine survey sites N1, N2, N3, N4 and B7 (May 2021) and N5 (December 2021)

Group	Family	Species	Site N1	Site N2	Site N3	Site N4	Site B7	Site N5	EPA class
Ephemeroptera	Heptageniidae	*Rhithrogena semicolorata*		19	5	28	15	22	A
Ephemeroptera	Heptageniidae	*Ecdyonurus venosus*			9	2	1	27	A
Plecoptera	Chloroperlidae	*Chloroperla tripunctata*		8				18	A
Plecoptera	Chloroperlidae	*Siphonoperla torrentium*			9		6		A
Plecoptera	Perlidae	*Perla bipunctata*						23	A
Plecoptera	Nemouridae	*Amphinemura sulcicollis*		2	1		1		A
Plecoptera	Perlodidae	*Isoperla grammatica*			1	4	11		A
Ephemeroptera	Baetidae	*Alainites (Baetis) muticus*		4	2		1		B
Plecoptera	Leuctridae	*Leuctra inermis*		6	3	1	17		B
Plecoptera	Leuctridae	*Leuctra hipposus*						18	B
Trichoptera	Goeridae	*Silo pallipes*		4		8	1		B
Trichoptera	Limnephilidae	*Drusus annulatus*		1		4	3		B
Trichoptera	Odontoceridae	*Odontocerum albicorne*				3	2		B
Trichoptera	Sericostomatidae	*Sericostoma personatum*					1	3	B
Ephemeroptera	Baetidae	*Baetis rhodani*		27	63	4	11	15	C
Ephemeroptera	Ephemerellidae	*Serratella ignita*					6		C
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*					1		C
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*						3	C
Trichoptera	Philopotamidae	*Philopotamus montanus*					1		C
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*			1		2		C
Trichoptera	Polycentropodidae	*Polycentropus flavomaculatus*					1		C
Coleoptera	Dytiscidae	*Oreodytes sanmarkii*			1	3	5		C
Coleoptera	Dytiscidae	Unidentified larva						1	C
Coleoptera	Elmidae	*Limnius volckmari*				1	1		C
Coleoptera	Elmidae	*Elmis aenea*					4	1	C
Coleoptera	Hydraenidae	*Hydraena gracilis*		1					C
Diptera	Chironomidae	Chironomid larva		2	2		7		C

Group	Family	Species	Site N1	Site N2	Site N3	Site N4	Site B7	Site N5	EPA class
Diptera	Pediciidae	*Dicranota* sp.		1	2		3		C
Diptera	Simuliidae	Unidentified larva		5	10		2	5	C
Crustacea	Gammaridae	*Gammarus duebenii*		8	19	2	3	8	C
Arachnida	Hydrachnidiae	Unidentified species		1					C
Annelidae	Naididae (Tubificidae)	Unidentified species	3	1			2		E
Oligochaeta	Lumbricidae	*Lumbriculus* sp.	1		3	1	3		n/a
Abundance			4	90	131	61	111	125	
Taxon richness			2	8	7	6	8	10	
Q-rating			***n/a**	**Q4**	**Q4-5**	**Q4**	**Q4-5**	**Q4**	
WFD status			***n/a**	**Good**	**High**	**Good**	**High**	**Good**	

*n/a - Whilst a Q-sample was taken in June 2021, the low numbers of macro-invertebrate individuals and species recorded (very low numbers of Tubificidae larvae and *Lumbriculus* sp.) was not sufficient to reliably calculate water quality status. This was considered an artefact of the non-perennial nature of the stream.

3.3 Physiochemical water quality

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

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

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

Levels of total oxidised nitrogen (TON) ranged from 0.011 to 2.489mg N/l across the sampling sites. Particularly high levels were recorded at sites B10 (2.299mg N/l) and C17 (2.489mg N/l). Total oxidised nitrogen is taken to be equivalent to nitrate given the concentration of nitrite is usually negligible (O'Boyle et al., 2019). Whilst there are no environmental quality standards for nitrate, average nitrate concentration values ≤4 mg/l NO_3 (≤0.9mg N/l) and ≤8mg/l NO_3 (≤1.8mg N/l) are considered by the EPA to be indicative of high and good quality water, respectively. Thus, only sites B10 (Ballynagree East Stream) and C17 (Coolaniddane River) fell outside acceptable parameters for nitrate.

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

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

Whilst there are no clearly defined standards for COD concentrations in surface waters, levels were elevated at sites A1 and A2 on the Nadanuller Beg Stream (i.e., an order of magnitude higher than other sampling sites at 66.9mg and 35mg O_2/l, respectively). Water with high COD typically contains high levels of oxidizable organic matter (e.g., decaying plant matter) and COD elevations often accompany clear-felling activities (Drinan et al., 2013). Higher COD results in lower dissolved oxygen levels which may negatively impact aquatic biota.

Table 9: Summary of physiochemical water quality results, June 2021 and June 2021 (B7 & N1-N4 only). Values in bold indicate failure to achieve 'good status' targets set out under the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. 77 of 2019)

	Site														
Parameter	**A1**	**A2**	**A5**	**B6**	**B7**	**B8**	**B9**	**B10**	**C7**	**C13**	**C17**	**N1**	**N2**	**N3**	**N4**
pH	6.69	7.16	7.21	7.04	7.20	7.33	7.32	7.54	7.40	7.40	7.46	6.22	6.96	7.00	6.96
Alkalinity (mg $CaCO_3$/l)	9.6	18.3	21.1	12.8	16.3	16.5	18.4	26.3	16.9	18.3	38.0	11.5	11.4	12.4	11.4
Total Ammonia (mg N/l)	**0.094**	0.023	0.006	0.003	0.021	0.005	0.008	0.008	0.019	0.017	0.025	0.006	0.009	0.008	0.009
MRP (mg P/l)	**0.043**	0.016	0.004	0.001	0.024	0.002	0.005	0.009	0.010	0.006	**0.116**	0.001	0.003	0.003	0.005
TON (mg N/l)	0.155	0.126	0.011	0.267	0.951	0.443	0.265	**2.299**	0.730	0.701	**2.489**	0.179	0.359	0.376	0.445
DOC (mg C/l)	18.7	10.4	5.61	1.95	2.61	2.41	2.95	1.38	3.27	3.75	3.40	2.95	1.70	1.02	2.39
BOD (mg O_2/l)	1.3	0.9	0.5	0.3	0.6	0.5	0.4	0.6	0.6	1.1	1.0	0.5	0.5	0.4	0.8
COD (mg O_2/l)	66.9	35.2	16.4	8.2	13.1	9.1	13.2	8.6	12.7	13.7	9.5	9.5	7.7	5.0	13.6
Suspended Solids (mg/l)	3.8	2.4	0.4	0.2	0.8	1	1.6	14.6	1.0	2.0	2.2	0.4	0.2	0.8	0.6

3.4 Aquatic ecological evaluation

An aquatic ecological evaluation of each survey site was based on the results of aquatic surveys, electro-fishing, white-clawed crayfish, freshwater pearl mussel, physiochemical water quality and biological water quality surveys (Table 10).

A total of *n*=14 survey locations (A2, B2, B3, C4, C8, C9, C10, C14, C15, C16, C17, C19, N1 & N3) (36% of total locations) did not support fish at the time of survey (i.e., non-perennial/seasonal channels). Where fish were present, brown trout (*Salmo trutta*) dominated across the survey area, with low abundances of European eel (*Anguilla anguilla*) also recorded. *Lampetra* sp. larvae (ammocoetes) were recorded at a single site only (C5, Carrigthomas Stream). A single Atlantic salmon (*Salmo salar*) was recorded via electro-fishing at site C11 on the River Laney at Knocknagappul Bridge.

No freshwater pearl mussel or white-clawed crayfish were recorded during the aquatic surveys. Aquatic vegetation communities representative of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and aquatic mosses [3260]' ('floating river vegetation') were recorded at sites A5 (Glen River), C12 (Awboy River) and sites B8, B11, C7, C11, C13 (all on River Laney).

The majority of survey locations featured low alkalinity, circum-neutral pH, low MRP and low to moderate total oxidised nitrogen (TON) levels (Table 9). However, TON was particularly high at sites C17 and B10 (failed to meet EPA's threshold for good status). Levels of molybdate reactive phosphorus (MRP) were particularly high at site A1, with the site failing to meet the good status threshold set out under S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019.

A total of *n*=18 sites achieved ≥Q4 'good status'. Three unnamed River Laney tributaries (sites C7, B9 and N3) achieved high status (Q4-5) water quality. Two sites (C5 and C17) were of Q3 (poor status) Tables 6, 7 and 8). Siltation and afforestation pressures (siltation, eutrophication etc.) were evident on numerous watercourses within the survey area which were not achieving good status.

Site A5 on the Glen River was located within the Boggeragh Mountains NHA (0002447), a site designated for peatlands. This site was therefore considered of national importance. None of the other aquatic survey locations were evaluated as being of greater than local importance. Over half of the sites surveyed in the vicinity of the proposed Ballinagree wind farm (22 of 40, 55% of sites) were evaluated as being of local importance in terms of their aquatic ecology (i.e., A2, A3, A4, B1, B4, B5, B6, B7, B8, B9, B10, B11, C3, C5, C6, C7, C11, C12, C13, N2, N3, N4 & N5). Primarily this was due to the presence of overall moderate to good salmonid habitat and the presence of brown trout at the survey sites, in addition to good status (Q4) water quality. Site B9 (unnamed stream at Carrigagulla) achieved high status (Q4-5) water quality (i.e., pristine water quality). A single Atlantic salmon parr was recorded at site C11 (River Laney), with *Lampetra* sp. ammocoetes recorded from site C5 (Carrigthomas Stream). A kingfisher was recorded at site C12 (Awboy River).

A total of *n*=16 sites (41% of sites) were evaluated as being of site value in terms of their aquatic ecology (i.e., sites A1, B2, B3, C1, C2, C4, C8, C9, C10, C14, C15, C16, C17, C18, C19 & N1). Generally, this was due to low or a lack of fisheries value, in addition to poor or moderate water quality (i.e., ≤Q3-4) and an absence of other species/habitats of high conservation value.

Table 10: Aquatic ecological evaluation summary of the *n*=40 survey locations according to NRA (2009) criteria

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
A1	Nadanuller Beg Stream	18N05	Site value	Low fisheries value (no fish recorded); Q4 (good status) water quality; site failed to meet S.I. No. 77/2019 MRP & total ammonia good status thresholds; no other aquatic species or habitats of high conservation value
A2	Nadanuller Beg Stream	18N05	Local importance	Excellent salmonid (brown trout) nursery; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
A3	Unnamed stream	n/a	Local importance	Moderate salmonid habitat, brown trout present; no other aquatic species or habitats of high conservation value
A4	Unnamed stream	n/a	Local importance	Moderate salmonid habitat, brown trout & European eel present; no other aquatic species or habitats of high conservation value
A5	Glen Stream	18G04	National importance	Located within Boggeragh Mountains NHA (002447); good salmonid habitat, very good nursery, brown trout present; aquatic vegetation with good links to Annex I 'floating river vegetation' habitat[1]; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
B1	Carrigagulla Stream	19C22	Local importance	Moderate salmonid habitat, brown trout present; no other aquatic species or habitats of high conservation value
B2	Unnamed stream	n/a	Site value	No fisheries or aquatic ecology value (non-perennial, 100% dry channel)
B3	West Ballinagree Stream	19W12	Site value	No fisheries or aquatic ecology value (non-perennial, 100% dry channel)
B4	Knocknagappul 19 Stream	19K04	Local importance	Moderate salmonid habitat, brown trout present; no other aquatic species or habitats of high conservation value
B5	River Laney	19L01	Local importance	Good salmonid habitat, brown trout present; no other aquatic species or habitats of high conservation value
B6	River Laney	19L01	Local importance	Good salmonid habitat, very good nursery, brown trout present; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
B7	Unnamed stream	n/a	Local importance	Moderate salmonid habitat, brown trout present; no other aquatic species or habitats of high conservation value
B8	River Laney	19L01	Local importance	Good salmonid habitat, very good nursery, brown trout & European eel present; aquatic vegetation with good links to Annex

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
				I 'floating river vegetation' habitat[1]; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
B9	Unnamed stream	n/a	Local importance	Good salmonid habitat, good nursery, brown trout & European eel present; Q4-5 (high status) water quality; no other aquatic species or habitats of high conservation value
B10	Ballynagree East Stream	19B21	Local importance	Poor salmonid habitat but brown trout present in low density; Q4 (good status) water quality; failed to meet EPA's TON target for good status water quality; no other aquatic species or habitats of high conservation value
B11	River Laney	19L01	Local importance	Good salmonid habitat, very good nursery, brown trout present; aquatic vegetation with good links to Annex I 'floating river vegetation' habitat[1]; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
C1	Carrigthomas Stream	19C48	Site value	Low fisheries value (no fish recorded); no other aquatic species or habitats of high conservation value
C2	Maulnahorna Stream	19M10	Site value	Low fisheries value (no fish recorded); no other aquatic species or habitats of high conservation value
C3	Carrigthomas Stream	19C48	Local importance	Good salmonid habitat, very good nursery, brown trout present; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
C4	Rahalisk Stream	19R08	Site value	Low fisheries value (no fish recorded); no other aquatic species or habitats of high conservation value
C5	Carrigthomas Stream	19C48	Local importance	Good salmonid habitat, excellent nursery, good spawning, brown trout & *Lampetra* sp. ammocoetes present; Q3 (poor status) water quality; no other aquatic species or habitats of high conservation value
C6	Unnamed stream	n/a	Local importance	Poor salmonid habitat but brown trout present in low density; no other aquatic species or habitats of high conservation value
C7	River Laney	19L01	Local importance	Excellent salmonid spawning, nursery & holding habitat, brown trout present; aquatic vegetation aquatic vegetation representative of Annex I 'floating river vegetation' habitat[1]; Q4 (good status) water quality; dipper nest under bridge; no other aquatic species or habitats of high conservation value
C8	Lacknahaghny Stream	19L21	Site value	Low fisheries value (no fish recorded); no other aquatic species or habitats of high conservation value

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
C9	Unnamed stream	n/a	Site value	Low fisheries value (no fish recorded), non-perennial channel; no other aquatic species or habitats of high conservation value
C10	Unnamed stream	n/a	Site value	Low fisheries value (no fish recorded), non-perennial channel; no other aquatic species or habitats of high conservation value
C11	River Laney	19L01	Local importance	Excellent salmonid nursery & holding habitat, good spawning, Atlantic salmon & brown trout present; aquatic vegetation representative of Annex I 'floating river vegetation' habitat[1]; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
C12	Awboy River	19A03	Local importance	Good salmonid spawning, nursery & holding habitat, brown trout present; aquatic vegetation aquatic vegetation representative of Annex I 'floating river vegetation' habitat[1]; Q4 (good status) water quality; kingfisher recorded in flight; no other aquatic species or habitats of high conservation value
C13	River Laney	19L01	Local importance	Good salmonid spawning & nursery, excellent holding habitat, brown trout present; aquatic vegetation with good links to Annex I 'floating river vegetation' habitat[1]; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
C14	Clonavrick Stream	19C74	Site value	Low fisheries value (no fish recorded), non-perennial channel with gross siltation pressures; no other aquatic species or habitats of high conservation value
C15	Coolaniddane River	19C67	Site value	Low fisheries value (no fish recorded), non-perennial channel with evident water quality pressures; no other aquatic species or habitats of high conservation value
C16	Kilberrihert Stream	19K24	Site value	No fisheries or aquatic ecology value (non-perennial, 100% dry channel)
C17	Coolaniddane River	19C67	Site value	Low fisheries value (no fish recorded); Q3 (poor status) water quality; failed to meet EPA's TON target for good status water quality; no other aquatic species or habitats of high conservation value
C18	Caherbaroul Stream	19C76	Site value	Low fisheries value (no fish recorded), non-perennial channel, evident water quality pressures; no other aquatic species or habitats of high conservation value
C19	Bealick Stream	19B45	Site value	Low fisheries value (no fish recorded), non-perennial channel; no other aquatic species or habitats of high conservation value

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
N1	West Ballynagree Stream	19W12	Site value	Very low fisheries value (non-perennial stream); biological water quality sample taken but not sufficient to calculate status; no other aquatic species or habitats of high conservation value
N2	River Laney	19L01	Local importance	Moderate quality salmonid and eel habitat; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
N3	Unnamed stream	n/a	Local importance	Low fisheries value; Q4-5 (high status) water quality; no other aquatic species or habitats of high conservation value
N4	River Laney	19L01	Local importance	Excellent quality salmonid nursery and spawning habitat, moderate European eel habitat; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value
N5	Unnamed stream	n/a	Local importance	Moderate quality salmonid and eel habitat; Q4 (good status) water quality; no other aquatic species or habitats of high conservation value

[1] Both Annex I habitats 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation or aquatic mosses [3260]' and 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]' recorded at sites A5, B8, B11, C7, C11, C12 & C13

*** Conservation value:** Atlantic salmon (*Salmo salar*), sea lamprey (*Petromyzon marinus*), brook lamprey (L*ampetra planeri*), river lamprey (*Lampetra fluviatilis*), white-clawed crayfish (*Austropotamobius pallipes*) and otter (*Lutra lutra*) are listed under Annex II of the Habitats Directive [92/42/EEC]. Atlantic salmon, river lamprey, white-clawed crayfish and otter are also listed under Annex V of the Habitats Directive [92/42/EEC]. Otters, along with their breeding and resting places, are also protected under provisions of the Irish Wildlife Acts 1976 to 2021. European eel are 'critically endangered' according to most recent ICUN red list (Pike et al., 2020) and listed as 'critically engendered' in Ireland (King et al., 2011). With the exception of the Fisheries Acts 1959 to 2019, brown trout have no legal protection in Ireland.