Appendix 15.4

Aquatic Ecology Report

Coolglass Wind Farm EIAR Volume 3

Coolglass Wind Farm Limited

SLR Project No.: 501.V00727.00006

27 June 2023

Aquatic baseline report for Coolglass wind farm, Co. Laois

Prepared by Triturus Environmental Ltd. for SLR Consulting

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1. Introduction

1.1 Background

Triturus Environmental Ltd. were commissioned by SLR Consulting to conduct baseline aquatic surveys to inform EIAR preparation for the proposed Coolglass (formerly Fossy) wind farm project (inclusive of potential grid connection routes). The following report provides a baseline assessment of the aquatic ecology including fisheries and biological water quality, as well as protected aquatic species and habitats in the vicinity of the proposed Coolglass wind farm, approximately 11km south-east of Portlaoise, Co. Laois.

Undertaken on a catchment-wide scale, the baseline surveys focused on the detection of freshwater habitats and species of high conservation value. These included surveys for white-clawed crayfish (*Austropotamobius pallipes*), freshwater pearl mussel (*Margaritifera margaritifera*) (eDNA only), macro-invertebrates (biological water quality) and fish of high conservation inclusive of supporting nursery and spawning habitat. The surveys also documented macrophyte and aquatic bryophyte communities including Annex I Habitat associations in the vicinity of the project (**Figure 2.1**). The surveys were undertaken in August and September 2022.

1.2 Project description

A full description of the proposed project is provided in the accompanying Environmental Impact Assessment Report (EIAR).

2. Methodology

2.1 Selection of watercourses for assessment

All freshwater watercourses which could be affected directly or indirectly by the proposed wind farm project were considered as part of the current assessment. A total of *n*=33 riverine sites were selected for detailed aquatic assessment (see **Table 2.1, Figure 2.1** below). The nomenclature for the watercourses surveyed is as per the Environmental Protection Agency (EPA). Aquatic survey sites were present on the Fallowbeg Upper Stream (EPA code: 14F06), Crooked River (14C02) an unnamed tributary, Honey Stream (14H01), Honey Stream North (14H21), Aghoney Stream (14A08), Fossy Lower Stream (14F10), Timahoe Stream (14T09) and Stradbally River (14S02) in the Barrow_SC_050 river sub-catchment. Sites were also surveyed on the Scotland Stream (15S06), Owveg River 915O01), Cleanagh Stream (15C58), Garrintaggart Stream (15G30), Graiguenahown Stream (15G29), Knocklead Stream (15K21), Clogh River (15C03), Brennanshill River (15B51), Moyadd Stream (15M22) and the Douglass River (15D03) in the Nore_SC_060, Dinin[North]_SC_10 and Barrow_SC_070 river sub-catchments (**Table 2.1**).

The proposed wind farm site was not located within a European site. However, there was potential downstream connectivity to the River Barrow and River Nore SAC (002162) via the Stradbally River (flowing north-east), Owveg River (flowing south-west) and Clogh River (flowing south) (**Figure 2.1**).

Please note this aquatic report should be read in conjunction with the final Environmental Impact Assessment Report (EIAR) prepared for the proposed project. More specific aquatic methodology is outlined below and in the appendices of this report.

2.2 Aquatic site surveys

Aquatic surveys of the watercourses within the vicinity of the proposed wind farm project were conducted on Wednesday 31st August to Saturday 3rd September 2022. Survey effort focused on both instream and riparian habitats at each aquatic sampling location (**Figure 2.1**). Surveys at each of these sites included a fisheries assessment (electro-fishing and or fisheries habitat appraisal), white-clawed crayfish survey, macrophyte and aquatic bryophyte survey and (where suitable) biological water quality sampling (Q-sampling) or macro-invertebrate sweep sampling. (**Figure 2.1**).

Suitability for freshwater pearl mussel (*Margaritifera margaritifera*) was assessed at each survey site with environmental DNA (eDNA) sampling undertaken for the species at *n*=4 strategically chosen riverine locations within the vicinity of the project. These water samples were also analysed for white-clawed crayfish (*Austropotamobius pallipes*) and crayfish plague (*Aphanomyces astaci*). This holistic approach informed the overall aquatic ecological evaluation of each site in context of the proposed project and ensured that any habitats and species of high conservation value would be detected to best inform mitigation for the wind farm project.

In addition to the ecological characteristics of the site, a broad aquatic and riparian 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). This broad characterisation helped

define the watercourses' conformity or departure from naturalness. All sites were assessed in terms of:

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

2.3 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 watercourses in the vicinity of the proposed Coolglass wind farm in August and September 2022, following notification to Inland Fisheries Ireland, under the conditions of a Department of the Environment, Climate and Communications (DECC) licence. Electro-fishing was proposed for all riverine survey sites. However, eight sites, A2 (Crooked River), A3 (unnamed stream), A7 (Aghoney Stream), A8 (Fossy Lower Stream), A10 (Timahoe Stream), A13 (unnamed stream), B7 (Owveg River) and C5 (Moyaddd Stream) were dry at the time of survey. Therefore, a total of *n*=25 sites were surveyed via electro-fishing (**Table 2.1, Figure 2.1; Appendix A**). The survey was undertaken in accordance with best practice (CEN, 2003; CFB, 2008) and Section 14 licencing requirements.

Furthermore, a fisheries habitat appraisal of the aquatic survey sites (**Figure 2.1**) (inclusive of ephemeral sites) was undertaken to establish their importance for salmonid, lamprey, European eel and other fish species. The baseline assessment also considered the quality of spawning, nursery and holding habitat for salmonids and lamprey within the vicinity of the survey sites. For detailed survey methodology, please refer to accompanying fisheries assessment report in **Appendix A.**

2.4 White-clawed crayfish survey

White-clawed crayfish (*Austropotamobius pallipes*) surveys were undertaken at the aquatic survey sites in August 2022 under a National Parks and Wildlife (NPWS) open licence (no. C31/2022), 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. 6 of the licence. As per Inland Fisheries Ireland recommendations, the crayfish 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). An appraisal of white-clawed crayfish habitat at each site was conducted based on physical channel attributes, water chemistry and incidental records in mustelid spraint. Additionally, a desktop review of crayfish records within the wider Coolglass wind farm survey area was completed.

Table 2.1 Location of *n*=33 aquatic survey sites in the vicinity of Coolglass wind farm, Co. Laois (* indicates eDNA sampling)

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1	Fallowbeg Upper Stream	14F06	Fallowbeg Upper	656707	687902
A2	Crooked River	14C02	Local road crossing, Luggacurreen	658211	689541
A3	Unnamed stream	n/a	Fallowbeg Upper	656788	688433
A4	Honey Stream	14H01	L38401 road crossing, Fossy Upper	655208	689315
A5	Honey Stream North	14H21	Proposed GCR crossing, L3838	655099	692723
A6	Crooked River	14C02	Timogue Bridge	655370	693764
A7	Aghoney Stream	14A08	Proposed GCR crossing, R426	654051	687536
A8	Fossy Lower Stream	14F10	Proposed GCR crossing, Fossy Upper	654858	688621
A9	Fossy Lower Stream	14F10	Proposed GCR crossing, R426	653868	689102
A10	Timahoe Stream	14T09	Proposed GCR crossing, Fossy Lower	654764	689909
A11	Stradbally River	14S02	Proposed GCR crossing, R426	653558	690506
A12	Cremorgan Stream	14C24	Proposed GCR crossing, R426	653153	691145
A13	Unnamed stream	n/a	Proposed GCR crossing, L3838	654951	692751
A14	Stradbally River	14S02	Bauteogue Bridge	655141	693888
A15*	Stradbally River	14S02	Stradbally Bridge, N80	657185	696352
B1	Scotland Stream	15S06	Proposed GCR crossing, L3851	655422	687083
B2	Owveg River	15O01	Knocklead	654720	686814
B3	Owveg River	15O01	L7792 road crossing	653312	685554
B4	Cleanagh Stream	15C58	L7792 road crossing	653016	684528
B5	Garrintaggart Stream	15G30	L7792 road crossing	653083	683731
B6	Garrintaggart Stream	15G30	R430 road crossing	652727	683607
B7	Owveg River	15O01	Spink Bridge	652536	683673
B8	Owveg River	15O01	R430 road crossing, Garrintaggart	651827	683752
B9	Graiguenahown Stream	15G29	Graiguenahown	651287	683688
B10*	Owveg River	15O01	Graiguenasmuttan Bridge	650631	684829
C1	Knocklead Stream	15K21	R426 road crossing	654950	685010
C2	Clogh River	15C03	Coolglass	656127	685555
C3	Brennanshill River	15B51	Coolglass	656927	684329
C4	Clogh River	15C03	Moyadd	656502	683555
C5	Moyadd Stream	15M22	Kylenabehy	656765	683282
C6	Clogh River	15C03	Swan Bridge	656345	682442
C7*	Clogh River	15C03	Clogh Bridge	656513	679057
D1*	Douglas River	15D03	Shanragh Bridge	660818	684702

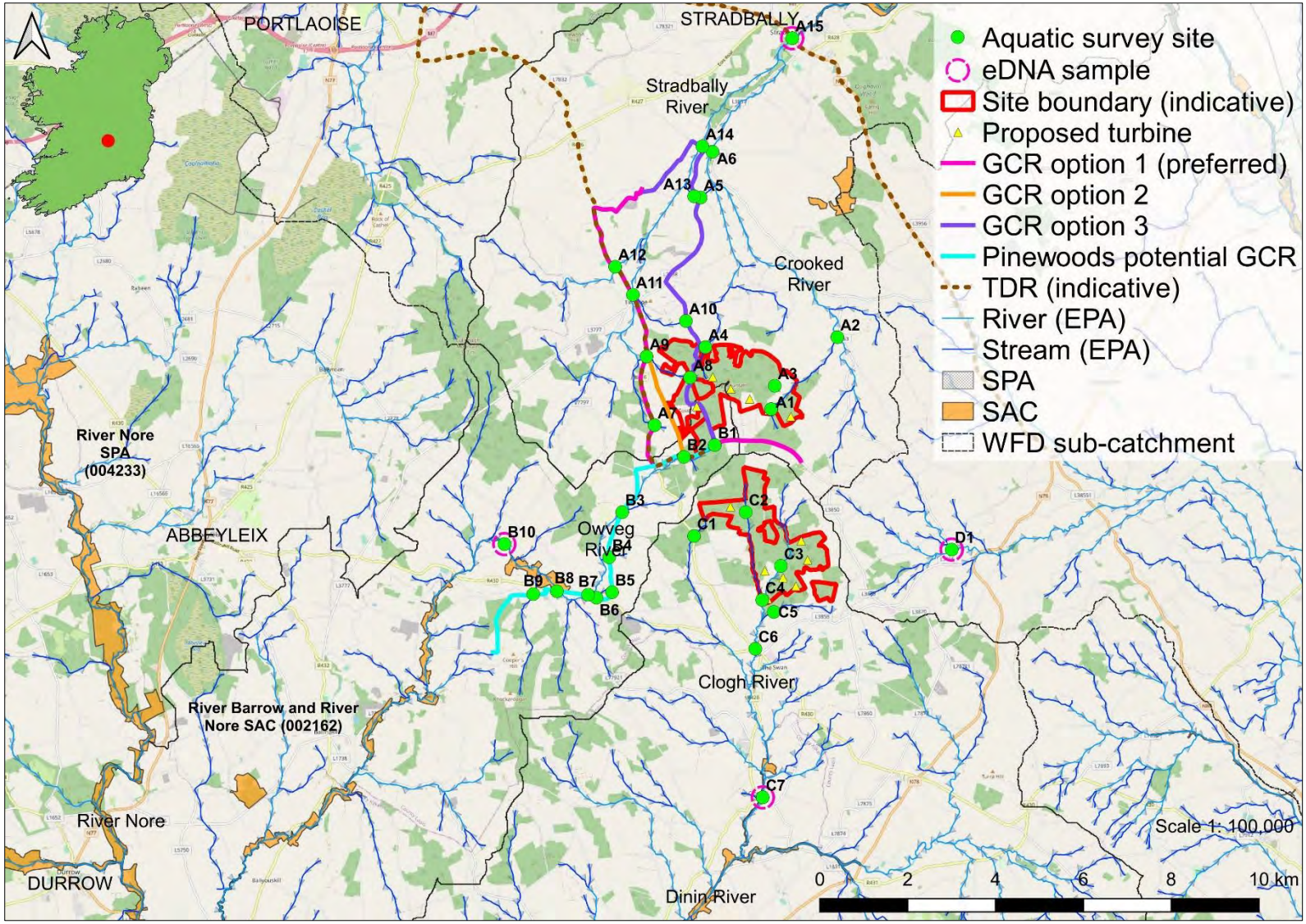

Figure 2.1 Overview of the *n*=33 aquatic survey site locations for Coolglass wind farm, Co. Laois

2.5 Freshwater pearl mussel survey (including eDNA)

There are no known freshwater pearl mussel (*Margaritifera margaritifera*) records in the Nore_SC_060, Dinin[North]_SC_10, Barrow_SC_050 and Barrow_SC_070 river sub-catchments. This was based on an extensive literature review and also examination of NPWS sensitive species data. However, records are known on the downstream-connecting River Nore in the vicinity of Ballyragget (see below). Following to the precautionary principle and to account for any lacunae in data for the species, environmental DNA (eDNA) samples were collected from the Stradbally River, Owveg River, Clogh River and Douglas River and analysed for freshwater pearl mussel eDNA to confirm the species' absence within vicinity of the proposed wind farm site. Please refer to section 2.6 (eDNA analysis) below for further detail.

Furthermore, a Stage 1 and 2 pearl mussel survey was undertaken on the 4th August by Sweeny Consultancy on 3.9km of the River Nore in the vicinity of the Owveg River confluence, ranging from Archer's Island (upstream of confluence) to Old Bridge, Ballyragget. The methodology and full survey report is provided in **Appendix D**.

2.6 eDNA analysis

To validate site surveys and to detect potentially cryptically-low populations of sensitive aquatic receptors within the study area, *n*=4 composite water samples were collected from the Stradbally River (site A15), Owveg River (B10), Clogh River (C7) and Douglas River (D1) and analysed for freshwater pearl mussel, white-clawed crayfish and crayfish plague environmental DNA (eDNA) (**Figure 2.1**). The water samples were collected on the 1st September 2022, with the sites strategically chosen to maximise longitudinal (instream) coverage within the catchment (i.e. facilitating a greater likelihood of species detection).

In accordance with best practice, a composite (500ml) water sample was collected from the sampling point, maximising the geographic spread at the site (20 x 25ml samples at each site), thus increasing the chance of detecting the target species' DNA. The composite sample was filtered on site using a sterile proprietary eDNA sampling kit. The fixed sample was stored at room temperature and sent to the laboratory for analysis with 48 hours of collection. A total of *n*=12 qPCR replicates were analysed for the site. Given the high sensitivity of eDNA analysis, a single positive qPCR replicate is considered as proof of the species' presence (termed qPCR No Threshold, or qPCR NT). Whilst an eDNA approach is not currently quantitative, the detection of the target species' DNA indicates the presence of the species at and or upstream of the sampling point. Please refer to **Appendix C** for full eDNA laboratory analysis methodology.

2.7 Otter signs

The presence of otter (*Lutra lutra*) within 150m of each aquatic survey site was determined through the recording of otter signs. Notes on the age and location (ITM coordinates) were made for each otter sign recorded, in addition to the quantity and visible constituents of spraint (i.e. remains of fish, molluscs etc.).

2.8 Biological water quality (Q-sampling)

All wetted riverine survey sites (*n*=25) were assessed for biological water quality through Q-sampling in August 2022 (sites A2, A3 , A7, A8, A10, A13, B7 & C5 were dry at the time of survey; **Figure 2.1).** All samples were taken with a standard kick sampling hand net (250mm width, 500µm mesh size) from areas of riffle/glide utilising a 2-minute kick sample, as per Environmental Protection Authority (EPA) methodology (Feeley et al., 2020). Large cobble was also washed at each site for 1-minute (where present) to collect attached macro-invertebrates (as per Feeley et al., 2020). Samples were elutriated and fixed in 70% ethanol for subsequent laboratory identification. Samples were converted to Q-ratings as per Toner et al. (2005) and assigned to WFD status classes. 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 2.2 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

2.9 Macrophytes and aquatic bryophytes

Surveys of the macrophyte and aquatic bryophyte community were conducted by instream wading at *n*=33 riverine, with specimens collected (by hand or via grapnel) for on-site identification. An assessment of the aquatic vegetation community helped to identify any rare macrophyte species or habitats corresponding to Annex I habitats, e.g. 'Water courses of plain to montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses [3260]' (more commonly referred to as 'floating river vegetation').

2.10 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).

2.11 Biosecurity

A strict biosecurity protocol following IFI (2010) and 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. Cognisance was given towards preventing the spread or introduction of crayfish plague (*Aphanomyces astaci*) given the known distribution of white-clawed crayfish (*Austropotamobius pallipes*) in the wider survey area. Furthermore, staff did not undertake any work in a known crayfish plague catchment for a period of <72hrs in advance of the survey. Where feasible, equipment was also thoroughly dried (through UV exposure) between survey areas. Any aquatic invasive species or pathogens recorded within or adjoining the survey areas were geo-referenced. All Triturus staff are certified in 'Good fieldwork practice: slowing the spread of invasive non-native species' by the University of Leeds.

3. Receiving environment

3.1 Coolglass wind farm catchment and survey area description

The proposed Coolglass wind farm is located in the vicinity of Fossy Mountain within the townlands of Scotland, Orchard Upper, Fallowbeg Upper, Aghoney, Clashboy, Fossy Upper, Fossy Lower, Knocklead, Moyadd, Aghadreen, Monamanry, Slatt Lower, Coolglass, Fallowbeg Lower, Gorreelagh, Kylenabehy, Brennanshill, Luggacurren, Fallowbeg Middle and Crissard, approximately 11km south-east of Portlaoise, Co. Laois (**Figure 2.1**). The proposed wind farm site is within the South Eastern River Basin District and within hydrometric areas 14 (Barrow) and 15 (Nore). The aquatic survey sites were located within Nore_SC_060, Dinin[North]_SC_10, Barrow_SC_050 and Barrow_SC_070 river sub-catchments (**Figure 2.1**). The proposed wind farm site is drained by the numerous watercourses, namely the Fallowbeg Upper Stream (14F06), Honey Stream (14H01), Fossy Lower Stream (14F10), Owveg River (15O01), Knocklead Stream (15K21), Clogh River (15C03) and Brennanshill River (15B51), with numerous other watercourses crossed by the proposed GCR alignments.

The watercourses and aquatic surveys sites in the vicinity of Coolglass wind farm are typically small, upland eroding (FW1; Fossitt, 2000) and, further down the catchment, small lowland depositing channels (FW2) which have been historically modified. Predominantly, the watercourses flow over upland areas of shale, sandstone, siltstone and coal, with Visean limestone and calcareous shale dominating in the adjoining lowlands (Geological Survey of Ireland data). Land use practices in the wider survey area comprise coniferous forests (CORINE 312), transitional woodland scrub (324) and land principally occupied by agriculture with significant areas of natural vegetation (243) in upland areas with pastures (CORINE 231) dominating in the adjoining lowlands.

3.2 Fisheries asset of the survey area

The Stradbally River is a valuable brown trout nursery and also supports stone loach, minnow and three-spined stickleback and, in the lower reaches, Atlantic salmon and invasive dace (*Leuciscus leuciscus*) (Gordon et al., 2021; IFI 2020 data[1]; Delanty et al., 2017).

The Crooked River, a tributary of the Stradbally River, is known to support brown trout and stone loach (Delanty et al., 2017). Lamprey (*Lampetra* sp.) are also present in both the Stradbally and Crooked Rivers (IFI 2020 data; Gallagher et al., 2019; King, 2006).

The Douglas River, a tributary of the River Barrow, is known to support Atlantic salmon, brown trout, lamprey (*Lampetra* sp.), minnow, stone loach and three-spined stickleback (Gordon et al., 2021a; Delanty et al., 2017). Lamprey are present in the lower catchment only, with none recorded in the vicinity of Shanragh Bridge (survey site D1) in 2017 (Gallagher et al., 2019).

The Owveg (syn. Owenbeg) River, a tributary of the River Nore, is known to support Atlantic salmon, brown trout, stone loach, lamprey (*Lampetra* sp.), three-spined stickleback and minnow (IFI 2021 data[1]; Galetech Energy Services, 2020). High densities of Atlantic salmon and brown trout, in addition

[1] Inland Fisheries Ireland data for Water Framework Directive Fish Ecological Status 2008-2021. Available at https://opendata-ifigis.hub.arcgis.com/datasets/IFIgis::water-framework-directive-fish-ecological-status-2008-2021/

to minnow and lamprey (*Lampetra* sp.), were recorded from the lower Owveg River (Loughill Bridge) in 2021 (Triturus, 2021).

A number of significant barriers to fish passage (mostly ramps but also weirs & culverts) have been identified on numerous watercourses in vicinity of the proposed project, namely the Crooked River, Stradbally River, Aghoney Stream, Douglas River, Owveh River and Clogh River (AMBER Barrier Tracker app data; AMBER Consortium, 2020; **Appendix A**).

Fisheries data for the other watercourses within the survey area was not available at the time of survey.

3.3 Protected aquatic species[2]

A comprehensive desktop review of available data (NPWS, NBDC & BSBI data) for 10km grid squares containing and adjoining the project (i.e. S47, S48, S49, S57, S58, S59, S68 & S78) identified records for a low number of rare and or protected aquatic species within the vicinity of the proposed project.

A high number (c.47) of contemporary records (year >2000) for white-clawed crayfish (*Austropotamobius pallipes*) were available for respective grid squares, including a low number of records for Owveg River (grid square S47), Stradbally River (S59) and Douglas River (S68) (**Figure 3.1**). These records ranged from 2000-2011. Most records in the wider vicinity of the proposed project were available for the River Barrow catchment, with many historical only (1972-1998).

Records for otter (*Lutra lutra*) were widespread within the respective grid squares. However, most records were historical only (c.1980). More contemporary records (2000 onwards) were available for the Owveg River, Crooked River, Stradbally River, Clogh River and the Douglas River (**Figure 3.1**). These locations overlapped with several survey sites, including the Owveg River at site B8, the Clogh River at Clogh Bridge (site C7) and the Douglas River at Shanragh Bridge (site D1).

A high number of records were available for the Nore freshwater pearl mussel (*Margaritifera durrovensis*[3]) on the River Nore in grid squares S47 and S48. However, the majority of these records were located upstream of the Owveg-Nore confluence (i.e. upstream of potential hydrological pathway from the proposed project) (**Figure 3.1**).

3.4 EPA water quality data (existing data)

The following outlines the available water quality data for the watercourses in context of the proposed wind farm project. Only recent water quality is summarised below. Apart from the below watercourses, there was no contemporary EPA biological monitoring data available for the survey area.

[2] **This report may not be made available to the public without redaction given the inclusion of sensitive species data (e.g. pearl mussel)**

[3] Nore freshwater pearl mussel is no longer considered a separate species based on genetic analysis, i.e. now included within the *Margaritifera margaritifera* taxon but still considered a separate conservation unit (central-eastern) (Geist et al., 2018)

Please note that biological water quality analysis (Q-sampling) was undertaken as part of this survey, with the results presented in the **section 4** and **Appendix B** of this report.

3.4.1 Crooked River

Three contemporary EPA biological monitoring stations were located on the Crooked River (14C02). Upstream of survey site A2, the river achieved **Q4 (good status)** at station RS14C020200 in 2020. The river also achieved **Q4 (good status)** at Timogue Bridge (survey site A6, station RS14C020600) and station RS14C020800, 3km downstream of survey site A6, in 2020.

The upper and middle reaches of the Crooked River (Crooked (Stradbally)_010 river water body) achieved good status in the 2016-2021 period and was considered 'not at risk' of achieving target good status water quality. The lower river, located within the Stradbally (Laois)_030 river water body, also achieved good status in the same period but was considered 'at risk' of not achieving good status.

3.4.2 Stradbally River

There were two contemporary EPA biological monitoring station located on the Stradbally River (14S02) in the vicinity of the proposed project. At Bauteoge Bridge (survey site A14, station RS14S020100) the river achieved **Q4 (good status)** in 2020. The river also achieved Q4 (good status) at station RS14S020350, c.3km downstream of Stradbally, in 2020.

The upper reaches of the Stradbally River (Stradbally (Laois)_010, Stradbally (Laois)_020 and Stradbally (Laois)_030 river water bodies) achieved good status in the 2016-2021, with only the Stradbally (Laois)_030 considered at risk of not achieving good ecological status. Forestry (felling) and urban waste water are the primary threats to water quality in these waterbodies (EPA, 2018a).

3.4.3 Owveg River

Two contemporary EPA biological monitoring stations were located on the Owveg River (15O01) in the vicinity of the project. The river achieved **Q4 (good status)** at station RS15O010050 (survey site B8) and station RS15O010080 in 2019. The Owveg achieved Q4 (good status) at a further 3 no. stations downstream (as far as the Nore confluence), also in 2019.

The upper reaches of Owveg (Owveg (Nore)_010 and Owveg (Nore)_020 river waterbodies) achieved good status in the 2016-2021 period, and were considered not at risk of failing to achieve good ecological status.

3.4.4 Clogh River

A single contemporary EPA biological monitoring station was located on the Clogh River (15C03). The river achieved **Q3-4 (moderate status)** at Clogh Bridge (survey site C7, station RS15C030300).

The upper and middle reaches of Clogh River (Clogh_010 river water body) achieved moderate status in the 2016-2021 period, and was 'at risk' of not achieving target good status water quality. Agriculture is the primary risk to water quality in the river water body (EPA, 2019). The lower reaches, part of the Dinin (North)_020 river water body, achieved good status in the same period and were not at risk.

3.4.5 Douglas River

A number of contemporary EPA biological monitoring stations were located on the lower reaches of the River Brosna. The river achieved **Q4-5 (high status)** at Shanragh Bridge (survey site D1, station RS14D03004) in 2020. The river retained its Q4-5 (high status) at Gale's Bridge (station RS14D030100) and station RS14D030200 in 2021 and 2020, respectively.

The upper reaches of Douglas River (Douglas (Laois)_010 river water body) achieved high status in the 2016-2021 period and was therefore 'not at risk' of failing to achieve target good status water quality. Water quality pressures increase moving downstream with agriculture and urban waste waters the most significant threats (EPA, 2018b).

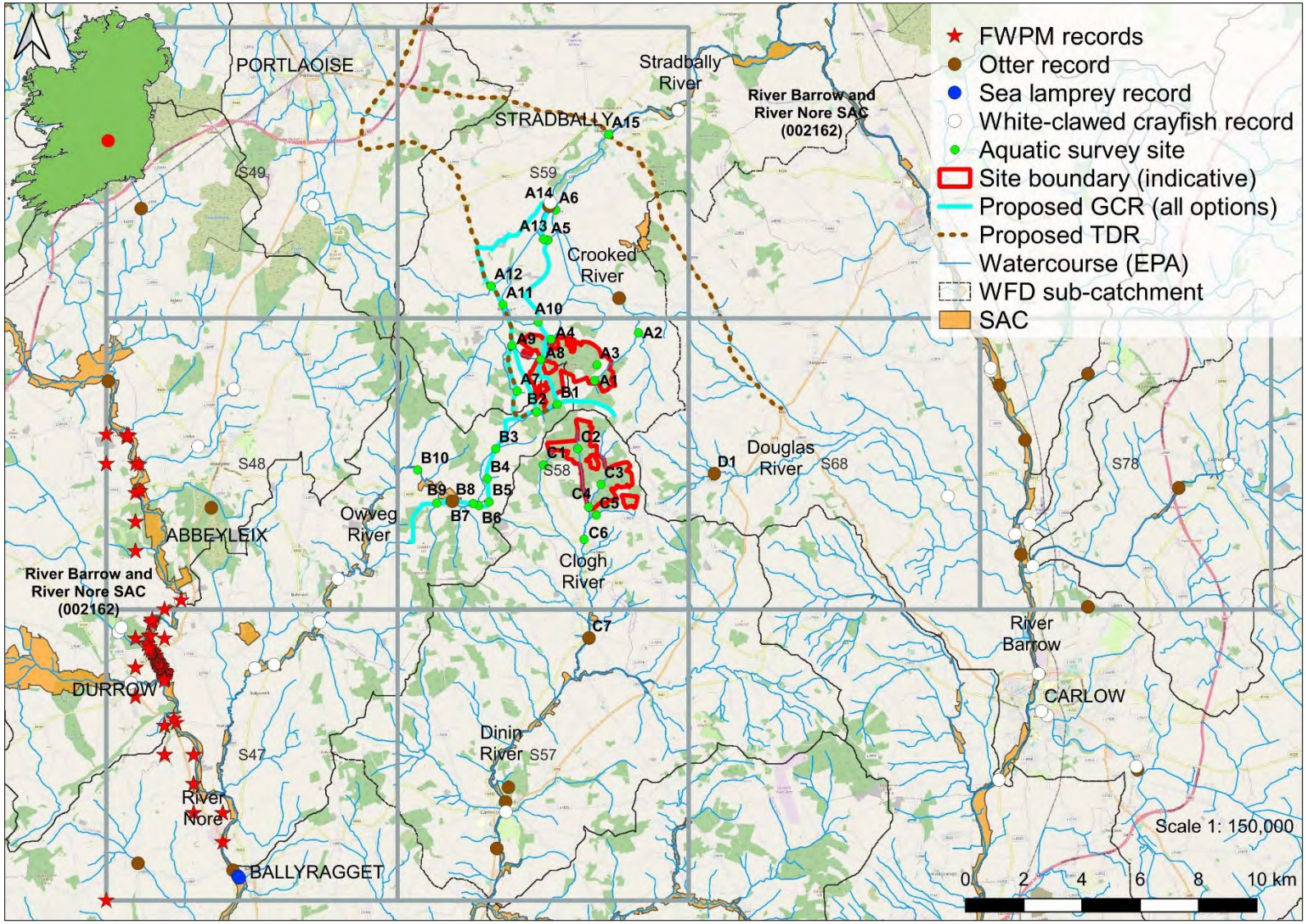

Figure 3.1 Distribution of selected protected aquatic species records in the vicinity of the proposed Coolglass wind farm (NPWS & NBDC data, 2000 onwards)

4. Results of aquatic surveys

The following section summarises each of the *n*=33 survey sites in terms of aquatic habitats, physical characteristics and overall value for fish, white-clawed crayfish and macrophyte/aquatic bryophyte communities. Biological water quality (Q-sample) results are also summarised for each (wetted) riverine sampling site (*n*=25) and in **Appendix B**. Habitat codes are according to Fossitt (2000). Scientific names are provided at first mention only. Sites were surveyed in August 2022. Please refer to **Appendix A** (fisheries assessment report) for more detailed fisheries results. A summary of the fish species recorded at each survey site is provided in **Table 4.2**. A summary of the aquatic species and habitats of high conservation concern recorded during the surveys is provided in **Table 4.3**. An evaluation of the aquatic ecological importance of each survey site based on these aquatic surveys is provided and summarised in **Table 4.4**.

4.1 Aquatic survey site results

4.1.1 Site A1 – Fallowbeg Upper Stream, Fallowbeg Upper

Site A1 was located on the Fallowbeg Upper Stream (14F06), a Crooked River tributary, adjacent to proposed turbine T2. The upland eroding watercourse (FW1) flowed over a relatively steep gradient in a natural, deeply incised valley, with bankfull heights of >10m. The small spate channel suffered from low flows at the time of survey and averaged 2m wide and 0.1-0.2m deep, with few deeper areas. The profile was of shallow glide over boulder cascades, with frequent small plunge pools. Typical of an upland stream, the substrata were dominated by angular boulder and cobble with frequent mixed interstitial gravels. Siltation was moderate (exacerbated by low flows). No soft sediment accumulations were present although beds of sand were occasional along the stream margins. Given the high-energy nature of the site and high shading, macrophyte growth was limited to only very occasional watercress (*Nasturtium officinale*). Aquatic bryophyte coverage was also low with occasional *Hygrohypnum* sp. and *Thamnobryum alopecurum* on larger boulder. *Chiloscyphus polyanthos* was present but rare overall. The steep valley escarpments supported hazel (Corylus avellana), rowan (*Sorbus aucuparia*), holly (*Ilex aquilinum*), bramble (*Rubus fruticosus* agg.), great wood rush (*Luzula sylvatica*), sedges (*Carex* spp.), ferns and a well-developed moss layer. The stream flowed through a coniferous plantation (WD4) and was adjoined to the north by heavily improved pasture (GA1).

No fish were recorded via electro-fishing at site A1 (**Appendix A**). Despite some physical suitability for salmonids and European eel, the did not support fish at the time of survey. This reflected low seasonal flows and high natural gradients which would reduce the inherent fisheries value of the stream at this location. The upland eroding site as unsuitable for lamprey or white-clawed crayfish. Incidentally, a series of small landlocked ponds/ruts on an old forestry track c.200m west of the site (ITM 656546, 688053) were found to support plentiful juvenile smooth newt (*Lissotriton vulgaris*) (i.e. efts) at the time of survey (**Plate 4.2**).

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of site A1 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.1 Representative image of site A1 on the upper reaches of the Fallowbeg Upper Stream, September 2022

Plate 4.2 A series of small ponds on an old forestry track (used to access site A1) were found to support moderate densities of smooth newt efts in September 2022

4.1.2 Site A2 – Crooked River, Luggacurreen

Site A2 was located on the upper reaches of the Crooked River (14C02) at a local road crossing. The Stradbally River tributary at this location had been historically straightened and deepened in vicinity of the road crossing, with intermittent retaining walls on both banks. The river was dry at the time of survey, with no ponding of water present, featuring a dry, dusty mud base. The channel likely conveys water during wetter periods, i.e. an ephemeral channel. Livestock poaching was excessive in vicinity of the bridge.

Site A2 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site A2 was of **local importance (lower value) (Table 4.4).**

Plate 4.3 Representative image of site A2 on the upper reaches of the Crooked River, September 2022 (dry, ephemeral channel)

4.1.3 Site A3 – Unnamed stream, Fallowbeg Upper

Site A3 was located on the upper reaches of an unmapped (by EPA), unnamed Crooked River tributary adjacent to the proposed turbine T13. The stream at this location had been historically straightened and deepened as part of land drainage works, with a resulting steep trapezoidal profile and banks of up to 2.5m in height. The stream channel was 1.5-2m wide and dry at the time of survey, with no ponding of water present. The substrata comprised angular cobble and boulder with occasional mixed gravels, indicating the channel conveys water during wetter periods, i.e. an ephemeral channel. The

channel was heavily tunnelled by scrub vegetation dominated by bramble with an intermittent treeline of alder (*Alnus glutinosa*), willow (*Salix cinerea*), sycamore (*Acer psuedoplatanus*) and holly. The site was located in heavily improved agricultural pasture (GA1).

Site A3 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Its location in the upper reaches of the stream, with high natural gradients downstream, would likely prelude fish populations during wetted periods. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collect a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site A3 was of **local importance (lower value) (Table 4.4).**

Plate 4.4 Representative image of site A3 on an unnamed Crooked River tributary, September 2022 (dry, ephemeral channel)

4.1.4 Site A4 – Honey Stream, Fossy Upper

Site A4 was located on the upper reaches of the Honey Stream (14H01) at the L38401 road crossing, adjoining the proposed site boundary. The upland eroding watercourse (FW1) had been deepened historically. The stream flowed along a moderate gradient and under the road via a masonry box culvert. The channel was semi-dry with an imperceptible flow and frequent ponding of water. The small spate channel suffered from very low seasonal flows at the time of survey and averaged 1m wide and <0.05m deep, with a deep trapezoidal channel and bankfull heights of up to 2m. The profile of the semi-dry channel was of stagnant pool but would typically represent shallow glide and riffle at higher flows. Bank scouring was frequent and further indicative of the spate nature of the stream. The substrata were dominated by angular cobble and small boulder with frequent fine to medium gravels.

However, these were compacted and heavily bedded in silt. Livestock poaching was present at the road crossing. Given semi-dry conditions and heavy tunnelling (by scrub), macrophytes were limited to very occasional watercress and fool's watercress (*Apium nodiflorum*) along channel margins in more open areas. Aquatic bryophytes were limited to *Pellia* sp. liverwort on the cobbled culvert apron. The fenced-off riparian zones were heavily scrubbed with mature willow and hawthorn (*Crataegus monogyna*) and dense bramble, with scattered ash (*Fraxinus excelsior*) and hazel. The site was bordered by intensive agricultural pasture (GA1) and mixed broad-leaved woodland (WD1). Coniferous afforestation (WD4) was present upstream.

No fish were recorded via electro-fishing at site A4 (**Appendix A**). This reflected low seasonal flows, its likely ephemeral nature and poor connectivity with downstream habitats which would reduce the inherent fisheries value of the stream at this location. Suitability for white-clawed crayfish was poor and none were recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of site A4 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.5 Representative image of site A4 on the Honey Stream, September 2022

4.1.5 Site A5 – Honey Stream North, Timogue

Site A5 was located on the upper reaches of the Honey North Stream (14H21) adjacent to a proposed GCR (option 3) crossing of the L3838 road. The stream had been extensively straightened and

deepened as far as its confluence with the Crooked River approx. 0.4km downstream and featured a steep trapezoidal channel with bank heights of up to 2m. The stream averaged 2-2.5m wide and <0.05m deep and was semi-dry at the time of survey, with an imperceptible flow and stagnant pools of water. The substrata of the ephemeral channel were dominated by mobile mixed gravels but these were heavily silted. Deep silt deposits were also present locally. The site was heavily vegetated with abundant watercress and fool's watercress covering >90% of the channel width. The stream was heavily shaded by scrub vegetation dominated by bramble and hedge bindweed (*Calystegia sepium*) with a mature treeline (WL2) of ash, elder (*Sambucus nigra*) and alder along the south bank. The site was bordered by intensive agricultural pasture (GA1).

No fish were recorded via electro-fishing at site A5 (**Appendix A**). This reflected low seasonal flows, its ephemeral nature and poor connectivity with downstream habitats which would reduce the inherent fisheries value of the stream at this location. The stream would have some improved (although still low) fisheries value during higher flow periods given the proximity of the Crooked River. Suitability for white-clawed crayfish was poor and none were recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of site A5 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.6 Representative image of site A5 on the Honey North Stream, September 2022 (semi-dry channel)

4.1.6 Site A6 – Crooked River, Timogue Bridge

Site A6 was located on the Crooked River (14C02) at Timogue Bridge, a proposed GCR crossing, approx. 6km downstream of site A2 (which was dry). The small lowland depositing watercourse (FW2) had been historically straightened and deepened in vicinity of the bridge. The river suffered from low seasonal flows at the time of survey and averaged 3m wide and 0.2-0.4m deep, with very few deeper areas present. The profile was of swift-flowing glide and riffle with occasional pool downstream of the bridge and associated apron. Upstream of the rendered bridge apron (0.15m fall) comprised depositional glide. The substrata were dominated by compacted cobble and frequent boulder, with mixed gravels in faster-flowing areas (increasing in frequency downstream). Siltation was high overall with frequent organic-rich silt deposits in depositional areas. Livestock poaching was evident throughout and excessively high upstream of the bridge. The site supported frequent water crowfoot (*Ranunculus* sp.) instream, with frequent fool's watercress and watercress beds along channel margins. Water starwort (*Callitriche* sp.) was also frequent. Common duckweed (*Lemna minor*) was present locally. Aquatic bryophyte coverage was high with abundant *Leptodictyum riparium*[4] and more occasional *Fontinalis antipyretica* on cobble and boulder. Given the poor quality of the habitat, the aquatic vegetation community did not correspond to the Annex I habitat 'floating river vegetation [3260]'. Filamentous algae and floc[5] cover was very high (>75%), indicating significant enrichment. Reed canary grass (*Phalaris arundinacea*) was abundant along the margins with several mid-channel islands also dominated by the species. The riparian areas also supported dense scrub of bramble, hedge bindweed and nettle (*Urtica dioica*). A mature treeline of hawthorn, horse chestnut (*Aesculus hippocastanum*), ash and beech (*Fagus sylvatica*) lined the channel along the north bank downstream of the bridge, providing valuable thermal refugia. Upstream, the banks were grazed and open. The site was bordered by improved pasture (GA1).

Brown trout (*Salmo trutta*), lamprey (*Lampetra* sp.), stone loach (*Barbatula barbatula*) and three-spined stickleback (*Gasterosteus aculeatus*) were recorded via electro-fishing at site A6 (**Appendix A**). The site was of good value for salmonids, supporting a moderate density of mixed-cohort brown trout. Despite significant siltation and enrichment pressures, the site was of most value as a salmonid nursery. Good quality spawning habitat for both salmonids and lamprey were also present but these areas were highly localised (>40m downstream of the bridge). The pool immediately below the bridge apron (a barrier to fish at low flows only) provided good quality holding habitat for adult salmonids but suitable areas were sparse elsewhere given the generally shallow nature of the site. The site was also of good value as a lamprey nursery, with frequent soft sediment deposits supporting a low density of ammocoetes. Despite some good suitability, no European eel were recorded. White-clawed crayfish habitat was of moderate value given less accessible refugia and none were recorded. A regular otter spraint site (mixed age including fresh) was recorded underneath the dry western arch (ITM 655362, 693763). This did not contain any crayfish remains.

[4] An indicator of eutrophication (Weekes et al., 2021)

[5] floc is defined as an aggregation of (mostly dead) organic material, mainly from algae and diatoms, but also with potential origins from decaying macrophytes and associated decomposers (bacteria and fungi). The floc can form a layer at the surface of the substrate, or infiltrate the substrate, generally where there is insufficient flow to keep the material in suspension (Moorkens & Killeen, 2020)

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonid and lamprey (*Lampetra* sp.), in addition to utilisation by otter, the aquatic ecological evaluation of site A6 was of **local importance (higher value) (Table 4.4).**

Plate 4.7 Representative image of site A6 on the Crooked River at Timogue Bridge, September 2022 (facing downstream from bridge)

4.1.7 Site A7 – Aghoney Stream, Aghoney

Site A7 was located on the upper reaches of the Aghoney Stream (14A08) at the R426 road and proposed GCR (option 1) crossing. The semi-natural upland eroding watercourse (FW1) averaged 2-2.5m wide in a steep incised valley but was dry at the time of survey. The substrata comprised angular cobble and boulder with occasional mixed gravels, indicating the channel conveys water during wetter periods, i.e. an ephemeral spate channel. Whilst macrophytes were absent, occasional (desiccated) *Rhynchostegium riparoides* and *Thamnobryum alopecurum* was present on larger boulder. The stream was heavily shaded by mature treelines and mixed-broad-leaved woodland (WD1) featuring hazel, ash, hawthorn, blackthorn (*Prunus spinosa*) and sycamore with an understory dominated by ferns and bramble. Historical clear-fell (WS5), immature coniferous plantation (WS2) and coniferous afforestation (WD4) was present downstream.

Site A7 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Its location in the upper reaches of the stream, with high natural gradients downstream, would likely prelude fish populations during wetted periods. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site A7 was of **local importance (lower value) (Table 4.4).**

Plate 4.8 Representative image of site A7 on the Aghoney Stream, September 2022 (dry, ephemeral channel)

4.1.8 Site A8 – Fossy Lower Stream, Fossy Upper

Site A8 was located on the upper reaches of the Fossy Lower Stream (14F10) at a proposed GCR (option 3) crossing. The small upland eroding watercourse (FW1) had been historically straightened in the vicinity of coniferous plantations with a pipe culvert (0.5m fall) at the forestry track crossing. The stream averaged <1m wide with bank heights of up to 1m and was dry at the time of survey. The substrata comprised angular cobble and boulder with occasional mixed gravels and sands, indicating the channel conveys water during wetter periods, i.e. an ephemeral spate channel. Whilst macrophytes were absent, occasional (desiccated) *Thamnobryum alopecurum* was present on larger boulder. The stream was heavily shaded by mature coniferous woodland (WD4) with bramble-dominated scrub along the riparian zone.

Site A8 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Its location in the upper reaches of the stream, with high natural gradients downstream, would likely prelude fish and white-clawed crayfish populations during wetted periods. No otter signs were recorded in vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site A8 was of **local importance (lower value) (Table 4.4).**

Plate 4.9 Representative image of site A8 on the Fossy Lower Stream, September 2022 (dry, ephemeral channel)

4.1.9 Site A9 – Fossy Lower Stream, Ballintlea Lower

Site A9 was located on the upper reaches of the Fossy Lower Stream (14F10) at the R426 road and proposed GCR (option 1) crossing. The upland eroding watercourse (FW1) had been locally straightened and deepened historically but retained some semi-natural characteristics instream. However, the stream was semi-dry at the time of survey with no flows and stagnant pools of water only. The channel averaged 2-2.5m wide with steep banks of up to 2.5m in height. Some of these had been recently modified in vicinity of the road crossing, with slumping of spoil into the channel. Indicative of a spate channel, the substrata were dominated by cobble and boulder with localised beds of mixed gravels and frequent scour areas. Siltation was moderate. Macrophytes and aquatic bryophytes were not recorded. The site was heavily shaded by mature treelines of horse chestnut, holly, elder and hawthorn. Tunnelling was present downstream of the bridge. The site was bordered by improved pasture (GA1) with narrow but mature riparian buffers.

No fish were recorded via electro-fishing at site A9 (**Appendix A**). The site was not of fisheries value given its semi-dry, ephemeral nature containing stagnant pools only. However, given some physical suitability, the stream at this location may support a low density of fish during wetter periods. The ephemeral stream had poor suitability for white-clawed crayfish. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle

areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of site A9 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.10 Representative image of site A9 on the lower reaches of the Fossy Lower Stream, September 2022 (ephemeral channel)

4.1.10 Site A10 – Timahoe Stream, Fossy Lower

Site A10 was located on the uppermost reaches of the Timahoe Stream (14T09) at the L38401 road and proposed GCR (option 3) crossing. The upland eroding watercourse (FW1) had been extensively straightened and deepened historically and averaged 1.5m wide in a steep trapezoidal channel of up to 2m in height. The stream was dry at the time of survey with a dry, dusty, leaf litter-filled base colonised by terrestrial plants indicative of sporadic water flows (ephemeral channel). Water abstraction (for livestock) was evident (Plate 4.11). The stream crossed under the local road via a pipe culvert with a 0.25m fall on the downstream side. Whilst the substrata featured cobble and small boulder these were bedded in dry mud and largely covered by terrestrial plant growth. No macrophytes or aquatic bryophytes were recorded. The channel was heavily tunnelled by a mature treeline of ash, hawthorn, blackthorn and willow with bramble-dominated scrub. The site was bordered by intensive pasture (GA1).

Site A10 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Its location in the uppermost reaches of the stream would likely prelude fish and white-clawed crayfish populations during wetted periods. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site A10 was of **local importance (lower value) (Table 4.4).**

Plate 4.11 Representative image of site A10 on the Timahoe Stream, September 2022 (water abstraction for livestock evident)

4.1.11 Site A11 – Stradbally River, Timahoe

Site A11 was located on the Stradbally River at the R426 road and proposed GCR (options 1 & 2) crossing near Timahoe village. The lowland depositing watercourse (FW2) had been straightened and deepened historically, with resulting poor hydromorphology, a trapezoidal channel and bankfull heights of up to 3m. Fractured masonry bank revetments were present downstream of the bridge. The river suffered from low seasonal flows at the time of survey and averaged 2.5m wide and 0.2-0.5m deep, with locally deeper pools to 1.2m. The 2-stage channel was often up to 5m in width with only a narrow water width of 2-2.5m. The profile was of very slow-flowing, shallow glide with occasional pool and very rare riffle (3m section of river only). However, at higher water levels the site would feature swift-flowing deep glide (as indicated by flood debris on riparian trees). The substrata comprised compacted cobble with mixed gravels and boulder. More mobile gravels were present in rare faster-flowing areas adjoining pools. Beds of sand and clay-dominated soft sediment were abundant on the margins of pools, with some more organic-rich areas present under riparian treelines. Siltation was high overall (exacerbated by low seasonal flows). With the exception of a short, shaded section of channel, macrophyte cover was very high with abundant fool's watercress and narrow-fruited watercress (*Nasturtium microphyllum*) (>80% cover). Common duckweed was also present in near-stagnant glide and pool areas. Blue water-speedwell (*Veronica anagallis-aquatica*) and water mint (*Mentha aquatica*) were occasional in open areas of channel. Aquatic bryophytes were limited

to occasional *Leptodictyum riparium*. The cover of floc and filamentous algae was relatively high, further indicating enrichment pressures. The riparian zone was dominated by great willowherb (*Epilobium hirsutum*) with abundant reed canary grass, hedge bindweed, broad-leaved dock (*Rumex obtusifolius*) and nettle with high levels of encroachment on the channel (often covering 50% of the channel width). The river was open in the vicinity of the bridge with a mature alder, elder and hawthorn treeline with bramble scrub present 75m downstream. The site was bordered by intensive pasture (GA1).

Brown trout, lamprey (*Lampetra* sp.), stone loach, minnow (*Phoxinus phoxinus*) and three-spined stickleback were recorded via electro-fishing at site A11 (**Appendix A**). The site only supported a low density of juvenile brown trout, with no adults recorded via electro-fishing despite supporting some good holding habitat (i.e. deep pool) and the site was considered of moderate value to salmonids overall. The evident hydromorphological, enrichment and siltation pressures reduced the value of the site as a salmonid nursery considerably. Spawning habitat for both salmonids and lamprey was present but highly localised and significantly compromised by siltation. Some good quality lamprey habitat was present adjoining localised pool areas and supported a low density of mixed cohort ammocoetes. Despite some moderate suitability, no European eel or white-clawed crayfish were recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q4 (poor status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and *Lampetra* sp., in addition to Q4 (good status) water quality, the aquatic ecological evaluation of site A11 was of **local importance (higher value)** (**Table 4.4**).

Plate 4.12 Representative image of site A11 on the Stradbally River, September 2022

4.1.12 Site A12 – Cremorgan Stream, Coolnabacky

Site A12 was located on the Cremorgan Stream (14C24) at the R426 road and proposed GCR (options 1 & 2) crossing, approx. 1km upstream of the Stradbally River confluence. The semi-natural upland eroding watercourse (FW1) was semi-dry at the time of survey, with no flow and local ponding of water only. The channel width averaged 4-5m with bankfull heights of up to 2m. The river was characteristic of a high-energy spate channel with frequent bank scouring and a bed dominated by angular boulder and cobble with frequent mixed gravels. Sand accumulations were frequent along channel margins. Soft sediment deposits were not present but siltation was moderate given the presence of damp mud of the channel bed. Macrophytes and aquatic bryophytes were absent. Cyanobacterial crusts (calcification) were abundant on instream substrata. The river flowed through a mature linear block of mixed broad-leaved woodland (WD1) supporting sycamore, hazel, holly, blackthorn and ash with an ivy, fern and bramble-dominated ground flora. The site was bordered by improved pasture (GA1).

Three-spined stickleback was the only species recorded via electro-fishing at site A12 (**Appendix A**). Despite good physical suitability for salmonids, albeit compromised by low flows none were recorded via electro-fishing of the remnant stagnant pools. Given downstream connectivity and site attributes (high energy, hard substrata, glide and pool habitat etc.), the site likely supports salmonids (and other fish species such as European eel) at higher water levels. Stagnant pools supported low densities of three-spined stickleback only. There was no suitability (even under higher water levels) for lamprey given the spate nature of the channel (i.e. during normal flows). Suitability for white-clawed crayfish was poor. Three otter spraint sites, two fresh (ITM 653149, 691126) and one mixed age (ITM 653160, 691153) were recorded upstream and downstream of the bridge, respectively.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given an absence of flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of otter, the aquatic ecological evaluation of site A12 was of **local importance (higher value) (Table 4.4).**

Plate 4.13 Representative image of site A12 on the Cremorgan Stream, September 2022 (upstream of bridge)

4.1.13 Site A13 – Unnamed stream, Timogue

Site A13 was located on the uppermost reaches of an unnamed Stradbally River tributary, adjacent to a proposed GCR (option 3) crossing of the L3838 road. The stream had been extensively straightened and deepened as far as its confluence with the Stradbally River approx. 0.4km downstream and typically featured a steep trapezoidal channel with bank heights of up to 2m (except at the road crossing where present in a residential lawn). The stream averaged 1.5-2m wide and was dry at the time of survey. The substrata of the ephemeral channel were dominated by mixed gravels and cobble heavily bedded in mud/silt. The site was heavily vegetated with abundant fool's watercress and frequent water mint. Whilst present in open amenity grassland near the road crossing (Plate 4.14), downstream the dry channel was heavily shaded by scrub vegetation dominated by reed canary grass, nettle and bramble with a mature treeline (WL2) of ash and willow. The site was bordered by a residential property (BL3, GA2) and agricultural pasture (GA1).

Site A13 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. The stream would likely have some improved (although still low) fisheries value in its lowermost reaches only during higher flow periods given the proximity of the Stradbally River. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site A13 was of **local importance (lower value) (Table 4.4).**

Plate 4.14 Representative image of site A13 on an unnamed Stradbally River tributary, August 2022 (dry, ephemeral channel)

4.1.14 Site A14 – Stradbally River, Bauteogue Bridge

Site A14 was located on the Stradbally River (14S02) at Bauteogue Bridge, a proposed GCR (option 3) crossing, approx. 4km downstream of site A11. The river suffered from very low seasonal flows at the time of survey with near imperceptible flows, ponding of water and poor fluvial connectivity in the trapezoidal channel (2.5m bankfull heights). The river had been historically straightened and deepened in vicinity of the bridge but demonstrated some good instream recovery. The profile at the time of survey was of near-stagnant glide and pool but under higher flows the river at this location would feature swift-flowing glide and pool. A large plunge pool was present immediately downstream of the rendered bridge apron (c.1m in depth). The substrata were dominated by mixed gravels with occasional areas of cobble and boulder. However, these were compacted and quite heavily calcified. Beds of finer gravels and sand were present in pool tailings. Siltation was moderate overall but exacerbated by very low flows. Soft sediment accumulations were shallow and superficial where present (further indicative of normal higher energy conditions). In terms of macrophytes, fool's watercress and watercress were frequent along the channel margins, with occasional blue water speedwell and water mint. The site was heavily encroached by reed canary grass which often covered >50% of the channel width upstream of the bridge. Common duckweed, branched bur-reed (*Sparganium erectum*) and brooklime (*Veronica beccabunga*) were occasional. The coverage of aquatic bryophytes was high, with abundant *Fontinalis antipyretica* on cobble and boulder. *Rhynchostegium riparioides* was frequent, with *Leptodictyum riparium* occasional. The calcicolous aquatic liverwort, *Riccardia chamedryfolia* was occasional. Filamentous algal mats were abundant. The riparian zones supported abundant reed canary grass, hedge bindweed, nettle, great willowherb and bramble with scattered alder, ash and willow species. Downstream, the river was heavily shaded by a more continuous treeline of mature ash and willow (providing valuable thermal refugia). The site was bordered by agricultural pasture (GA1).

Brown trout, three-spined stickleback, stone loach and minnow were recorded via electro-fishing at site A14 (**Appendix A**). Despite very low seasonal flows, site A14 was of moderate value for salmonids, supporting a low density of mixed-cohort brown trout. Physically, the site provided good quality nursery, spawning and holding habitat but the value was reduced significantly given very low seasonal flows and poor connectivity. The bridge apron was a significant barrier to fish passage at low flows. Better quality glide habitat was present downstream of the bridge. Overhanging macrophyte vegetation and scoured banks (including tree roots) provided valuable holding areas for salmonids. Whilst some good quality lamprey spawning habitat was present, the site was unsuitable as a nursery area given a paucity of soft sediment accumulations. No white clawed crayfish were recorded which was reflective of high levels of calcification and a lack of accessible refugia. A regular otter spraint site (mixed age) was recorded on the bridge ledge, containing fish remains (no crayfish) (ITM 655146, 693889).

Biological water quality, based on Q-sampling, was calculated as **Q3 (moderate status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and utilisation by otter, the aquatic ecological evaluation of site A14 was of **local importance (higher value) (Table 4.4).**

Plate 4.15 Representative image of site A14 on the Stradbally River at Bauteogue Bridge, September 2022 (facing upstream from bridge)

4.1.15 Site A15 – Stradbally River, Stradbally Bridge

Site A15 was located on the Stradbally River (14S02) at Stradbally Bridge, approx. 3.2km downstream of site A14, at the upstream boundary of the River Barrow and River Nore SAC (002162). The lowland

depositing watercourse (FW2) had been heavily modified in the vicinity of the bridge with retaining walls and local straightening. The river suffered from low seasonal flows at the time of survey and averaged 8-10m wide upstream of the bridge and 3-4m downstream. The depth averaged 0.2-0.4m deep with very few deeper areas present. The profile was of slow-flowing glide with localised riffle downstream of the bridge. Pool areas were very localised. The substrata were dominated by compacted cobble and boulder with localised mixed gravels (mostly downstream of the bridge in faster-flowing glide). Sand accumulations were also present locally (heavily silted). The substrata were also heavily silted (exacerbated by low seasonal flows), with cyanobacterial crusts (calcification) present. Organic-rich soft sediment accumulations were present in marginal and pool slacks, and also in association with *Ranunculus* beds. The site supported abundant water crowfoot (*Ranunculus* sp.) (40% cover) with abundant fool's watercress. Water starwort (*Callitriche* sp.) and branched bur-reed were occasional, with frequent water mint and blue water speedwell along channel margins. The non-native Canadian pondweed (*Elodea canadensis*) was rare. Common duckweed and ivy-leaved duckweed (*Lemna trisulca*) were both occasional. The moss *Fontinalis antipyretica* was locally frequent on larger boulder and cobble, with occasional *Leptodictyum riparium* and *Fissidens* sp. Given the dominance of *Ranunculus* sp. vegetation, in addition to a high cover of *Fontinalis antipyretica*, the aquatic vegetation community corresponded to the Annex I habitat 'floating river vegetation [3260]'. The river at this location was heavily enriched with excessive cover (>70% in open areas) of filamentous algae and floc. The riparian zone supported a typical nitrophilous community dominated by reed canary grass, nettle, great willowherb and hedge bindweed. The site was bordered by buildings and artificial surfaces (BL3).

Atlantic salmon (*Salmo salar*), brown trout, lamprey (*Lampetra* sp.), minnow and three-spined stickleback were recorded via electro-fishing at site A15 (**Appendix A**). The site was of high value for salmonids, supporting mixed-cohort populations of both Atlantic salmon and brown trout. The site was of highest value as a salmonid nursery, despite evident enrichment and siltation pressures impacting the quality of the cobble and boulder refugia. Spawning habitat for both salmonids and lamprey was present but highly localised, mostly downstream of the bridge. The shallow modified site was of poor value as a holding area although some overhanging vegetation provided valuable thermal refugia. Despite high suitability, no European eel or white-clawed crayfish were recorded. Environmental DNA analysis at the site did not detect white-clawed crayfish but crayfish plague (*Aphanomyces astaci*) was present (see **Table 4.1**). A high number of otter signs were recorded in vicinity of the site. The northernmost (dry) arch of the bridge featured a muddy base with frequent boulders and debris which supported at least 4 no. spraint sites (in vicinity of ITM 657181, 696360). Furthermore, additional otter spraint sites (old) were recorded under the middle arch (ITM 657177, 696347) and on the retaining wall ledge upstream of the bridge (ITM 657161, 696336). An otter couch site and a latrine (in mud) were also identified under the northern arch (ITM 657171, 696352).

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the location of the site within the River Barrow and River Nore SAC (002162), the aquatic ecological evaluation of site A15 was of **international importance (Table 4.4)**. The site also supported salmonids (including Atlantic salmon), *Lampetra* sp., highly regular otter utilisation (including a resting area) and Annex I floating river vegetation [3260].

Plate 4.16 Representative image of site A15 on the Stradbally River at Stradbally Bridge, September 2022 (facing downstream form bridge)

4.1.16 Site B1 – Scotland Stream, Aghoney

Site B1 was located on the uppermost reaches of the Scotland Stream (15S06) at a local road and proposed GCR crossing (all options). The semi-natural upland eroding watercourse (FW1) flowed under the local road via a masonry box culvert but was semi-dry at the time of survey with no flow and only localised ponding of stagnant water. The narrow channel meandered over a moderate gradient through a shallow V-shaped valley and averaged 1m wide with bankfull heights of up to 6m. Under higher flows, the channel would feature shallow glide and riffle habitat with occasional small pools associated with meanders and natural falls. Bank scouring was frequent, indicating the spate nature of the stream at this location. Scouring also contributed to siltation of the channel bed (slumping of soil). The substrata were dominated by angular cobble with frequent boulder and coarse gravels. Large woody debris was frequent instream. The site did not support macrophytes, with very localised *Scapania undulata* indicating occasional water flows. The liverwort *Pellia epiphylla* was occasional on muddy banks. The steep banks supported abundant hazel and beech with hawthorn and a well-developed terrestrial moss and fern layer. The site was bordered by coniferous afforestation (WD4) and wet improved grassland (GA1).

No fish were recorded via electro-fishing at site B1 (**Appendix A**). The site was not of fisheries value given its semi-dry, ephemeral nature and location in the upper reaches of the catchment. Given this, and naturally high gradients, connectivity with downstream habitats was poor and the stream is unlikely to support fish at this location even under higher water levels. There was no suitability for white-clawed crayfish. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q2-3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given an absence of flows and lack of suitable

riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of siteB1 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.17 Representative image of site B1 on the Scotland Stream, September 2022

4.1.17 Site B2 – Owveg River, Knocklead

Site B2 was located on the uppermost reaches of the Owveg River (15O01) at a local road crossing. The upland eroding watercourse (FW1) at this location featured a slight flow at the time of survey although still suffered from very low seasonal water levels, with a semi-dry channel. The river had been modified historically upstream of the bridge (straightened and over-deepened) with a steep trapezoidal channel and bankfull heights of up to 4m. Downstream of the rendered bridge apron (barrier to fish passage at low flows), the river retained a semi-natural profile as it meandered through a coniferous forestry block. Here the channel averaged 2-2.5m wide with banks of 1.5-2m high. The shallow site supported only slight flows (<0.05m deep) with occasional ponding areas of up to 0.25m in depth. Under higher water flows, the spate channel would feature a profile dominated by riffle and shallow glide with occasional pool. The substrata were dominated by angular cobble and boulder (some large) with occasional mixed gravels. Sand-silt deposits were occasional along channel margins (mostly originating from bank scouring/slumping). Siltation was moderate overall (exacerbated by low seasonal flows). In more open areas near the bridge supported locally frequent brooklime and watercress and occasional water mint. Aquatic bryophyte cover was low with only localised *Rhynchostegium riparioides*, *Fontinalis antipyretica* and *Leptodictyum riparium* on and near the bridge apron. The riparian zone supported gorse (*Ulex europaeus*), bramble and hawthorn scrub with nettle, wild angelica (*Angelica sylvestris*), pendulous sedge (*Carex pendulata*) and rank grasses. The site was

bordered by coniferous afforestation (WD4) with narrow sycamore buffers and improved pasture (GA1).

Brown trout was the only fish species recorded via electro-fishing at site B2 (**Appendix A**). The site was of low value for salmonids, supporting only a very low fish density. Low seasonal flows reduced the value of the habitat significantly, with intermittent flows and poor longitudinal connectivity (including an impassable bridge apron). However, the site was of some low value as a salmonid nursery and spawning habitat, with good quality holding areas for adults absent. Despite some low suitability for European eel, none were recorded. The upland eroding site was unsuitable for lamprey or white-clawed crayfish. No otter signs were recorded in vicinity of the bridge.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given a lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, the aquatic ecological evaluation of site B2 was of **local importance (higher value) (Table 4.4).**

Plate 4.18 Representative image of site B2 on the upper reaches of the Owveg River, September2022 (upstream of bridge)

4.1.18 Site B3 – Owveg River, Knocklead

Site B3 was located on the Owveg River (15O01) at the L7792 road and proposed (Pinewoods) GCR crossing. The small upland eroding watercourse (FW1) had been historically straightened and modified in the vicinity of the bridge (retaining walls, cobbled apron) but retained good semi-natural features upstream. The river suffered from very low seasonal water levels at the time of survey with near imperceptible flows and local ponding of water (i.e. intermittent fluvial connectivity). The stream

meandered along a slight gradient and averaged 2m wide and 0.1-0.2m deep, with very few deeper areas present (0.3m max.). The profile was of near stagnant glide and stagnant pool but under basal flows the stream at this location would feature shallow glide and frequent riffle areas with occasional small pool (typically on meanders & at LWD). Bank scouring was frequent, further indicative of the spate nature of the channel. The substrata were dominated by angular cobble and boulder with only occasional interstitial mixed gravels. Sand accumulations were present in pools, with soft sediment areas only present adjoining areas exposed to livestock poaching (e.g. immediately downstream of the bridge). Siltation was high overall but this was exacerbated by low seasonal flows (would typically be low to moderate). Macrophyte coverage was high in open areas, with locally abundant watercress and fool's watercress, with frequent corn mint (*Mentha arvensis*) along channel margins. High shading precluded macrophyte growth elsewhere. Aquatic bryophyte coverage was low but some *Leptodictyum riparium* was present. Cover of filamentous algae and floc was high (again, exacerbated by low flows). Upstream of the bridge, the river was shaded by mature willow, ash, hawthorn and blackthorn with bramble scrub, whilst downstream was more open (historically cleared) with scattered scrub (WS1). The site was bordered by improved pasture (GA1).

Atlantic salmon, brown trout, minnow and stone loach were recorded via electro-fishing at site B3 (**Appendix A**). Despite very low seasonal flows, the site was of moderate value for salmonids with a low density of juvenile brown trout and a single Atlantic salmon parr recorded via electro-fishing. Physically, the site was of highest value as a salmonid nursery given a predominance of cobble and boulder refugia. Spawning habitat was present but localised and compromised by siltation pressures and naturally high compaction of the bed. Holding habitat was poor in the small, shallow upland watercourse at this location although some valuable pools were associated with meanders and overhanging tree root systems (thermal refugia). Despite some suitability for European eel, none were recorded. The upland eroding site was unsuitable for lamprey and none were recorded. Suitability for white-clawed crayfish was low and none were recorded. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q4 (good status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids (including Atlantic salmon), in addition to Q4 (good status) water quality, the aquatic ecological evaluation of site B3 was of **local importance (higher value)** (**Table 4.4**).

Plate 4.19 Representative image of site B3 on the upper reaches of the Owveg River, September 2022

4.1.19 Site B4 – Cleanagh Stream, Cleanagh

Site B4 was located on the upper reaches of the Cleanagh Stream (15C58) at the L7792 road and proposed (Pinewoods) GCR crossing. The small upland eroding watercourse (FW1) suffered from very low seasonal flows at the time of survey, with an imperceptible flow and ponding of water only. The stream flowed over a steep gradient downstream of the masonry box culvert in a deeply incised V-shaped valley with bankfull heights of up to 6m. Bank scouring and erosion was widespread, with slumping of material into the narrow channel. The evidently spate channel featured stagnant pools of up to 0.25m in depth with a cascading profile in a 2m wide channel. The substrata were dominated by angular boulder with localised interstitial cobble, coarse gravels and coarse sands. Siltation was evident but likely exacerbated by low flows. Given the site characteristics , no macrophytes or aquatic bryophytes were recorded. Iron oxide deposits were frequent instream. The valley escarpments supported mature ash, hazel, holly and willow with scrubby understories of ivy, bramble and ferns with mosses such as *Thamnobryum alopecurum*. The site was bordered by improved pasture (GA1) and farm outbuildings (BL3).

No fish species were recorded via electro-fishing at site B4 (**Appendix A**). The site was not of fisheries value given its ephemeral nature in addition to high natural gradients. However, given the close proximity to the downstream connecting Owveg River (<0.2km), the stream may have some low fisheries (salmonid) value during higher flow periods. The box culvert was inaccessible to fish given high gradients. The upland eroding ephemeral channel was unsuitable for white-clawed crayfish. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q2-3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle

areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of site B4 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.20 Representative image of site B4 on the Cleanagh Stream, September 2022

4.1.20 Site B5 – Garrintaggart Stream, Knockbaun

Site B5 was located on the upper reaches of the Garrintaggart Stream (15G30) at the L7792 road and proposed (Pinewoods) GCR crossing. The diminutive upland eroding watercourse (FW1) flowed under the road via a pipe culvert and suffered from low seasonal flows at the time of survey, with only a slight flow. The stream had been historically straightened and deepened in vicinity of the road crossing, with a steep trapezoidal channel and bankfull heights of 2m. The stream averaged 0.5-1m wide and <0.05m deep with a profile comprised exclusively of very shallow glide. The substrata were heavily compacted cobble and gravels exposed to moderate siltation. Given excessive riparian shading, macrophytes and aquatic bryophytes were not present downstream of the culvert. However, watercress and fool's watercress were abundant upstream of the road crossing (more open channel). The stream at this location was heavily tunnelled (near 100%) with very dense blackthorn and willow hedging (WL2). Open areas near the road were heavily encroached by herbaceous vegetation dominated by great willowherb, wild angelica and meadowsweet (*Filipendula ulmaria*). The site was bordered by intensive pasture (GA1) with coniferous afforestation (WD4) upstream.

No fish species were recorded via electro-fishing at site B5 (**Appendix A**). The site was not of fisheries value given its very shallow and likely ephemeral nature, in addition to the location at the headwaters

of the stream. The upland eroding channel was unsuitable for white-clawed crayfish. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of site B5 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.21 Representative image of site B5 on the Garrintaggart Stream, September 2022

4.1.21 Site B6 – Garrintaggart Stream, Knockbaun

Site B6 was located on the Garrintaggart Stream (15G30) at the R430 road and proposed (Pinewoods) GCR crossing, approx. 0.2km upstream of the Owveg River confluence. The small upland eroding watercourse (FW1) flowed over a high gradient under the road via a series of culverts. The spate channel suffered from very low seasonal water levels at the time of survey, with an imperceptible flow and localised ponding of water. The stream flowed in a deeply incised natural valley downstream of the road crossing, with bankfull heights of up to 8m. Natural bank erosion (scouring) was high. The channel averaged 1-1.5m wide and <0.1m deep at the time of survey, with localised stagnant pools to 0.3m. Typical of a spate channel, the substrata were dominated by angular cobble and boulder with interstitial mixed gravels. Siltation was high and exacerbated by very low flows. Soft sediment and sand accumulations were present along the channel margins and in depositional pool areas. Given very high shading at the base of the valley, macrophytes were not recorded with only very occasional *Rhynchostegium riparioides* present on boulder. The steep escarpments were densely vegetated by

mature ash, elder and holly with abundant ivy, nettle, bramble and ferns. The site was bordered by intensive sloping pasture (GA1).

No fish species were recorded via electro-fishing at site B6 (**Appendix A**). The site was not of fisheries value given poor seasonal flows, high natural gradients, poor connectivity with downstream habitats and the location in the upper reaches of the stream. The upland eroding channel was unsuitable for white-clawed crayfish. No otter signs were recorded in vicinity of the site,

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of site B6 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.22 Representative image of site B6 on the Garrintaggart Stream, September 2022

4.1.22 Site B7 – Owveg River, Spink Bridge

Site B7 was located on the Owveg River (15O01) at Spink Bridge (R430), a proposed (Pinewoods) GCR crossing, approx. 2.4km downstream of site B3. With the exception of a single large, stagnant plunge pool at the bridge apron (**Plate 4.23**), the high gradient upland eroding watercourse was dry at the time of survey. The river is known to flow underground upstream of this point. The river channel averaged 5-8m wide with bank heights of 2-3m downstream of the bridge crossing. Typical of a spate channel, the substrata were dominated by angular boulder and cobble, with localised beds of mixed gravels. The only water present was located in a deep (1.5m) plunge pool immediately below a fractured bridge apron that featured a fall of c.1.5m and was very poorly passable to fish (impassable

to lamprey). The pool supported abundant sand deposits with moderate siltation. With the exception of localised watercress on the dry channel bed, macrophytes were absent. No aquatic bryophytes were recorded. The channel was lined by mature treelines of ash, willow and hazel with bramble scrub. The site was bordered by improved pasture (GA1) with coniferous afforestation (WD4) upstream.

European eel, minnow and stone loach were recorded via electro-fishing at site B7 (**Appendix A**). The site provided high physical suitability for salmonids. However, the dry karstic nature of the channel (other than the plunge pool) precluded the presence of brown trout or Atlantic salmon, despite their presence upstream (at site B3). Salmonid presence upstream provides evidence that salmonids are able to navigate this site during higher water flows. Despite limited suitability for crayfish (i.e. spate channel nature of survey area), a low density of white-clawed crayfish were recorded from the plunge pool via hand-searching of refugia (adults and juveniles). No otter signs were recorded in the vicinity of the site.

Site B7 (a single large plunge pool of stagnant water) was not suitable for biological water quality assessment via Q-sampling. However, a composite sweep sample was taken to gain a representation of the macro-invertebrate community. No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded (**Appendix B**).

Given the presence of white-clawed crayfish and European eel, the aquatic ecological evaluation of site B7 was of **local importance (higher value)** (**Table 4.4**).

Plate 4.23 Representative image of site B7 on the Owveg River at Spink Bridge, September 2022 (deep plunge pool in an otherwise dry channel)

4.1.23 Site B8 – Owveg River, Garrintaggart

Site B8 was located on the Owveg River (15O01) at the R430 road and proposed (Pinewoods) GCR crossing, approx. 0.9km downstream of site B7. The lowland depositing watercourse (FW2) had been historically straightened downstream of the bridge but demonstrated some good instream recovery. The channel averaged 3-4m wide and 0.1-0.2m deep, with locally deeper pool to 0.5m (e.g. under bridge). The river suffered from low seasonal water levels at the time of survey, with a profile dominated by shallow very slow-flowing glide and riffle with very occasional small pool. The substrata were dominated by compacted cobble with frequent boulder and mixed gravels. However, these were heavily silted (exacerbated by low seasonal flows) and supported excessive cover of filamentous algae and floc. Boulder habitat dominated underneath the bridge. Beds of soft sediment were present along pool and channel margins but these were shallow and largely superficial. Siltation was high overall, with livestock poaching present upstream and downstream of the bridge. The open channel supported frequent beds of watercress along channel margins and on exposed cobble bars, with more occasional fool's watercress and water mint. Common duckweed was also present but rare overall. Aquatic bryophyte coverage was low but some *Leptodictyum riparium* was present locally on larger cobble and boulder. *Fontinalis antipyretica* was present but rare. The riparian zones supported scattered osier (*Salix viminalis*) and grey willow, hawthorn and alder with abundant great willowherb, broad-leaved dock, reed canary grass and rank grasses, frequent butterbur (*Petasites hybridus*) and bramble-dominated scrub. The site was bordered by intensive pasture (GA1).

Brown trout, European eel, minnow and stone loach were recorded via electro-fishing at site B8 (**Appendix A**). The site was of moderate value for salmonids, despite evident siltation and water quality issues, supporting a low density of mixed-cohort brown trout. Atlantic salmon are known from the site (IFI 2021 data). The site provided some good quality spawning and nursery habitat downstream of the bridge, although the quality of both were impacted by considerable siltation and eutrophication pressures. Marginal macrophyte beds provided valuable nursery refugia and also some limited holding habitat for adults. Holding habitat for larger adults was confined to the deeper pool underneath the bridge This boulder habitat provided high quality European eel habitat, with abundant diurnal refugia by way of boulder and retaining wall crevices. Whilst some moderate quality lamprey spawning habitat was present, no suitable nursery areas were identified (shallow & superficial where present). A single juvenile white-clawed crayfish was recorded via hand searching (6mm carapace length). No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q4 (poor status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, European eel and white-clawed crayfish, in addition to Q4 (good status) water quality, the aquatic ecological evaluation of site B8 was of **local importance (higher value)** (**Table 4.4**).

Plate 4.24 Representative image of site B8 on the Owveg River, September 2022 (facing downstream from bridge)

4.1.24 Site B9 – Graiguenahown Stream, Graiguenahown

Site B9 was located on the Graiguenahown Stream (15G29) at the L77932 road and proposed (Pinewoods) GCR crossing, approx. 0.5km upstream of the Owveg River confluence. The small upland eroding watercourse (FW1) had been straightened in vicinity of the twin road pipe culvert, with retaining walls present upstream and (more so) downstream. Whilst the stream had been heavily modified downstream of a residential property (near Spink NS), the channel retained some natural characteristics upstream. Connectivity was poor given the presence of a 0.5m fall on the downstream side of the pipe culvert and the semi-dry channel. The stream suffered from very low seasonal water levels at the time of survey with no flow and stagnant pools of standing water only. These pools were 0.1-0.2m deep, with the exception of a plunge pool immediately below the culvert which was up to 0.5m deep. The semi-dry channel averaged 2m wide with steep banks of 1-1.5m high. The substrata were dominated by cobble and mixed gravels with occasional boulder and marginal sand beds. Macrophytes were absent upstream but downstream of the culvert featured rare watercress and fool's watercress in a heavily encroached channel. Aquatic bryophytes were limited to very occasional *Rhynchostegium riparioides*. Filamentous algae were present (20% cover in open areas) indicating enrichment. Upstream, the stream was heavily shaded by mature hazel, holly, ash, hawthorn, blackthorn and willow (WD1) with bramble scrub. Downstream, the modified channel was open with scattered willow, hazel and butterbur dominating the narrow riparian zones. The site was bordered by residential properties (GA2, BL3) and improved pasture (GA1).

No fish were recorded via electro-fishing at site B9 (**Appendix A**). Whilst the site was physically suitable for salmonids the semi-dry nature caused by low seasonal water levels and poor downstream connectivity to superior fisheries habitats precluded the presence of salmonids and other fish species. Three-spined stickleback were absent, indicating the stream may dry out periodically (i.e. ephemeral).

Suitability for white-clawed crayfish was low and none were recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q2-3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given a lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of site B9 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.25 Representative image of site B9 on the Graiguenahown Stream, September 2022 (downstream of twin pipe culvert)

4.1.25 Site B10 – Owveg River, Graiguenasmuttan Bridge

Site B10 was located on the Owveg River (15O01) at Graiguenasmuttan Bridge, approx. 1.9km downstream of site B8. The river had been historically modified in vicinity of the bridge (e.g. a livestock crossing) but retained a meandering profile throughout. The lowland depositing watercourse (FW2) suffered from low seasonal flows at the time of survey and was dominated by shallow, slow-flowing glide and pool habitat, with rare riffle areas. The river averaged 3m wide and 0.1-0.2m deep, with localised pool to 1.5m on meanders. Frequent bank scouring and bankfull heights of up to 2.5m indicated the channel conveyed significantly higher water volumes seasonally. The substrata were dominated by relatively mobile gravels and cobble, with rare boulder. However, these were exposed to high levels of siltation (exacerbated by high flows). Livestock poaching and livestock access to the channel was excessive. Sand-silt accumulations were present on the inside of meanders and occasionally in association with pool areas. The relatively open channel supported locally frequent

beds of watercress with occasional brooklime and fool's watercress. Water starwort (*Callitriche* sp.) and water mint were occasional, with rare branched bur-reed. Aquatic bryophyte coverage was high locally in more shaded glide habitat, with frequent *Leptodictyum riparium* and rare *Fontinalis antipyretica*. Cover of filamentous algae and floc was very high (>70% of the bed), further indicating significant enrichment pressures. The narrow riparian zones supported intermittent treelines of hazel, ash, willow and hawthorn with bramble scrub and typical nitrophilous species such as great willowherb. The site was bordered by intensive pasture (GA1).

Atlantic salmon, brown trout, lamprey (*Lampetra* sp.), minnow and stone loach were recorded via electro-fishing at site B10 (**Appendix A**). The site was of moderate value for salmonids, despite low seasonal flows and evident siltation pressures, supporting a low density of mixed-cohort brown trout and Atlantic salmon. The heavily impacted site provided some good quality holding habitat, typically associated with meanders and large woody debris instream. However, these deeper areas supported a very low density of adult salmonids only. Whilst some physically suitable nursery and spawning habitat was present, the value was again compromised by high levels of siltation and enrichment. Shallow soft sediment accumulations along channel margins supported low densities (c.5 per m^2) of *Lampetra* sp. ammocoetes. Despite some good suitability for European eel, none were recorded. The site was of moderate value for white-clawed crayfish only given poorly condition bed refugia (siltation & calcification), low seasonal flows - none were recorded. However, eDNA sampling at the site produced a positive result for white-clawed crayfish (**Table 4.1**). No otter signs were recorded in vicinity of the site, despite some good suitability.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids (including Atlantic salmon), *Lampetra* sp. and white-clawed crayfish (detected via eDNA), the aquatic ecological evaluation of site B10 was of **local importance (higher value) (Table 4.4).**

Plate 4.26 Representative image of site B10 on the Owveg River at Graiguenasmuttan Bridge, September 2022 (facing upstream from bridge)

4.1.26 Site C1 – Knocklead Stream, Knockacrin

Site C1 was located on the uppermost reaches of the Knocklead Stream (15K21) at the R426 road crossing. The small upland eroding watercourse (FW1) emanated from a coniferous forestry block (WD4) and passed under the road via a pipe culvert. The stream suffered from very low seasonal flows at the time of survey, with the channel semi-dry and supporting occasional near stagnant pools of water only (i.e. a near imperceptible flow). The stream flowed over a relatively high gradient in a deeply incised, cascading channel typical of upland spate channel. The stream averaged 1m wide and <0.05m deep. The substrata were dominated by siliceous bedrock with occasional superficial mixed gravels. Macrophytes were limited to very localised watercress along channel margins with a low bryophyte cover supporting *Scapania undulata* and very occasional *Racomitrium aciculare* on wet cascade areas. The channel was located in an area of historical clear-fell (WD5) with the riparian zone supporting frequent grey willow and bramble scrub and rosebay willowherb (*Chamaenerion angustifolium*). The site was bordered by mature sitka spruce plantation (WD4).

No fish were recorded via electro-fishing at site C1 (**Appendix A**). The site was not of fisheries value given its semi-dry, ephemeral nature and location in the upper reaches of the catchment. Given this, and naturally high gradients, connectivity with downstream habitats was poor and the stream had no suitability to support fish at this location even under higher water levels. There was no suitability for white-clawed crayfish. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to less than good status water quality, the aquatic ecological evaluation of site C1 was of **local importance (lower value)** (**Table 4.4**).

Plate 4.27 Representative image of site C1 on the Knocklead Stream, August 2022

4.1.27 Site C2 – Clogh River, Coolglass

Site C2 was located on the uppermost reaches of the Clogh River (15C03) within the proposed site boundary. The upland eroding watercourse (FW1) meandered through a coniferous forestry block (WD4) in a deeply incised natural valley with bankfull heights of up to 4m (often 2-3m). The spate river suffered from low seasonal flows at the time of survey with only a slight flow present. The river averaged 2-2.5m wide and 0.1-0.2m deep, with deeper plunge pools associated with natural falls/cascades and frequent meanders. The profile of the natural, high-energy site was of frequent pool and riffle. The substrata were dominated by angular cobble and boulder with abundant bedrock and frequent beds of mixed gravels. There were moderately silted (exacerbated by low flows). Iron-oxidising bacterial deposits were frequent instream. Given the high energy characteristics of the site, macrophytes were limited to very occasional watercress along the river margins. Aquatic bryophyte cover was low with occasional *Scapania undulata* and *Racomitrium aciculare* and rare *Chiloscyphus polya*nthos. The steep (often vertical) bedrock-dominated banks supported occasional *Marchantia polymorpha*. The riparian zone was dominated by moss species such as *Polytrichum* sp. and big shaggy moss (*Rhytidiadelphus triquetrus*) with frequent bramble scrub (WS1) and ferns.

Brown trout was the only fish species recorded via electro-fishing at site C2 and the site was of relatively low value for salmonids given its location in the upper reaches of the catchment and spate nature (**Appendix A**). However, the site nonetheless supported a very low density of trout with some suitable spawning and holding habitat was present. The site was of poor value as a salmonid nursery. Holding areas supporting boulder and cobble provided some low suitability for European eel but none

were recorded. The upland eroding channel was unsuitable for lamprey or white-clawed crayfish. However, the site was likely of greater fisheries value during higher flow periods and suitability improved considerably downstream. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, the aquatic ecological evaluation of site C2 was of **local importance (higher value) (Table 4.4).**

Plate 4.28 Representative image of site C2 on the upper reaches of the Clogh River, August 2022

4.1.28 Site C3 – Brennanshill River, Coolglass

Site C3 was located on the upper reaches of the Brennanshill River (15B51) at a local track crossing (box culvert, rendered apron) within the proposed site boundary. The upland eroding watercourse (FW1) meandered through a coniferous forestry block (WD4) in a naturally incised channel with bankfull heights of 1-1.5m. The river suffered from low seasonal flows at the time of survey (very slight flow) and averaged <2m wide and 0.1m deep. The profile of the spate channel comprised riffle with frequent small, shallow pool. The substrata were dominated by cobble and mixed gravels with frequent angular boulder. Natural bank erosion and siltation was moderate (exacerbated by low flows). Woody debris was frequent instream and often formed debris dams and associated pool areas. Given high shading and spate characteristics, macrophyte growth was limited to very occasional watercress along channel margins. Coverage of aquatic bryophytes was low with very occasional *Scapania undulata*, *Racomitrium aciculare* and rare *Leptodictyum riparium*. Filamentous algae were frequent (20% cover), indicating enrichment. Downstream of the coniferous forestry block, the

riparian zone supported abundant willow, blackthorn, nettle and bramble scrub, with heavy encroachment of the narrow channel.

Brown trout was the only fish species recorded via electro-fishing at site C3 (**Appendix A**). The site was of moderate value for salmonids, supporting a very low density of mixed-cohort brown trout. Whilst some good quality spawning (finer gravels) and moderate quality nursery habitat (cobble & boulder) were present, low seasonal flows reduced the value of the site considerably (i.e. semi-dry). Although small pools were frequent, these provided poor quality holding habitat for adult salmonids given the small nature of the river at this location. Likewise, the shallow depth and seasonality of the spate site provided poor suitability for European eel (none recorded). The site was likely of greater fisheries value during higher flow periods (given connectivity with downstream habitats) and suitability improved considerably downstream. The upland eroding channel was unsuitable for lamprey or white-clawed crayfish. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q4 (good status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling given very low summer flows (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, in addition to Q4 (good status) water quality, the aquatic ecological evaluation of site C3 was of **local importance (higher value)** (**Table 4.4**).

Plate 4.29 Representative image of site C3 on the Brennanshill River, August 2022

4.1.29 Site C4 – Clogh River, Moyadd

Site C4 was located on the Clogh River (15C03) at the Brennanshill River confluence and livestock access point, approx. 2km downstream of site C2. The upland eroding watercourse (FW1) suffered from very low seasonal flows at the time of survey, with only a slight flow and a semi-dry channel with ponding of water. The river averaged 3m wide in a channel of up to 6m. The depth varied from 0.1-0.3m (at very low water levels). The profile was of riffle and glide with frequent pool (glide would predominate at higher water levels). Given the spate nature of the channel, the substrata were dominated by angular, mobile cobble and boulder although beds of exposed mixed gravels and sands were abundant along the exposed margins. Soft sediment accumulations were present locally but limited in extent and shallow, where present (<0.02m). Siltation was low overall but exacerbated by low flows, with some seasonal deposition (of sand-dominated) silt present along channel margins. Livestock poaching was present but not excessive (well-fenced buffer zones). Large woody debris was frequent instream and often resulted in the formation of deeper pools. Macrophyte growth was sparse given high shading and hard mobile substrata. Watercress was present locally along channel margins. Aquatic bryophytes were limited to occasional *Racomitrium aciculare* and *Rhynchostegium* riparioides. *Pellia* sp. liverwort was frequent on muddy banks. The site was heavily shaded by a mature buffer of hazel woodland (WN2), with frequent holly and more occasional grey willow, hawthorn and scattered mature ash. The site was bordered by improved pasture (GA1).

Brown trout, lamprey (*Lampetra* sp.), three-spined stickleback, minnow and stone loach were recorded via electro-fishing at site C4 (**Appendix A**). The site was of moderate value to salmonids despite low (and known regular) low seasonal flows and subsequent reduction in fisheries habitat quality. The site supported a low density of mixed-cohort brown trout (primarily adult fish). Physically, the site was of most value as spawning and nursery area although these attributes were compromised by very low seasonal water levels (i.e. a semi-dry channel with only slight flows). Good quality holding habitat was also present, with frequent small pools and scoured banks providing valuable areas for adult salmonids. These areas were especially important given evident low flows. Furthermore, the heavily shaded nature of the site likely facilitated the persistence of a small salmonid population given the presence of thermal refugia. Despite the upland eroding characteristics and presence of sub-optimal, sand-dominated soft sediment, the site supported *Lampetra* sp. ammocoetes. These were present but highly localised, with one area supporting 14 per m^2. Despite some good suitability for European eel, none were recorded via electro-fishing. Suitability for white-clawed crayfish was low and none were recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and *Lampetra* sp., the aquatic ecological evaluation of site C4 was of **local importance (higher value) (Table 4.4).**

Plate 4.30 Representative image of site C4 on the Clogh River, August 2022 (very low water levels)

4.1.30 Site C5 – Moyadd Stream, Kylenabehy

Site C5 was located on the Moyadd Stream (15M22) approx. 50m upstream of the Clogh River confluence. The meandering upland eroding watercourse (FW1) was dry at the time of survey with no flow or ponding of water present. The channel averaged 1.5m wide with naturally incised banks of up to 2m high. Scouring of the banks was indicative of a spate channel, as was the predominance of cobble and boulder substrata. Mixed gravels were also present, locally. These were evident moderately silted, with livestock poaching adding to the siltation load. The ephemeral stream supported very occasional brooklime and watercress, with sparse growth of *Racomitrium aciculare*. Filamentous algae were also present on the bed, indicating enrichment. The narrow channel was heavily shaded by hazel-dominated treelines, with abundant bramble scrub. The site was bordered by historical clear-fell (WS5) with improved pasture (GA1) to the south. Coniferous afforestation (WD4) was present upstream.

Site C5 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. However, given some physical suitability and close proximity to the Clogh River, the stream in its lower reaches may support a low density of fish during wetter periods. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site C5 was of **local importance (lower value) (Table 4.4).**

Plate 4.31 Representative image of site C5 on the Moyadd Stream, August 2022 (dry, ephemeral channel at the Clogh River confluence)

4.1.31 Site C6 – Clogh River, Swan Bridge

Site C6 was located on the Clogh River at Swan Bridge (R430), approx. 1km downstream of site C4. The upland eroding watercourse (FW1) had been historically modified (bank revetment) downstream of the bridge but retained a natural profile upstream of the 3-arch masonry bridge (rendered bed and arch). The spate channel suffered from very low seasonal flows at the time of survey, with only a slight flow and a semi-dry channel with ponding of water causing habitat fragmentation and poor fluvial connectivity. The river averaged 3-5m wide and 0.2-0.4m deep (where water was present). Whilst the river upstream of the bridge featured stagnant pools, the river would typically be dominated by glide habitat and shallow riffle over bedrock. The substrata were dominated by calcareous bedrock (>70%) with localised angular cobble and boulder. Mixed gravels were present locally (e.g. pool slacks) but these were limited in extent and heavily silted (exacerbated by low flows). Shallow, organic-rich soft sediment deposits were abundant upstream of the bridge in depositional glide. Livestock poaching was evidently contributing to the siltation load (as well as upstream). Given bedrock substrata and high shading, macrophytes were limited to occasional marginal brooklime and narrow-fruited watercress. The moss *Fontinalis antipyretica* was locally abundant on bedrock with very occasional *Rhynchostegium riparioides* on larger boulder. The river was heavily shaded by dense scrubby treelines of willow, hawthorn and sycamore with abundant bramble and dog rose (*Rosa canina*). The site was bordered by residential properties (with amenity grassland, GA2) and improved pasture (GA1).

Brown trout, lamprey (*Lampetra* sp.), three-spined stickleback, minnow and stone loach were recorded via electro-fishing at site C6 (**Appendix A**). The site was of moderate value for salmonids and supported a low density of juvenile brown trout, despite low seasonal water levels and evident siltation pressures. Whilst spawning habitat was sparse and of moderate quality (at best), some good quality nursery and holding habitat was present. The semi-dry channel over bedrock and the bridge

aprons created impassable barriers to salmonid migration at low flows. The site was of good value as a *Lampetra* sp. nursery, with shallow (<5cm) organic-rich soft sediment deposits supporting a relatively high density (>c.10 per m^2) of particularly large ammocoetes (**Appendix A**). Lamprey spawning habitat (finer gravels) was present but limited in extent at exposed to siltation pressures. Despite some suitability for European eel (scoured banks, pool areas etc.), none were recorded. There was low suitability for white-clawed crayfish given a paucity of suitable refugia and burrowing habitat and none were recorded. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q4 (good status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and *Lampetra* sp., in addition to Q4 (good status) water quality, the aquatic ecological evaluation of site C3 was of **local importance (higher value)** (**Table 4.4**).

Plate 4.32 Representative image of site C6 on the Clogh River at Swan Bridge, August 2022 (upstream of bridge with near-dry bedrock bed visible in background)

4.1.32 Site C7 – Clogh River, Clogh Bridge

Site C7 was located on the Clogh River (15C03) at Clogh Bridge, approx. 4km downstream of site C6. The lowland depositing watercourse (FW2) suffered from very low seasonal flows at the time of survey, with only a slight flow and resulting habitat fragmentation and poor fluvial connectivity. The river had been modified in the vicinity of the bridge (upstream and downstream), with bank revetment, a weir and local straightening. The river averaged 6-8m wide and 0.2.-0.6m deep, with deeper areas present >50m upstream. The profile comprised near-stagnant glide and pool (ponding) with localised riffle areas associated with the weir aprons. The substrata were dominated by heavily

silted boulder and cobble with frequent interstitial mixed gravels. Areas of improved quality mixed gravels (mostly coarse) with lower siltation were present between macrophyte beds locally upstream of the bridge. Soft sediment deposits were frequent along channel margins given evident livestock poaching pressures. The weir apron(s) downstream of the bridge were cobbled. Given low flows and evident enrichment, the river was heavily vegetated upstream of the bridge. Non-native Canadian pondweed (*Elodea canadensis*) was abundant (30% cover) with occasional water starwort (*Callitriche* sp.) and curled pondweed (*Potamogeton crispus*) (indicator of enrichment). Branched bur reed was occasional instream. Whorled mint (*Mentha x verticillata*) was frequent along channel margins and on exposed mid-channel areas. Brooklime, narrow-fruited watercress, common duckweed, lesser pondweed (*Potamogeton pusillus*) and broad-leaved pondweed (*Potamogeton natans*) were also present but rare overall. Aquatic bryophytes were limited to very occasional *Fontinalis antipyretica* (locally frequent on cobbled bridge apron). The cover of filamentous algae was excessive (50% cover), indicating significant eutrophication. The open (grazed) riparian zones supported a narrow fringe of nettle, water forget-me-not (*Myosotis scorpiodes*), marsh marigold (*Caltha palustris*), great willowherb, thistles and water figwort (*Scrophularia umbrosa*) with an intermittent treeline of willow, sycamore, hawthorn, blackthorn and bramble along the west bank. The site was bordered by intensive agricultural pasture (GA1).

Brown trout, lamprey (*Lampetra* sp.), three-spined stickleback, minnow and perch (*Perca fluviatilis*) were recorded via electro-fishing at site C7 (**Appendix A**). The site was of high value to salmonids, supporting a high density of adult brown trout. The site was of most value as an adult holding habitat, with deeper glide areas and macrophyte beds providing valuable holding areas and thermal refugia in an otherwise open, shallow channel. The site was of poor value as a nursery habitat given poor seasonal flows (physically suitable but no juveniles recorded). Spawning habitat was present for both salmonids and lamprey but was limited in extent and exposed to siltation pressures. Atlantic salmon are also known from this site (IFI 2021 data). The site supported a low density of *Lampetra* sp. ammocoetes, despite apparent widespread suitability (e.g. silt deposits associated with rooting macrophyte areas). Despite some good suitability, no European eel or white-clawed crayfish were recorded. However, eDNA sampling at the site produced a positive result for white-clawed crayfish but also crayfish plague (**Table 4.1**). The weir located downstream of the bridge was a significant barrier to fish passage and was poorly passable to salmonids and impassable to lamprey at low and basal flows (i.e. 0.8m fall, no functional fish pass) (**Plate 4.34**). A regular otter spraint site (mixed age including fresh) was recorded under the eastern arch of the bridge (ITM 656347, 682442), with a second old site also recorded on the upstream side of the same arch (ITM 656349, 682447).

Biological water quality, based on Q-sampling, was calculated as **Q2-3 (poor status)** (**Appendix B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids (including Atlantic salmon) and Annex II *Lampetra* sp., the aquatic ecological evaluation of site E2 was of **local importance (higher value) (Table 4.4).**

Plate 4.33 Representative image of site C7 on the Clogh River at Clogh Bridge, August 2022 (facing upstream from bridge)

Plate 4.34 The historical weir at Clogh Bridge is a significant barrier to fish passage at low flows

4.1.33 Site D1 – Douglas River, Shanragh Bridge

Site D1 was located on the upper reaches of the Douglas River (14D03) at Shanragh Bridge, approx. 2.8km east of the proposed site boundary. The upland eroding watercourse (FW1) had been modified in the vicinity of the road crossing, with a cobbled bridge apron and bank modifications (revetment) present. However, the river was otherwise natural with an incised, often V-shaped valley and banks of up to 3m high. Bank scouring was frequent and indicative of spate characteristics. The river flowed over a moderate gradient and averaged 4-5m wide and 0.1-0.2m deep. As the river suffered from low seasonal flows at the time of survey, the 7-8m wide channel was often only partially wetted. The profile was of shallow glide and riffle over boulder cascades with frequent small pools (to a maximum depth of 0.5m). A larger pool was present immediately downstream of the cobbled bridge apron (**Plate 4.35**). The high-energy site featured substrata dominated by compacted angular cobble and boulder with mixed interstitial gravels. Beds of mixed gravels were also present at the tailing of pools. Siltation was low with no soft sediment accumulations present. Given the spate nature of the site and high shading, macrophytes were limited to occasional watercress in open areas near the bridge. Aquatic bryophyte coverage was low overall, though the moss *Rhynchostegium riparium* was locally frequent on the bridge apron. The red alga *Lemanea fluviatilis*[6] was present on stable cobble and boulder but rare. Filamentous algae were present (<1%), indicating enrichment. The river was heavily shaded by mature linear woodland (WN2) dominated by hazel with ash, holly, hawthorn and bramble and ivy scrub. The site was bordered by a residential property (BL3, GA2) and improved pasture (GA1).

Brown trout, three-spined stickleback and stone loach were recorded via electro-fishing at site D1 (**Appendix A**). Site D1 was considered of moderate value for salmonids. However, despite the presence of good quality nursery habitat and good quality (albeit localised) spawning substrata, the site supported only a very low density of brown trout. This was perhaps reflective of low seasonal flows (i.e. fish had perhaps dropped down the system). Frequent small pools provided some suitable holding habitat for smaller adults although the paucity of deeper areas reduced suitability for larger migratory salmonids (e.g. Atlantic salmon). The cobbled bridge apron, in addition to natural cascades, were barriers to fish passage at low flows (depth <0.05m). Despite some moderate suitability as a nursery habitat, no European eel were recorded. The upland eroding site was not suitable for lamprey or white-clawed crayfish. Furthermore, eDNA sampling at the site produced a negative result for white-clawed crayfish (**Table 4.1**). No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q4 (poor status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, in addition to Q4 (good status) water quality, the aquatic ecological evaluation of site D1 was of **local importance (higher value)** (**Table 4.4**).

[6] A macroalgal species typical of fast-flowing, non-alkaline waters (Weekes et al., 2014)

Plate 4.35 Representative image of site D1 on the upper reaches of the Douglas River, August 2022 (downstream of bridge)

4.2 White-clawed crayfish

Small white-clawed crayfish populations were recorded from sites B7 and B8 on the Owveg River. Whilst site B7 (Spink Bridge) supported a low number of adult crayfish, only a single juvenile was recorded from site B8.

Environmental DNA analysis detected white-clawed crayfish in the Owveg River (site B10) and Clogh River (C7) but not in the Stradbally River (A15) or Douglas River (D1) (see below section 4.3). No white-clawed crayfish remains were identified in field inspection of 12 no. otter spraint sites and a latrine at sites recorded across the Stradbally River, Cremorgan Stream and Clogh River.

4.3 eDNA analysis

Composite water samples collected from the from the Stradbally River (site A15), Owveg River (B10), Clogh River (C7) and Douglas River (D1) returned a negative result for freshwater pearl mussel eDNA, i.e. freshwater pearl mussel eDNA not present or was present below the limit of detection in a series of 12 qPCR replicates (0 positive replicates out of 12, respectively) (**Table 4.1** above; **Appendix C**). These results were considered as evidence of the species' absence at and or upstream of the sampling locations and support the absence of records for the species within the wider survey area.

White-clawed crayfish eDNA was detected at sites B10 on the Owveg River and C7 on the Clogh River (11 and 1 positive qPCR replicates out of 12, respectively) (**Table 4.1**; **Appendix C).** However, no crayfish eDNA was detected in the Stradbally River at Stradbally Bridge (site A15) or Douglas River (D1), i.e. eDNA not present or was present below the limit of detection in a series of 12 qPCR replicates**.**

Crayfish plague eDNA was detected in the Stradbally River at site A15 (11 positive qPCR replicates out of 12) and Clogh River at site C7 (1 positive qPCR replicates out of 12) (**Table 4.1**; **Appendix C).**

Table 4.1 eDNA results in the vicinity of the proposed Coolglass wind farm, Co. Laois (positive qPCR replicates out of 12 in parentheses)

Sample	Watercourse	Freshwater pearl mussel [7]	White-clawed crayfish	Crayfish plague
FK784	Stradbally River (site A15)	Negative (0/12)	Negative (0/12)	**Positive (11/12)**
FK772	Owveg River (site B10)	Negative (0/12)	**Positive (12/12)**	Negative (0/12)
FK785	Clogh River (site C7)	Negative (0/12)	**Positive (1/12)**	**Positive (1/12)**
FK774	Douglas River (site D1)	Negative (0/12)	Negative (0/12)	Negative (0/12)

4.4 Otter signs

Despite some good suitability at numerous survey locations, otter signs were only recorded at a total of four sites during the course of aquatic surveys undertaken in August-September 2022.

Regular otter spraint sites were recorded at sites A12 on the Cremorgan Stream (3 no. spraint sites), A14 and A15 on the Stradbally River (total of 7 no. sites) and site C7 on the Clogh River (2 no. sites). A latrine and couch (resting) area were also identified under Stradbally Bridge at site A15.

No breeding (holts) areas were identified in the 150m vicinity of the survey sites in August-September 2022.

4.5 Invasive aquatic species

The invasive macrophyte Canadian pondweed (*Elodea canadensis*) was recorded at site A15 on the Stradbally River at Stradbally Bridge and site C7 on the River Clogh at Clogh Bridge. The species is very widespread in Ireland and is listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011-2021 (S.I. 477/2011). It is considered a high-risk invasive species in Irish waters (O' Flynn et al., 2014).

Environmental DNA analysis detected the non-native pathogen crayfish plague (*Aphanomyces astaci*) in the Stradbally River and Clogh River (**Table 4.1**; see section 4.3 above).

[7] The historical range of freshwater pearl mussel is known from the River Nore between Poorman's Bridge to Ballyragget. The Stage 1 and 2 surveys completed for this report in addition to the eDNA sampling recorded no live mussels along c.4km of the Nore between Archer's Island and Ballyragget Bridge (Appendix D, Freshwater Pearl Mussel Survey).

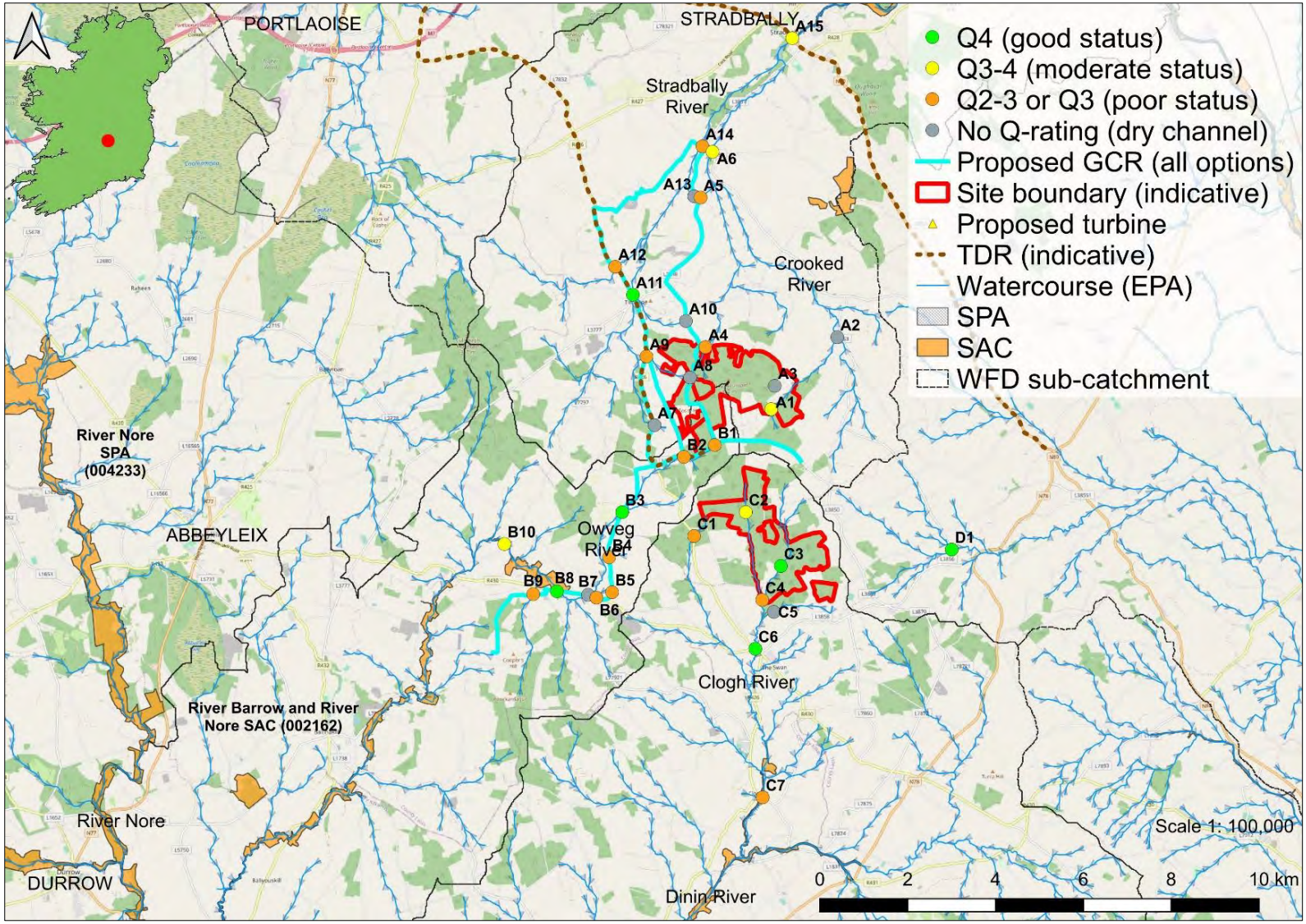

Figure 4.1 Overview of the biological water quality status in the vicinity of the proposed Coolglass wind farm project, Co. Laois, August 2022

4.6 Biological water quality (macro-invertebrates)

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the biological water quality samples taken from *n*=25 wetted riverine sites in August-September 2022 (**Appendix A**).

Sites on the Stradbally River (site A11), Owveg River (B3 & B8), Brennanshill River (C3), Clogh River (C6) and Douglas River (D1) achieved **Q4 (good status)** given the presence of fair numbers (5-10%) of EPA group A species such as the mayfly *Ecdyonurus* dispar and *Heptagenia* sp. (**Appendix B**). Low numbers of group A mayfly *Rithrogena semicolorata* (site A11 & D1) and the stonefly *Nemoura cinerea* (B8) were also present. Therefore, these 6 no. sites met the target good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC) (**Figure 4.1** above). Given low seasonal flows at the time of survey and resulting sub-optimal sampling conditions (Toner et al., 2005), the ratings for sites B3, C3 and C6 were considered tentative.

Sites on the Fallowbeg Upper Stream (A1), Crooked River (A6), Stradbally River (A15), Owveg River (B10) and Clogh River (C2) achieved **Q3-4 (moderate status)** water quality. This was given the low numbers (<5%) of group A species, namely the mayfly species *Ecdyonurus dispar* and *Heptagenia* sp. The sites also supported low numbers of group B species such as the mayfly *Alainites muticus* or the stonefly *Leuctra hippopus* (**Appendix B**).

The 14 no. remaining sites on the Honey Stream (A4), Honey Stream North (A5), Fossy Lower Stream (A9), Cremorgan Stream (A12), Stradbally River (A14), Scotland Stream (B1), Owveg River (B2), Cleanagh Stream (B4), Garrintaggart Stream (B5 & B6), Graiguenahown Stream (B9), Knocklead Stream (C1) and Clogh River (C4 & C7) achieved **Q2-3 or Q3 (poor status)**. This rating was based on an absence of group A species, an absence or low numbers of group B species (such as the caddis *Potamophylax cingulatus* and the stonefly *Leuctra hippopus*), and a dominance of group C species, particularly the mayflies *Baetis rhodani*, freshwater shrimp *Gammarus duebeni*, the non-native New Zealand mud snail (*Potamopyrgus antipodarum*) and biting midge larvae (non-*Chironomus* spp.) (**Appendix B**). Sites B1, B4, B9 and C7 were considered as **Q2-3 (poor status)** due to a higher proportion (but not dominance of) of group D (highly pollution tolerant) and group E (most pollution tolerant) species such as the snail *Ampullacaena balthica* and midge larvae (*Chironomus* spp.), respectively (**Appendix B**). Given low seasonal flows at most of these sites at the time of survey and resulting sub-optimal sampling conditions (Toner et al., 2005), the ratings for sites A4, A5, A9, A12, B1, B2, B4, B5, B6, B9, C1 and C7 were considered tentative.

4.7 Macrophytes and aquatic bryophytes

No rare or protected macrophytes or aquatic bryophytes were recorded at the *n*=33 survey sites.

An aquatic vegetation community representative of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation or aquatic mosses [3260]' (aka floating river vegetation) was present at site A15 on the Stradbally River at Stradbally Bridge. This site supported abundant water crowfoot (*Ranunculus* sp.) (40% cover) and a high cover of aquatic bryophytes such as *Fontinalis antipyretica*, in addition to other indicator species such as water starwort (*Callitriche* sp.) (Weekes et al., 2018; EC, 2013; Kelleher et al., 2011). The site

was located within the River Barrow and River Nore SAC (002162) for which floating river vegetation is listed as a qualifying interest (NPWS, 2011).

4.8 Aquatic ecological evaluation

An aquatic ecological evaluation of each survey site was based on the results of desktop review (i.e., presence of fish of conservation value), fisheries habitat assessments, the presence of protected or rare invertebrates (e.g. white-clawed crayfish, freshwater pearl mussel), environmental DNA analysis, the presence of rare macrophytes and aquatic bryophytes and or associated representations of Annex I habitats. Furthermore, biological water quality status also informed the aquatic evaluation (**Table 4.4** below).

Site A15 on the Stradbally River was evaluated as **international importance** given its location within the River Barrow and River Nore SAC (002162).

A total of 15 no. sites on the Crooked River (A6), Stradbally River (A11, A14), Cremorgan Stream (A12), Owveg River (B2, B3, B7, B8, B10), Clogh River (C2, C6 & C7), Brennanshill River (C3) and the Douglas River (D1) were evaluated as **local importance (higher value)** (**Table 4.4**). This evaluation was primarily due to the presence of salmonids, lamprey (*Lampetra* sp.) and or other aquatic species of high conservation value, such as white-clawed crayfish or otter.

The remaining 17 no. survey sites on the Fallowbeg Stream (A1), Crooked River (A2), unnamed stream (A3), Honey Stream (A4), Honey Stream North (A5), Aghoney Stream (A7), Fossy Lower Stream (A8 & A9), Timahoe Stream (A10), unnamed stream (A13), Scotland Stream (B1), Cleanagh Stream (B4), Garrintaggart Stream (B5 & B6), Graiguenahown Stream (B9), Knocklead Stream (C1) and the Moyadd Stream (C5) were evaluated as **local importance (lower value)** in terms of their aquatic ecology given an absence of species or habitats of high conservation value.

Table 4.2 Summary of fish species of higher conservation value recorded via electro-fishing per survey site in the vicinity of the proposed Coolglass wind farm, August-September 2022

Site	Watercourse	Atlantic salmon	*Lampetra* sp.	Brown trout	European eel	Other species
A1	Fallowbeg Upper Stream	No fish recorded – dry channel				
A2	Crooked River	No fish recorded – dry channel				
A3	Unnamed stream	No fish recorded – dry channel				
A4	Honey Stream	No fish recorded				
A5	Honey Stream North	No fish recorded				
A6	Crooked River		✓	✓		Three-spined stickleback, stone loach
A7	Aghoney Stream	No fish recorded				
A8	Fossy Lower Stream	No fish recorded – dry channel				
A9	Fossy Lower Stream	No fish recorded				

Site	Watercourse	Atlantic salmon	*Lampetra* sp.	Brown trout	European eel	Other species
A10	Timahoe Stream	No fish recorded – dry channel				
A11	Stradbally River		✓	✓		Three-spined stickleback, stone loach, minnow
A12	Cremorgan Stream					Three-spined stickleback
A13	Unnamed stream	No fish recorded				
A14	Stradbally River			✓		Three-spined stickleback, stone loach, minnow
A15	Stradbally River	✓	✓	✓		Three-spined stickleback, minnow
B1	Scotland Stream	No fish recorded				
B2	Owveg River			✓		
B3	Owveg River	✓		✓		Minnow, stone loach
B4	Cleanagh Stream	No fish recorded				
B5	Garrintaggart Stream	No fish recorded				
B6	Garrintaggart Stream	No fish recorded				
B7	Owveg River				✓	Minnow, stone loach
B8	Owveg River			✓	✓	Minnow, stone loach
B9	Graiguenahown Stream	No fish recorded				
B10	Owveg River	✓	✓	✓		Minnow, stone loach
C1	Knocklead Stream	No fish recorded				
C2	Clogh River			✓		
C3	Brennanshill River			✓		
C4	Clogh River		✓	✓		Three-spined stickleback, stone loach, minnow
C5	Moyadd Stream	No fish recorded – dry channel				
C6	Clogh River		✓	✓		Three-spined stickleback, stone loach, minnow
C7	Clogh River		✓	✓		Perch, minnow, three-spined stickleback
D1	Douglas River			✓		Three-spined stickleback, stone loach

Conservation value: Atlantic salmon (*Salmo salar*), brook lamprey (L*ampetra planeri*) and river lamprey (*Lampetra fluviatilis*) are listed under Annex II of the Habitats Directive [92/42/EEC]. Atlantic salmon and river lamprey are also listed under Annex V of the Habitats Directive [92/42/EEC]. 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 Inland Fisheries Acts 1959 to 2017, brown trout and coarse fish species have no legal protection in Ireland.

Table 4.3 Summary of aquatic species (excluding fish) and habitats of higher conservation value recorded in the vicinity of the proposed Coolglass wind farm, August 2022 (occurrence in **bold** for clarity)

Site	Watercourse	White-clawed crayfish	Freshwater pearl mussel	Otter signs[4]	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
A1	Fallowbeg Upper Stream	None recorded		None recorded	Not present	None recorded	None recorded	**Smooth newt populations recorded in small pools c.200m west of site**
A2	Crooked River	None recorded		None recorded	Not present	None recorded	None recorded	
A3	Unnamed stream	None recorded		None recorded	Not present	None recorded	None recorded	
A4	Honey Stream	None recorded		None recorded	Not present	None recorded	None recorded	
A5	Honey Stream North	None recorded		None recorded	Not present	None recorded	None recorded	
A6	Crooked River	None recorded		None recorded	Not present	None recorded	None recorded	
A7	Aghoney Stream	None recorded		None recorded	Not present	None recorded	None recorded	
A8	Fossy Lower Stream	None recorded		None recorded	Not present	None recorded	None recorded	
A9	Fossy Lower Stream	None recorded		None recorded	Not present	None recorded	None recorded	
A10	Timahoe Stream	None recorded		None recorded	Not present	None recorded	None recorded	
A11	Stradbally River	None recorded		None recorded	Not present	None recorded	None recorded	
A12	Cremorgan Stream	None recorded		**3 no. regular spraint sites**	Not present	None recorded	None recorded	
A13	Unnamed stream	None recorded		None recorded	Not present	None recorded	None recorded	
A14	Stradbally River	None recorded		**Regular spraint site**	Not present	None recorded	None recorded	
A15	Stradbally River	None recorded; negative eDNA result at site	**Negative eDNA result at site, no records in catchment**	**Couch & latrine identified with 6 no. regular spraint sites**	**Floating river vegetation [3260] present**	None recorded	None recorded	

Site	Watercourse	White-clawed crayfish	Freshwater pearl mussel	Otter signs[4]	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
B1	Scotland Stream	None recorded		None recorded	Not present	None recorded	None recorded	
B2	Owveg River	None recorded		None recorded	Not present	None recorded	None recorded	
B3	Owveg River	None recorded		None recorded	Not present	None recorded	None recorded	
B4	Cleanagh Stream	None recorded		None recorded	Not present	None recorded	None recorded	
B5	Garrintaggart Stream	None recorded		None recorded	Not present	None recorded	None recorded	
B6	Garrintaggart Stream	None recorded		None recorded	Not present	None recorded	None recorded	
B7	Owveg River	**Adults recorded**		None recorded	Not present	None recorded	None recorded	
B8	Owveg River	**Single juvenile recorded**		None recorded	Not present	None recorded	None recorded	
B9	Graiguenahown Stream	None recorded		None recorded	Not present	None recorded	None recorded	
B10	Owveg River	**None recorded but positive eDNA result at site**	**Negative eDNA result at site, no records in catchment**	None recorded	Not present	None recorded	None recorded	
C1	Knocklead Stream	None recorded		None recorded	Not present	None recorded	None recorded	
C2	Clogh River	None recorded		None recorded	Not present	None recorded	None recorded	
C3	Brennanshill River	None recorded		None recorded	Not present	None recorded	None recorded	
C4	Clogh River	None recorded		**Regular spraint site**	Not present	None recorded	None recorded	
C5	Moyadd Stream	None recorded		**Regular spraint site**	Not present	None recorded	None recorded	
C6	Clogh River	None recorded		None recorded	Not present	None recorded	None recorded	
C7	Clogh River	**None recorded but positive eDNA result at site**	**Negative eDNA result at site, no records in catchment**	**3 no. regular spraint sites**	Not present	None recorded	None recorded	

Site	Watercourse	White-clawed crayfish	Freshwater pearl mussel	Otter signs[4]	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
D1	Douglas River	None recorded; negative eDNA result at site	**Negative eDNA result at site, no records in catchment**	None recorded	Not present	None recorded	None recorded	

*** Conservation value:** White-clawed crayfish (*Austropotamobius pallipes*), freshwater pearl mussel (*Margaritifera margaritifera*) and Eurasian otter (*Lutra lutra*) are listed under Annex II and Annex V of the Directive on the Conservation of Natural Habitats of Wild Fauna and Flora (92/43/EEC) ('EU Habitats Directive') and all are protected under the Irish Wildlife Acts 1976-2021. White-clawed crayfish (Füreder et al., 2010) and freshwater pearl mussel (Moorkens et al., 2017) are also both listed as 'Endangered' according to the IUCN Red List. The European Union (Invasive Alien Species) (Freshwater Crayfish) Regulations 2018 (SI 354/2018) affords further protection to native white-clawed crayfish by prohibiting the introduction and spread of five no. invasive 'Union concern' crayfish species listed under EU Regulation 1143/2014. Smooth newt (*Lissotriton vulgaris*) are protected under the Irish Wildlife Acts 1976-2021.

[4] Otter signs within 150m of the survey site

Table 4.4 Aquatic ecological evaluation summary of the Coolglass wind farm survey sites according to NRA (2009) criteria

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
A1	Fallowbeg Upper Stream	14F06	Local importance (lower value)	Upper reaches of natural, high gradient spate channel with poor fisheries value; no fish recorded via electro-fishing; **Q3-4** (moderate status) water quality; no aquatic species or habitats of high conservation value
A2	Crooked River	14C02	Local importance (lower value)	Upper reaches of modified lowland ephemeral channel with no fisheries & aquatic value (dry at time of survey); no electro-fishing or biological water quality sample possible; no aquatic species or habitats of high conservation value
A3	Unnamed stream	n/a	Local importance (lower value)	Upper reaches of high gradient, modified ephemeral channel with no fisheries & aquatic value (dry at time of survey); no electro-fishing or biological water quality sample possible; no aquatic species or habitats of high conservation value
A4	Honey Stream	14H01	Local importance (lower value)	Upper reaches of semi-dry, modified channel with poor flows and fisheries value; no fish recorded via electro-fishing; **Q3** (poor status) water quality (tentative rating); no aquatic species or habitats of high conservation value
A5	Honey Stream North	14H21	Local importance (lower value)	Heavily modified, heavily vegetated ephemeral channel with imperceptible flows, of poor fisheries & aquatic value; **Q3** (poor status) water quality (tentative rating); no aquatic species or habitats of high conservation value
A6	Crooked River	14C02	**Local importance (higher value)**	Historically modified, heavily silted, heavily enriched lowland watercourse of good value to salmonids & moderate value to lamprey; brown trout, stone loach, three-spined stickleback & low density of *Lampetra* sp. recorded via electro-fishing; regular otter spraint site under bridge; **Q3-4** (moderate status) water quality
A7	Aghoney Stream	14A08	Local importance (lower value)	Upper reaches of natural ephemeral spate channel with no fisheries & aquatic value (dry at time of survey); no electro-fishing or biological water quality sample possible; no aquatic species or habitats of high conservation value
A8	Fossy Lower Stream	14F10	Local importance (lower value)	Upper reaches of modified, high gradient ephemeral spate channel with no fisheries & aquatic value (dry at time of survey); no electro-fishing or biological water quality sample possible; no aquatic species or habitats of high conservation value
A9	Fossy Lower Stream	14F10	Local importance (lower value)	Historically modified ephemeral spate channel with stagnant pools, of poor fisheries & aquatic value; **Q3** (poor status) water quality (tentative rating); no aquatic species or habitats of high conservation value
A10	Timahoe Stream	14T09	Local importance (lower value)	Upper reaches of heavily modified ephemeral channel with no fisheries & aquatic value (dry at time of survey); no electro-fishing or biological water quality sample possible; no aquatic species or habitats of high conservation value
A11	Stradbally River	14S02	**Local importance (higher value)**	Historically modified, heavily vegetated lowland watercourse of moderate value to salmonids & lamprey; brown trout, stone loach, minnow, three-spined stickleback & low density of *Lampetra* sp. recorded via electro-fishing; **Q4** (good status) water quality

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
A12	Cremorgan Stream	14C24	**Local importance (higher value)**	Semi-natural, high-energy calcareous but ephemeral river that was mostly dry at the time of survey; high physical suitability for salmonids (but none recorded at time of survey); three-spined stickleback recorded via electro-fishing from remnant pools; 3 no. otter spraint sites recorded; **Q3** (poor status) water quality (tentative rating)
A13	Unnamed stream	n/a	Local importance (lower value)	Heavily modified, heavily vegetated ephemeral channel with no fisheries & aquatic value (dry at time of survey); no electro-fishing or biological water quality sample possible; no aquatic species or habitats of high conservation value
A14	Stradbally River	14S02	**Local importance (higher value)**	Semi-natural, heavily vegetated calcareous lowland depositing river with very low water levels at the time of survey; of moderate value to salmonids; brown trout, stone loach, minnow & three-spined stickleback recorded via electro-fishing; regular otter spraint site recorded under bridge; **Q3** (poor status) water quality
A15*	Stradbally River	14S02	**International importance**	Located within the River Barrow and River Nore SAC (002162); heavily modified, heavily enriched lowland depositing river with low summer flows but high aquatic value; Atlantic salmon, brown trout, *Lampetra* sp., minnow & three-spined stickleback recorded via electro-fishing; Annex I floating river vegetation [3260] present; 6 no. otter spraints sites, latrine & couch (resting area) recorded; **Q3-4** (moderate status) water quality
B1	Scotland Stream	15S06	Local importance (lower value)	Upper reaches of semi-dry, semi-natural ephemeral spate channel with poor flows and fisheries value; no fish recorded via electro-fishing; **Q2-3** (poor status) water quality (tentative rating); no aquatic species or habitats of high conservation value
B2	Owveg River	15O01	**Local importance (higher value)**	Upper reaches of historically modified spate channel with very low water levels at the time of survey; brown trout recorded via electro-fishing; **Q3** (poor status) water quality (tentative rating)
B3	Owveg River	15O01	**Local importance (higher value)**	Upper reaches of semi-natural spate channel with very low water levels at the time of survey but of moderate value to salmonids; Atlantic salmon, brown trout, stone loach & minnow recorded via electro-fishing; **Q4** (good status) water quality (tentative rating)
B4	Cleanagh Stream	15C58	Local importance (lower value)	Small ephemeral spate channel with stagnant pools, of poor fisheries & aquatic value; no fish recorded via electro-fishing; **Q2-3** (poor status) water quality (tentative rating); no aquatic species or habitats of high conservation value
B5	Garrintaggart Stream	15G30	Local importance (lower value)	Upper reaches of modified semi-dry, spate channel with poor flows and fisheries value (likely ephemeral); no fish recorded via electro-fishing; **Q3** (poor status) water quality (tentative rating); no aquatic species or habitats of high conservation value
B6	Garrintaggart Stream	15G30	Local importance (lower value)	Semi-natural, high gradient spate channel with very low water levels at the time of survey; no fish recorded via electro-fishing; **Q3** (poor status) water quality (tentative rating); no aquatic species or habitats of high conservation value

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
B7	Owveg River	15O01	**Local importance (higher value)**	Large, moderate gradient, karstic ephemeral spate channel known to dry out seasonally; single large stagnant pool of water remaining (dry elsewhere) but of high aquatic value; European eel, minnow & stone loach recorded via electro-fishing; white-clawed crayfish recorded via hand searching; no biological water quality sample possible;
B8	Owveg River	15O01	**Local importance (higher value)**	Semi-natural, enriched, calcareous lowland depositing river with low water levels at the time of survey. The site was considered of moderate fisheries value; brown trout, European eel, minnow & stone loach recorded via electro-fishing; white-clawed crayfish recorded; **Q4** (good status) water quality
B9	Graiguenahown Stream	15G29	Local importance (lower value)	Historically modified channel with poor flows and fisheries value; no fish recorded via electro-fishing; **Q2-3** (poor status) water quality (tentative rating); no aquatic species or habitats of high conservation value
B10*	Owveg River	15O01	**Local importance (higher value)**	Semi-natural, calcareous, enriched lowland depositing river with low water levels at the time of survey but of good fisheries value; Atlantic salmon, brown trout, *Lampetra* sp., minnow & stone loach recorded via electro-fishing; white-clawed crayfish recorded (eDNA only); **Q3-4** (moderate status) water quality
C1	Knocklead Stream	15K21	Local importance (lower value)	Upper reaches of high gradient, semi-natural spate channel with very low water levels at the time of survey (likely ephemeral); no fish recorded via electro-fishing; **Q3** (poor status) water quality (tentative rating); no aquatic species or habitats of high conservation value
C2	Clogh River	15C03	**Local importance (higher value)**	Uppermost reaches of upland eroding river with low flows at the time of survey but of some lower value for salmonids; brown trout recorded via electro-fishing; **Q3-4** (moderate status) water quality
C3	Brennanshill River	15B51	**Local importance (higher value)**	Uppermost reaches of small, semi-natural upland eroding river with low flows at the time of survey but of some lower value for salmonids; brown trout recorded via electro-fishing; **Q4** (good status) water quality (tentative rating)
C4	Clogh River	15C03	**Local importance (higher value)**	Upland eroding spate channel with high siltation & very low water levels at the time of survey that was considered of moderate fisheries value; brown trout, *Lampetra* sp., three-spined stickleback, minnow & stone loach recorded via electro-fishing; **Q3** (poor status) water quality
C5	Moyadd Stream	15M22	Local importance (lower value)	Small upland eroding ephemeral channel with no fisheries & aquatic value (dry at time of survey); no electro-fishing or biological water quality sample possible; no aquatic species or habitats of high conservation value
C6	Clogh River	15C03	**Local importance (higher value)**	Semi-natural upland eroding spate river with very low water levels at the time of survey but of high fisheries value; brown trout, minnow, stone loach & high density of *Lampetra* sp. recorded via electro-fishing; **Q4** (good status) water quality
C7	Clogh River	15C03	**Local importance (higher value)**	Historically modified, semi-natural, enriched lowland depositing channel with very low water levels at the time of survey but of high fisheries value; brown trout,

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
				Lampetra sp., three-spined stickleback, minnow & perch recorded via electro-fishing; Atlantic salmon also known from site (IFI data); white-clawed crayfish recorded (eDNA only); 2 no. otter spraints sites recorded; **Q2-3** (poor status) water quality (tentative rating)
D1	Douglas River	15D03	**Local importance (higher value)**	Upper reaches of natural, high gradient upland eroding spate channel with low water levels at the time of survey; brown trout, three-spined stickleback & stone loach recorded via electro-fishing; **Q4** (good status) water quality

Conservation value: Atlantic salmon (*Salmo salar*), sea lamprey (*Petromyzon marinus*), brook lamprey (La*mpetra 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, freshwater pearl mussel, white-clawed crayfish and otter are also listed under Annex V of the Habitats Directive [92/42/EEC]. Freshwater pearl mussel and 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 Inland Fisheries Acts 1959 to 2017, brown trout and coarse fish species have no legal protection in Ireland.

5. Discussion

5.1 Most valuable areas for aquatic ecology

Site A15 on the Stradbally River was evaluated as **international importance** given its location within the River Barrow and River Nore SAC (002162). The site also supported Atlantic salmon, lamprey (*Lampetra* sp.), the Annex I habitat 'Water courses of plain to montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses [3260]' and highly regular otter activity, including a legally protected couch (resting area) for otter. The above species and habitats are also listed as qualifying interests for this European site.

A total of 15 no. sites on the Crooked River (A6), Stradbally River (A11, A14), Cremorgan Stream (A12), Owveg River (B2, B3, B7, B8, B10), Clogh River (C2, C6 & C7), Brennanshill River (C3) and the Douglas River (D1) were evaluated as **local importance (higher value)** (**Table 4.4**). This evaluation was primarily due to the presence of salmonids (*n*=13 sites) and or lamprey (*Lampetra* sp.) (*n*=7 sites). Other aquatic species of high conservation value, such as white-clawed crayfish (B7, B8, B10, C7) or otter (A12, A14, A15, C7) were also present at certain sites (**Table 4.2. 4.3**). Sites A11, B3, B8, C3, C6 and D1 also achieved Q4 (good status) water quality (**Appendix B**).

The remaining 17 no. survey sites on the Fallowbeg Stream (A1), Crooked River (A2), unnamed stream (A3), Honey Stream (A4), Honey Stream North (A5), Aghoney Stream (A7), Fossy Lower Stream (A8 & A9), Timahoe Stream (A10), unnamed stream (A13), Scotland Stream (B1), Cleanagh Stream (B4), Garrintaggart Stream (B5 & B6), Graiguenahown Stream (B9), Knocklead Stream (C1) and the Moyadd Stream (C5) were evaluated as **local importance (lower value)** in terms of their aquatic ecology given an absence of aquatic species or habitats of high conservation value and **less than Q4 (good status)** water quality. Sites A1, A2, A3, A8, A10 and C5 were of **local importance (lower value)** given an absence of aquatic habitats at the time of survey (i.e. dry, ephemeral channels).

5.1.1 Fish species of high conservation value

Apart from sites A12 on the Cremorgan Stream and B7 on the Owveg River (semi-dry spate channels), salmonids were recorded at all 15 no. sites supporting fish during the survey (**Table 4.2**). This was despite widespread low water levels in addition to siltation, eutrophication and or hydromorphological pressures. Atlantic salmon were present (in low densities) at 3 no. sites only, on the Stradbally River (A15) and Owveg River (B3 & B10). The Stradbally River and Crooked River, draining to the north of the proposed project, supported the highest densities of Atlantic salmon and brown trout, respectively (**Appendix A**).

Lamprey ammocoetes (*Lampetra* sp.) were recorded from 7 no. sites (**Table 4.2**), typically in low densities due to sub-optimal and or limited nursery habitat. Particularly high densities were present at sites C4 (14 per m^2) and C6 (13 per m^2) on the Clogh River. Low numbers of early-stage transformers (no speciation possible) were also recorded from sites on the Crooked River (A6) and Clogh River (C4 & C6). The siltation pressures and low summer flows observed across the study area reduced the quality of lamprey habitat, in addition to the often, high energy/spate characteristics of the survey watercourses (**Appendix A**).

Despite widespread suitability, European eel were only recorded in low densities from sites B7 and B8 on the Owveg River (**Table 4.2; Appendix A**). European eel are Red-listed in Ireland (King et al., 2011) and are classed as 'critically endangered' on a global scale (Pike et al., 2020). As eel occurrence decreases significantly with increasing distance from the sea (Degerman et al., 2019), the paucity of eel observed in the Nore_SC_010, Barrrow_SC_050 and Dinin (North)_SC_010 river sub-catchments can be partly explained by the distance between the survey area and marine habitats (Chadwick et al., 2007) (>100-140km instream distance). The absence of eel from many suitable sites also likely reflects the high number of barriers to fish passage present in the Nore and Barrow catchments as well as widespread low summer flow conditions (**Appendix A**).

5.1.2 Otter

Despite some good suitability at numerous survey locations, otter signs were only recorded at a total of four sites on the Cremorgan Stream (A12), Stradbally River (A14 & A15) and Clogh River (C7). This paucity of signs was considered to mainly reflect the influence of low (summer) water levels and flows on the health and distribution of fish populations, the key prey resource of otter (Krawczyk et al., 2016; Ruiz-Olmo & Jiménez, 2009). Site A15 on the Stradbally River at Stradbally Bridge was highly important for otter, supporting a total of 7 no. spraint sites, a latrine and (underneath the bridge) a couch (resting) area. This site supported a wide range of fish species and size classes during the survey period, despite low summer flows. Otters are food-limited and prey availability is a crucial factor in determining mortality, breeding success and the status of local populations (Sittenhaler et al., 2019; Ruiz-Olmo et al., 2002). No breeding (holt) areas were identified in the vicinity of the survey sites.

5.1.3 Freshwater pearl mussel

No freshwater pearl mussel eDNA was detected in the Stradbally River (site A15), Owveg River (B10), Clogh River (C7) or Douglas River (D1) samples collected in September 2022 (0 positive qPCR replicates out of 12, respectively) (**Table 4.1**; **Appendix C**). Suitability was poor or absent throughout the survey sites (heavy siltation, enrichment, historical modifications, spate channels, ephemeral channels etc.). These results were in keeping with the known distribution of this species within the wider survey area, i.e. only known from the River Nore (**Figure 3.1**).

However, whilst the historical range of the species in the River Nore extends from Poorman's Bridge to Ballyragget, stage 1 and 2 surveys completed for this report recorded no live mussels along c.4km of the Nore between Archer's Island and Ballyragget Bridge (**Appendix D**). This survey has reaffirmed that no live freshwater pearl mussels have been found in the River Nore downstream of the River Erkina confluence (near Durrow) since 2007 (**Appendix D**).

5.1.4 White-clawed crayfish & crayfish plague

Small, white-clawed crayfish populations were recorded from sites B7 and B8 on the Owveg River. Whilst site B7 (Spink Bridge) supported a low number of adult crayfish, only a single juvenile was recorded from site B8. Whilst not recorded via hand searching of instream refugia or sweep netting at the sites in question, white-clawed crayfish eDNA was detected at sites B10 on the Owveg River and C7 on the Clogh River (11 and 1 positive qPCR replicates out of 12, respectively) (**Table 4.1**; **Appendix C).**

There were no known records for crayfish in the Clogh River prior to this survey (NPWS data). The weak eDNA signature at site C7, coupled with the failure to record live crayfish elsewhere on the river and an absence of crayfish remains in otter spraint, would suggest the presence of a small, cryptic crayfish population within the Clogh River and or its tributaries. The detection of crayfish plague at site C7 is likely to jeopardise any such populations within the system.

In contrast to the known distribution of the species, eDNA analysis did not detect white-clawed crayfish at and or upstream of site A15 on the Stradbally River. Furthermore, no white-clawed crayfish remains were identified in field inspection of 12 no. otter spraint sites and a latrine at sites recorded across the Stradbally River or its tributary the Cremorgan Stream. Whilst highly sensitive and often detectable over long distances instream (including in crayfish; Chucholl et al., 2021), the detection of environmental DNA from an upstream (riverine) population depends on downstream transport of genetic material. The low summer flows present on the Stradbally at the time of survey may have limited the flow of eDNA and thus influenced detection rates of crayfish (i.e. DNA may have temporarily settled out of suspension; Buxton et al., 2018). The patchy distribution and often low abundances of white-clawed crayfish in a given river system may also strongly influence eDNA detection probability (Sint et al., 2022).

However, despite an apparent absence of hosts, crayfish plague was detected on the Stradbally River (A15) (**Table 4.1; Appendix C**). Crayfish plague is listed at one of the world's 100 worst invasive species (GISD, 2022; Lowe et al., 2000) and is becoming highly prevalent across Ireland. The first outbreaks of the pathogen in the wider Barrow catchment occurred in 2017, resulting in widespread mortality (NPWS, 2017). Environmental DNA monitoring (aside from this report) has continued to detect and confirm the spread of crayfish plague in the Barrow catchment since (Swords et al., 2021). *Aphanomyces astaci* is considered an obligate crayfish parasite not capable of surviving for a long period outside a crayfish host (Strand et al., 2011; Söderhall & Cerenius, 1999). Thus, the detection of crayfish plague in the Stradbally River exemplifies the recent rapid spread of the plague and likely extirpation of the historical crayfish population known from the river (pers. obs.). Our results highlight the importance of a multifaceted approach to crayfish surveying, using a combination of crayfish surveys, inspection of otter spraint and eDNA to improve detection rates.

5.1.5 Macro-invertebrates & biological water quality

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the biological water quality samples taken from *n*=25 riverine sites in August-September 2022 (**Appendix B**).

Only a total of 6 no. sites on the Stradbally River (site A11), Owveg River (B3 & B8), Brennanshill River (C3), Clogh River (C6) and Douglas River (D1) achieved **Q4 (good status)** water quality and therefore met the target good status (≥Q4) water quality requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC) (**Figure 4.1**).

The biological water quality of the survey area was evidently impacted by low water levels and poor summer flows in numerous watercourses at the time of sampling. The Q-rating for a total of 15 no. sites were considered tentative (**Appendix B**) given poor flows and or an absence of suitable riffle areas for sampling (as per Toner et al., 2005). Impacts from agriculture (e.g. eutrophication and

siltation) are known to be significant threats to water quality in the wider survey area (EPA 2018a, 2018b, 2019) and this was supported by observations made during the aquatic surveys.

5.2 Aquatic ecology summary

The majority of the surveyed watercourses in the vicinity of the study area suffered from very low (summer) water levels and flows during August-September 2022, resulting in reduced habitat and water quality, often poor fluvial connectivity, habitat fragmentation and fish passage issues. Low summer flows are common on certain rivers such as the upper Owveg River (karstic), Cremorgan Stream and Clogh River. Approximately half (15 no.) sites suffered from very low water levels or were completely dry at the time of survey. Low summer flows, in addition to considerable agricultural (eutrophication, siltation) pressures, are significant threats to aquatic ecology in the vicinity of the proposed Coolglass wind farm.

Nevertheless, salmonids and lamprey (*Lampetra* sp.) populations were widespread in the survey area. While brown tout were widespread, Atlantic salmon were present only in the Stradbally River and Owveg River while European eel were only recorded from the Owveg River. Otter signs were recorded on the Cremorgan Stream, Stradbally River and Clogh River only. The paucity of signs would reflect the lower order small size of many of the watercourses with otter presence negatively corelated with smaller stream width and altitude (i.e. otter favour larger more productive riverine sites). White-clawed crayfish were recorded, through a combination of traditional and eDNA methodologies, on the Owveg River and Clogh River. Annex I floating river vegetation [3260] was recorded at a single site only (site 15, Stradbally River).

Sites on the Stradbally River (site A11), Owveg River (B3 & B8), Brennanshill River (C3), Clogh River (C6) and Douglas River (D1) were the only ones to achieve **Q4 (good status)** and meet the target good status (≥Q4) biological water quality requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC). The limited number of good status sites was due to not only low summer flows but also widespread hydromorphological and agricultural pressures within the catchments adjoining the proposed project.

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7. Appendix A – fisheries assessment report

Please see accompanying fisheries assessment report

8. Appendix B – Q-sample results (biological water quality)

Table 8.1 Macro-invertebrate Q-sampling results for sites A1, A4, A5, A6, A9, A11, A12, A14, A15, B1B2, B3 & B4, August-September 2022

Group	Family	Species	A1	A4	A5	A6	A9	A11	A12	A14	A15	B1	B2	B3	B4	EPA class
Ephemeroptera	Heptageniidae	*Ecdyonurus dispar*				6		11			1		3	4		A
Ephemeroptera	Heptageniidae	*Heptagenia* sp.	1													A
Ephemeroptera	Heptageniidae	*Rhithrogena semicolorata*						1								A
Ephemeroptera	Baetidae	*Alainites muticus*	2			21	1			1	2					B
Plecoptera	Leuctridae	*Leuctra hippopus*	1					2					4			B
Trichoptera	Cased caddis pupa	sp. indet.											1	2		B
Trichoptera	Glossosomatidae	*Agapetus fuscipes*			2				25							B
Trichoptera	Limnephilidae	*Halesus radiatus*								4				3		B
Trichoptera	Limnephilidae	*Potamophylax cingulatus*							3							B
Trichoptera	Sericostomatidae	*Sericostoma personatum*			3	1		3		4						B
Ephemeroptera	Ephemerellidae	*Serratella ignita*				31		1			3		1			C
Ephemeroptera	Baetidae	*Baetis rhodani*	3	12	7	104		14		22	12		11	1	3	C
Ephemeroptera	Caenidae	*Caenis rivulorum*												1		C
Trichoptera	Hydropsychidae	*Hydropsyche instabilis*	3			1		4								C
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*						5								C
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*	5										1		1	C
Trichoptera	Polycentropodidae	*Polycentropus kingi*												4		C
Trichoptera	Polycentropodidae	*Polycentropus flavomaculatus*				1								4		C
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*				1										C
Gastropoda	Planorbidae	*Ancylus fluviatilis*	2				3						38		5	C
Gastropoda	Tateidae	*Potamopyrgus antipodarum*				12		35		8	1		63		7	C
Gastropoda	Lymnaeidae	*Lymnaea stagnalis*								2						C
Gastropoda	Bithyniidae	*Bithynia tentaculata*								8						C
Crustacea	Gammaridae	*Gammarus duebeni*	31	24	12	102	2	27	3	1	112	13	1			C

Group	Family	Species	A1	A4	A5	A6	A9	A11	A12	A14	A15	B1	B2	B3	B4	EPA class
Coleoptera	Dytiscidae	Dytiscidae larva				1										C
Coleoptera	Dytiscidae	*Hydroporus palustris*											1			C
Coleoptera	Dytiscidae	*Ilybius fuliginosus*											1			C
Coleoptera	Dytiscidae	*Nebrioporus depressus*								12						C
Coleoptera	Dytiscidae	*Stictotarsus duodecimpustulatus*											1			C
Coleoptera	Elmidae	*Brychius elevatus*				1				1						C
Coleoptera	Elmidae	*Elmis aenea*	1	2	5	5		18		5			7			C
Coleoptera	Elmidae	*Limnius volckmari*			1	2		5								C
Coleoptera	Gyrinidae	*Gyrinus substriatus*		2				3								C
Coleoptera	Gyrinidae	*Orectochilus villosus*						1								C
Coleoptera	Halipliidae	*Haliplus ruficollis group*						1								C
Diptera	Chironomidae	non-*Chironomus* spp.	10	1		1	9	3			21	8	2	1	17	C
Diptera	Culicidae	sp. indet.											4			C
Diptera	Dixidae	sp. indet.						1							1	C
Diptera	Muscidae	sp. indet.									1					C
Diptera	Pediciidae	*Dicranota* sp.				1		3								C
Diptera	Simuliidae	sp. indet.	3	3				15			20					C
Hemiptera	Corixidae	*Corixa punctata*								1						C
Hemiptera	Gerridae	*Gerris* sp.		1				2		1		12		7	14	C
Hemiptera	Notonectidae	*Notonecta obliqua*											1			C
Hemiptera	Veliidae	*Velia caprai*					1					3			2	C
Hemiptera	Veliidae	Veliidae nymph					2		2				1		2	C
Platyhelminthes	Planariidae	*Polycelis* sp.										2				C
Arachnida	Hydrachnidiae	sp. indet.					2	1	1		1					C
Gastropoda	Lymnaeidae	*Ampullacaena balthica*						15		27						D
Crustacea	Asellidae	*Asellus aquaticus*			6	1		1	1	1						D

Group	Family	Species	A1	A4	A5	A6	A9	A11	A12	A14	A15	B1	B2	B3	B4	EPA class
Hirudinidae	Glossiphoniidae	sp. indet.				1				1	1					D
Diptera	Chironomidae	*Chironomus* spp.	13					1				12		11	10	E
Abundance			**75**	**45**	**36**	**293**	**20**	**173**	**35**	**99**	**175**	**50**	**141**	**38**	**62**	
Q-rating			Q3-4	Q3*	Q3*	Q3-4	Q3*	Q4	Q3*	Q3	Q3-4	Q2-3*	Q3*	Q4*	Q2-3*	
WFD status			Mod	Poor	Poor	Mod	Poor	Good	Poor	Poor	Mod	Poor	Poor	Good	Poor	

* tentative Q-rating due to poor flows and or absence of suitable riffle areas for sampling (Toner et al., 2005)

Table 8.2 Macro-invertebrate Q-sampling results for sites B5, B6. B7, B8, B9, B10, C1, C2, C3, C4, C6, C7 &D1, August-September 2022

Group	Family	Species	B5	B6	B7 †	B8	B9	B10	C1	C2	C3	C4	C6	C7	D1	EPA class
Ephemeroptera	Heptageniidae	*Ecdyonurus dispar*				25		12					4		1	A
Ephemeroptera	Heptageniidae	*Heptagenia* sp.								2	6				7	A
Ephemeroptera	Heptageniidae	*Rhithrogena semicolorata*													1	A
Plecoptera	Nemouridae	*Nemoura cinerea*				1										A
Ephemeroptera	Baetidae	*Alainites muticus*	4				2	4		1	3	1				B
Plecoptera	Leuctridae	*Leuctra hippopus*	1			15	12	8		2	4	1	1		1	B
Trichoptera	Cased caddis pupa	sp. indet.	1	5						9	3		2	9		B
Trichoptera	Glossosomatidae	*Agapetus fuscipes*											2			B
Trichoptera	Leptoceridae	*Mystacides* sp.						1								B
Trichoptera	Limnephilidae	*Potamophylax cingulatus*		10	2				3	1						B
Trichoptera	Sericostomatidae	*Sericostoma personatum*		5		1						5			1	B
Ephemeroptera	Ephemerellidae	*Serratella ignita*				14		33							8	C
Ephemeroptera	Baetidae	*Baetis rhodani*				43	5	67	1		3	3		3	15	C
Ephemeroptera	Caenidae	*Caenis rivulorum*						1						3		C
Trichoptera	Hydropsychidae	*Hydropsyche instabilis*				6	6	2			1					C
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*											1			C

Group	Family	Species	B5	B6	B7 †	B8	B9	B10	C1	C2	C3	C4	C6	C7	D1	EPA class
Trichoptera	Philopotamidae	*Philopotamus montanus*													1	C
Trichoptera	Philopotamidae	*Wormaldia occipitalis*													1	C
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*		1			4		2	2	2				2	C
Trichoptera	Polycentropodidae	*Polycentropus kingi*				1		2		1			4	5		C
Trichoptera	Polycentropodidae	*Polycentropus flavomaculatus*						1								C
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*				4									5	C
Gastropoda	Planorbidae	*Ancylus fluviatilis*		15					3	26	3	34	2	1		C
Gastropoda	Tateidae	*Potamopyrgus antipodarum*		56		1		37						51		C
Crustacea	Gammaridae	*Gammarus duebeni*	9			5	1	2	11			1		5	6	C
Coleoptera	Dytiscidae	*Dytiscus marginalis*			1											C
Coleoptera	Dytiscidae	Dytiscidae larva		6			2				2			1		C
Coleoptera	Dytiscidae	*Hydroporus tessellatus*									1					C
Coleoptera	Dytiscidae	*Ilybius ater*					1		1							C
Coleoptera	Dytiscidae	*Nebrioporus depressus*			22			38					1			C
Coleoptera	Dytiscidae	*Oreodytes sanmarkii*										4				C
Coleoptera	Dytiscidae	*Oreodytes septetrionelis*						5								C
Coleoptera	Dytiscidae	*Stictotarsus duodecimpustulatus*					1						2	1		C
Coleoptera	Elmidae	*Brychius elevatus*				1		18								C
Coleoptera	Elmidae	*Elmis aenea*		1		3		3		1			5		4	C
Coleoptera	Elmidae	*Limnius volckmari*				2		2				1				C
Coleoptera	Gyrinidae	*Gyrinus substriatus*			9											C
Coleoptera	Halipliidae	*Haliplus lineatocollis*			1											C
Coleoptera	Halipliidae	*Haliplus ruficollis group*												1		C
Coleoptera	Hydraenidae	*Hydraena gracilis*				1										C
Coleoptera	Scirtidae	Scirtidae larva	1													C

Group	Family	Species	B5	B6	B7 †	B8	B9	B10	C1	C2	C3	C4	C6	C7	D1	EPA class
Diptera	Chironomidae	non-*Chironomus* spp.		3	2	6	7	3	17	7	8	12	6	2	2	C
Diptera	Culicidae	sp. indet.		1					2	2	1	1				C
Diptera	Dixidae	sp. indet.	1						8		4					C
Diptera	Muscidae	sp. indet.													1	C
Diptera	Pediciidae	*Dicranota* sp.				1										C
Diptera	Simuliidae	sp. indet.				3		79							8	C
Diptera	Tipuliidae	sp. indet.						2								C
Hemiptera	Corixidae	Corixidae nymph		6							1					C
Hemiptera	Gerridae	*Gerris* sp.	*6*		11	2		2		8						C
Hemiptera	Veliidae	*Velia caprai*		1					1	2		1				C
Hemiptera	Veliidae	Veliidae nymph	1	1					3	1	1					C
Arachnida	Hydrachnidiae	sp. indet.							1			10	2			C
Gastropoda	Lymnaeidae	*Ampullacaena balthica*			22	11		26						154		D
Gastropoda	Sphaeriidae	sp. indet.													1	D
Crustacea	Asellidae	*Asellus aquaticus*						2						29		D
Megaloptera	Sialidae	*Sialis lutaria*												2		D
Hirudinidae	Glossiphoniidae	sp. indet.								1				2		D
Diptera	Chironomidae	*Chironomus* spp.		6	21		31	25	7	21	6	5	9			E
Annelidae	Oligochaeta	sp. indet.	1													n/a
Nematomorpha	Gordiidae	sp. indet.		1						1						n/a
Abundance			**25**	**118**	**91**	**146**	**72**	**375**	**60**	**88**	**49**	**79**	**41**	**269**	**65**	
Q-rating			Q3*	Q3*	n/a	Q4	Q2-3*	Q3-4	Q3*	Q3-4	Q4*	Q3	Q4*	Q2-3*	Q4	
WFD status			Poor	Poor	n/a	Good	Poor	Mod	Poor	Mod	Good	Poor	Good	Poor	Good	

* tentative Q-rating due to poor flows and or absence of suitable riffle areas for sampling (Toner et al., 2005)

† sweep sample taken from stagnant pool, no Q-rating possible

9. Appendix C – eDNA analysis lab report

SureScreen Scientifics

Folio No: E15390
Report No: 1
Client: Triturus Environmental Ltd
Contact: Bill Brazier

TECHNICAL REPORT

ANALYSIS OF ENVIRONMENTAL DNA IN WATER FOR AQUATIC SPECIES DETECTION

SUMMARY

When aquatic organisms inhabit a waterbody such as a pond, lake or river they continuously release small amounts of their DNA into the environment. By collecting and analysing water samples, we can detect these small traces of environmental DNA (eDNA) to confirm the presence or absence of the target species within the waterbody.

RESULTS

Date sample received in laboratory: 12/09/22
Date results reported: 20/09/2022
Matters affecting result: None

TARGET SPECIES: Crayfish plague *(Aphanomyces astaci)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK784	A15 – Stradbally River	ITM 657185 696352	Pass	Pass	Pass	Positive	11/12
FK785	C7 - Clogh River	ITM 656513 679057	Pass	Pass	Pass	Positive	1/12
FK772	B10 – Owveg River	ITM 650631 684829	Pass	Pass	Pass	Negative	0/12
FK774	D1 – Douglas River	ITM 660818 684702	Pass	Pass	Pass	Negative	0/12

Forensic Scientists and Consultant Engineers
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Company Registration No. 08950940

SureScreen Scientifics

TARGET SPECIES: Freshwater pearl mussel *(Margaritifera margaritifera)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK784	A15 – Stradbally River	ITM 657185 696352	Pass	Pass	Pass	Negative	0/12
FK785	C7 - Clogh River	ITM 656513 679057	Pass	Pass	Pass	Negative	0/12
FK772	B10 – Owveg River	ITM 650631 684829	Pass	Pass	Pass	Negative	0/12
FK774	D1 – Douglas River	ITM 660818 684702	Pass	Pass	Pass	Negative	0/12

TARGET SPECIES: White-clawed crayfish *(Austropotamobius pallipes)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK784	A15 – Stradbally River	ITM 657185 696352	Pass	Pass	Pass	Negative	0/12
FK785	C7 - Clogh River	ITM 656513 679057	Pass	Pass	Pass	Positive	1/12
FK772	B10 – Owveg River	ITM 650631 684829	Pass	Pass	Pass	Positive	12/12
FK774	D1 – Douglas River	ITM 660818 684702	Pass	Pass	Pass	Negative	0/12

If you have any questions regarding results, please contact us: ForensicEcology@surescreen.com

Reported by: **Chelsea Warner** Approved by: **Gabriela Danickova**

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SureScreen Scientifics

METHODOLOGY

The samples detailed above have been analysed for the presence of target species eDNA following scientifically published eDNA assays and protocols which have been thoroughly tested, developed and verified for use by SureScreen Scientifics.

The analysis is conducted in two phases. The sample first goes through an extraction process where the filter is incubated in order to obtain any DNA within the sample. The extracted sample is then tested via real time PCR (also called q-PCR) for each of the selected target species. This process uses species-specific molecular markers (known as primers) to amplify a select part of the DNA, allowing it to be detected and measured in 'real time' as the analytical process develops. qPCR combines amplification and detection of target DNA into a single step. With qPCR, fluorescent dyes specific to the target sequence are used to label targeted PCR products during thermal cycling. The accumulation of fluorescent signals during this reaction is measured for fast and objective data analysis. The primers used in this process are specific to a part of mitochondrial DNA only found in each individual species. Separate primers are used for each of the species, ensuring no DNA from any other species present in the water is amplified.

If target species DNA is present, the DNA is amplified up to a detectable level, resulting in positive species detection. If target species DNA is not present then amplification does not occur, and a negative result is recorded.

Analysis of eDNA requires scrupulous attention to detail to prevent risk of contamination. True positive controls, negative controls and spiked synthetic DNA are included in every analysis and these have to be correct before any result is declared and reported. Stages of the DNA analysis are also conducted in different buildings at our premises for added security.

SureScreen Scientifics Ltd is ISO9001 accredited and participate in Natural England's proficiency testing scheme for GCN eDNA testing. We also carry out regular inter-laboratory checks on accuracy of results as part of our quality control procedures.

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SureScreen Scientifics

INTERPRETATION OF RESULTS

SIC: **Sample Integrity Check** [Pass/Fail]
When samples are received in the laboratory, they are inspected for any tube leakage, suitability of sample (not too much mud or weed etc.) and absence of any factors that could potentially lead to inconclusive results.

DC: **Degradation Check** [Pass/Fail]
Analysis of the spiked DNA marker to see if there has been degradation of the kit or sample, between the date it was made to the date of analysis. Degradation of the spiked DNA marker may indicate a risk of false negative results.

IC: **Inhibition Check** [Pass/Fail]
The presence of inhibitors within a sample are assessed using a DNA marker. If inhibition is detected, samples are purified and re-analysed. Inhibitors cannot always be removed, if the inhibition check fails, the sample should be re-collected.

Result: **Presence of eDNA** [Positive/Negative/Inconclusive]

Positive: DNA was identified within the sample, indicative of species presence within the sampling location at the time the sample was taken or within the recent past at the sampling location.

Positive Replicates: Number of positive qPCR replicates out of a series of 12. If one or more of these are found to be positive the pond is declared positive for species presence. It may be assumed that small fractions of positive analyses suggest low level presence, but this cannot currently be used for population studies. Even a score as low as 1/12 is declared positive. 0/12 indicates negative species presence.

Negative: eDNA was not detected or is below the threshold detection level and the test result should be considered as evidence of species absence, however, does not exclude the potential for species presence below the limit of detection.

Inconclusive: Controls indicate inhibition or degradation of the sample, resulting in the inability to provide conclusive evidence for species presence or absence.

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10. Appendix D – Stage 1 & 2 freshwater pearl mussel survey report

Sweeney Consultancy
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Survey of the Freshwater Pearl Mussel (*Margaritifera margaritifera*) in the River Nore Downstream of the R. Erkina Confluence

September 2022

Due to the sensitive nature of data concerning the locations of freshwater pearl mussels, distribution of this report should be restricted and not released to the public.

Cover Photo: Empty Freshwater Pearl Mussel in the River Nore at Tallyho Br., June 2016.

TABLE OF CONTENTS

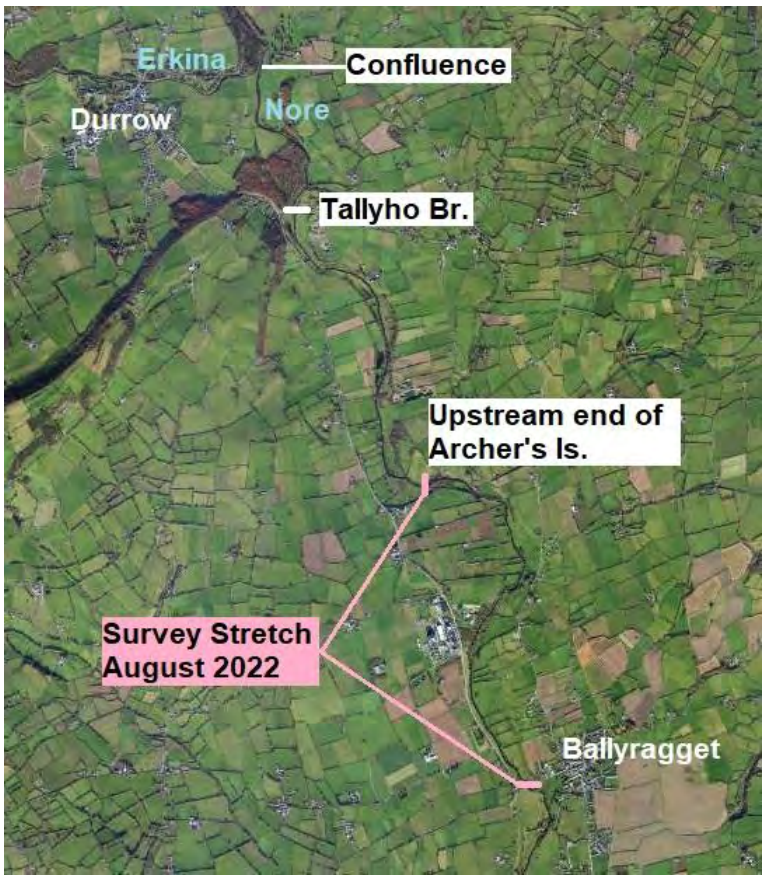
1. INTRODUCTION

1.1 Background

The Freshwater Pearl Mussel (*Margaritifera margaritifera*) is a Qualifying Interest of the River Barrow and River Nore Special Area of Conservation (Site Code 002162). The Nore population was formerly given species status (*Margaritifera durrovensis*), but genetic research has now placed it within the *Margaritifera margaritifera* taxon. Sweeney Consultancy was commissioned by Triturus Environmental Ltd. to undertake a Freshwater Pearl Mussel (FPM) survey in a section of the River Nore where historical records indicate the possible presence of this protected species.

FPM surveys have been conducted by Sweeney Consultancy in recent years in the vicinity of Tallyho Bridge, from where the most recent records of this species downstream of the River Erkina confluence are known. Data collected in these surveys is reviewed. To further inform the status of FPM in the River Nore, it was decided that a section of river from Archer's Island to Ballyragget Bridge would be surveyed (Figure 1).

Figure 1. River Nore FPM survey areas



2. METHODOLOGY

Field surveying was undertaken on 04 August, 2022. The river habitat surveyed was from the upstream end of Archer's Island (ITM 643553 673715) to Ballyragget Br. (ITM 644457 670879). For surveying and reporting purposes, the channel was divided into eight sections of approximately 500m (Figure 2 and Table 1).

Figure 2. River Nore FPM survey sections

Table 1. River Nore FPM survey section locations

Section	Grid Ref. (ITM) Upstream end	Grid Ref. (ITM) Downstream end	Description
1	64355 67371	64396 67363	Right and left channel around Archer's Island
2	64396 67363	644262 673374	Downstream of Archer's Island to 200m downstream of 1st bend.
3	644262 673374	644408 672863	Down to c. 70m upstream of Glanbia water intake.
4	644408 672863	644159 672583	Down to c. 120m upstream of Glanbia treated effluent diffuser.
5	644159 672583	643932 672173	Down to Glanbia former cooling water outfall.
6	643932 672173	643939 671696	Down to c. 50 0m downstream of Glanbia former cooling water outfall
7	643939 671696	644180 671292	Down to c. 90m upstream of broken weir.
8	644180 671292	644457 670879	Down to Ballyragget Br. (old bridge)

Grid reference were recorded using a hand-held Garmin GPS 72H. Photographs were taken with a waterproof digital camera (Aquapix W3048) and are presented in Appendix 1. The habitat quality for freshwater pearl mussels was visually, based on the criteria outlined by Hastie et al. (2000) and by Skinner et al. (2003). A licensed FPM survey (Licence No C56/2022) was carried out in accordance with the standard methodology (Anon 2004), by viewing the riverbed with a bathyscope while wading in a wetsuit and by snorkelling a few deeper sections.

3. RESULTS

3.1. SURVEY RESULTS: ARCHER'S ISLAND TO BALLYRAGGET BRIDGE

3.1.1. Section 1

From slow, deep glide upstream of Archer's Island (Photo 1), the river flows fast over mainly calcified bedrock in two channels, one on either side of the island (Photos 2 & 3). Moderate shade from bankside and island trees. A very limited amount of habitat suitable for FPM was identified in areas out of the main flow, where there is some gravel and sand among the bedrock.

No FPM were found.

3.1.2. Section 2

Slow-moderate flowing deep glide over mostly sand and silt in an unshaded channel (Photo 4). Unsuitable for FPM.

No FPM were found.

3.1.3. Section 3

Initially fast flowing shallow glide over cobble and gravel, but mostly calcified, limiting the suitability for FPM (Photo 5). Then there is a change to moderately fast flow over cobble, gravel and sand, which would be more suitable FPM habitat (Photo 6).

No FPM were found.

3.1.4. Section 4

At the upstream end, there is moderately fast glide over a sandy substratum with some cobble and gravel (Photo 7), then slowing down and deepening at the S-bend just upstream of the Glanbia water intake (Photo 8). Towards the end of this section, flow is faster again, over cobble and gravel, where the most suitable FPM habitat in this stretch occurs (Photo 9).

No FPM were found.

3.1.5. Section 5

This section is fast-flowing over cobble, gravel and sand (Photo 10). The treated effluent from the Glanbia plant is discharged at ITM 64402 67238, via a diffuser.

No FPM were found.

3.1.6. Section 6

Initially fast flowing shallow riffle over cobble and gravel (Photo 11), but deepening quickly to slide over a silty substratum, unsuitable for FPM (Photo 12).

No FPM were found.

3.1.7. Section 7

The water depth and slower flow in this section (Photo 13) is due to the weir downstream.

The habitat is unsuitable for FPM

No FPM were found.

3.1.8. Section 8

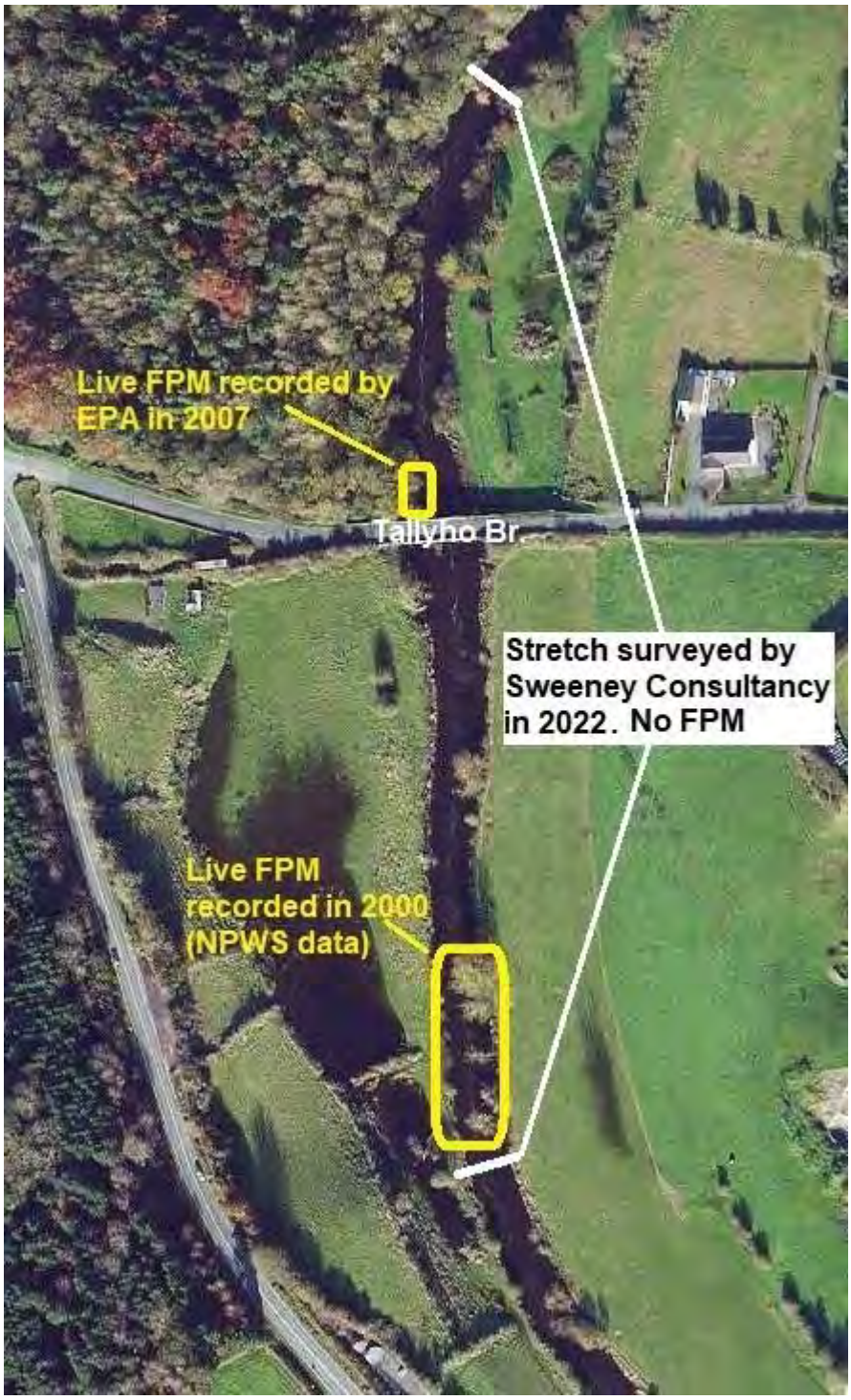
There is fast flow over the broken weir at ITM 64426 67111 (Photo 14). The river habitat upstream of the weir and downstream to Ballyragget Bridge consists of glide over a silted substratum, which is unsuitable for FPM (Photo 15).

No FPM were found.

3.2. SURVEY RESULTS: ERKINA CONFLUENCE TO ARCHER'S ISLAND

From the confluence of the Erkina to Archer's Island, there are several historical records of live FPM in the Nore. The most recent was just upstream of Tallyho Bridge under overhanging willows towards the right bank, where EPA last recorded live FPM in 2007. No live mussels were subsequently found here by Sweeney Consultancy during annual biological assessments3) for the Glanbia Ballyragget discharge licence. In 2016, a heavily calcified pair of empty shells were found a few metres upstream of the bridge (Photo 16). Following bankside and instream works along a short section of the right bank of the river in 2020, Sweeney Consultancy was commissioned to survey a section of the river, from 150m upstream to 150m downstream of Tallyho Bridge in 2022. For completeness, this survey was extended to downstream of the location where mussels were recorded in 2000 (Figure 3). No mussels were found in this survey.

Figure 3. Tallyho Bridge FPM records



4. CONCLUSIONS

No live freshwater pearl mussels have been found in the River Nore downstream of the Erkina confluence since 2007. This survey, combined with other recent data indicate that FPM no longer occur here.

APPENDIX 1- PHOTOGRAPHS

Photo 1: Upstream end of Archer's Island

Photo 2: Left channel on eastern side of Archer's Island

Photo 3: Right channel on western side of Archer's Island

Photo 4: Section 2

Photo 5: Section 3, upper end

Photo 6: Section 3, lower end

Photo 7: Section 4, upper end

Photo 8: Section 4 deep glide at bend

Photo 9: Section 4, lower end

Photo 10: Section 5, downstream of Glanbia outfall

Photo 11: Section 6, upper end

Photo 12: Section 6, lower end

Photo 13: Section 7

Photo 14: Section 8, broken weir

Photo 15: Section 8, lower end

Photo 16: Calcified empty FPM shells, Tallyho Br., 2016

APPENDIX 2 - REFERENCES

Anon (2004). *Margaritifera margaritifera*. Stage 1 and Stage 2 survey guidelines. *Irish Wildlife Manuals*, No. 12. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Hastie L.C., Boon P.J. and Young M.R. (2000). Physical microhabitat requirements of freshwater pearl mussel *Margaritifera margaritifera* (L.). *Hydrobiologia* 429 59-71

Skinner, A, Young M. & Hastie L. (2003). Ecology of the Freshwater Pearl Mussel. *Conserving Natura 2000 Rivers Ecology Series No. 2 English Nature, Peterborough.*

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Fisheries assessment of Coolglass wind farm, Co. Laois

Prepared by Triturus Environmental Ltd. for SLR Consulting

December 2022

Please cite as:

Triturus (2022). Fisheries assessment of Coolglass wind farm, Co. Laois. Report prepared by Triturus Environmental Ltd. for SLR Consulting. December 2022.

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1. Introduction

1.1 Background

Triturus Environmental Ltd. were commissioned by SLR Consulting to undertake a baseline fisheries assessment of numerous watercourses in the vicinity of the proposed Coolglass (formerly Fossy) wind farm, located approximately 11km southeast of Portlaoise, Co. Laois (**Figure 2.1**).

The survey was undertaken to establish baseline fisheries data used in the preparation of the EIAR for the proposed project. In order to gain an accurate overview of the existing and potential fisheries value of the riverine watercourses within the vicinity of the proposed project, a catchment-wide electro-fishing survey across *n*=33 riverine sites was undertaken (**Table 2.1; Figure 2.1**). Electro-fishing helped to identify the importance of the watercourses as nurseries and habitats for salmonids, lamprey and European eel (*Anguilla anguilla*), as well as other species, and helped to further inform impact assessment and any subsequent mitigation for the project.

Triturus Environmental Ltd. made an application under Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962, to undertake a catchment-wide electro-fishing survey in the vicinity of the proposed Coolglass wind farm. Permission was granted on the 4th August 2022 and the survey was undertaken between the 31st August and 3rd September 2022.

1.2 Fisheries asset of the survey area

The survey sites were located within Nore_SC_060, Dinin[North]_SC_10, Barrow_SC_050 and Barrow_SC_070 river sub-catchments (**Figure 2.1**). The proposed wind farm was not located within a European site although shared downstream hydrological connectivity, via several pathways, with the River Barrow and River Nore SAC (002162). Fisheries survey sites were present on the Fallowbeg Upper Stream (EPA code: 14F06), Crooked River (14C02) an unnamed tributary, Honey Stream (14H01), Honey Stream North (14H21), Aghoney Stream (14A08), Fossy Lower Stream (14F10), Timahoe Stream (14T09) and Stradbally River (14S02) in the Barrow_SC_050 river sub-catchment. Sites were also surveyed on the Scotland Stream (15S06), Owveg River 915O01), Cleanagh Stream (15C58), Garrintaggart Stream (15G30), Graiguenahown Stream (15G29), Knocklead Stream (15K21), Clogh River (15C03), Brennanshill River (15B51), Moyadd Stream (15M22) and the Douglass River (15D03) in the Nore_SC_060, Dinin[North]_SC_10 and Barrow_SC_070 river sub-catchments (**Table 2.1**).

The Stradbally River is a valuable brown trout nursery and also supports stone loach, minnow and three-spined stickleback and, in the lower reaches, Atlantic salmon and invasive dace (*Leuciscus leuciscus*) (Gordon et al., 2021; IFI 2020 data[1]; Delanty et al., 2017).

The Crooked River, a tributary of the Stradbally River, is known to support brown trout and stone loach (Delanty et al., 2017). Lamprey (*Lampetra* sp.) are also present in both the Stradbally and Crooked Rivers (IFI 2020 data; Gallagher et al., 2019; King, 2006).

[1] Inland Fisheries Ireland data for Water Framework Directive Fish Ecological Status 2008-2021. Available at https://opendata-ifigis.hub.arcgis.com/datasets/IFIgis::water-framework-directive-fish-ecological-status-2008-2021/

The Douglas River, a tributary of the River Barrow, is known to support Atlantic salmon, brown trout, lamprey (*Lampetra* sp.), minnow, stone loach and three-spined stickleback (Gordon et al., 2021a; Delanty et al., 2017). Lamprey are present in the lower catchment only, with none recorded in the vicinity of Shanragh Bridge (survey site D1) in 2017 (Gallagher et al., 2019).

The Owveg (syn. Owenbeg) River, a tributary of the River Nore, is known to support Atlantic salmon, brown trout, stone loach, lamprey (*Lampetra* sp.), three-spined stickleback and minnow (IFI 2021 data[1]; Galetech Energy Services, 2020). High densities of Atlantic salmon and brown trout, in addition to minnow and lamprey (*Lampetra* sp.), were recorded from the lower Owveg River (Loughill Bridge) in 2021 (Triturus, 2021).

The Clogh River, a tributary of the Dinin River, is known to support brown trout, minnow, stone loach and three-spined stickleback at Clogh Bridge (survey site C7) (Matson et al., 2018), with Atlantic salmon, pike and lamprey (*Lampetra* sp.) also recorded in the river in addition to these species in 2020 (Gordon et al., 2021b).

A number of significant barriers to fish passage (mostly ramps but also weirs & culverts) have been identified on numerous watercourses in vicinity of the proposed project, namely the Crooked River, Stradbally River, Aghoney Stream, Douglas River, Owveg River and Clogh River (AMBER Barrier Tracker app data; AMBER Consortium, 2020; **Figure 1.1**).

Fisheries data for the other watercourses within the survey area was not available at the time of survey.

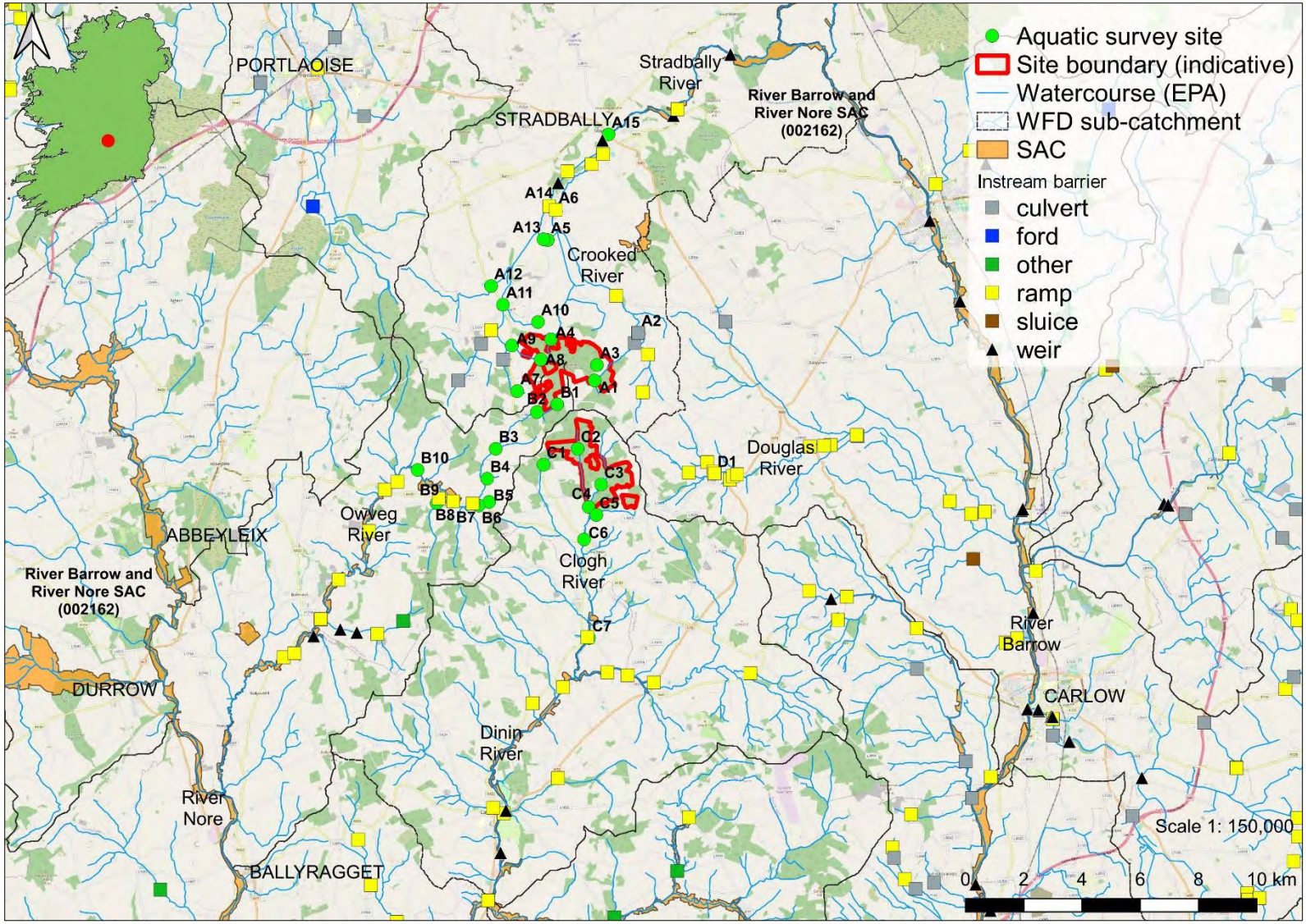

Figure 1.1 Overview of the known instream barriers in the vicinity of Coolglass wind farm, Co. Laois (source: AMBER data)

2. Methodology

2.1 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 watercourses in the vicinity of the proposed Coolglass wind farm between the 31st August and 3rd September 2022 following notification to Inland Fisheries Ireland and under the conditions of a Department of the Environment, Climate and Communications (DECC) licence. 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).

Electro-fishing was proposed for all riverine survey sites. However, sites A2 (Crooked River), A3 (unnamed stream), A7 (Aghoney Stream), A8 (Fossy Lower Stream), A10 (Timahoe Stream), A13 (unnamed stream), B7 (Owveg River) and C5 (Moyaddd Stream) were dry at the time of survey. Therefore, the catchment-wide electro-fishing (CWEF) survey was undertaken across a total of *n*=25 sites (see **Table 2.1, Figure 2.1**).

2.1.1 Salmonids and European eel

For salmonid species and European eel, as well as all 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. 50-100m 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 (**Table 3.1**).

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 high conductivity waters of the sites (draining limestone geologies) a voltage of 200-230v, frequency of 35-40Hz and pulse duration of 3.5-4ms was utilised to draw fish to the anode without causing physical damage.

2.1.2 Lamprey

Electro-fishing for lamprey ammocoetes was conducted using targeted 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. 10-15cm 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).

2.2 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 riverine sites (i.e., channel profiles, substrata etc.).

2.3 Biosecurity

A strict biosecurity protocol following IFI (2010) and 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. Particular cognisance was given towards preventing the spread or introduction of crayfish plague given the known distribution of white-clawed crayfish in the wider survey area and previous outbreaks of crayfish plague in the wider Barrow and Nore catchments. Furthermore, staff did not undertake any work in a known crayfish plague catchment for a period of <72hrs in advance of the survey. Where feasible, equipment was also thoroughly dried (through UV exposure) between survey areas. Any aquatic invasive species or pathogens recorded within or adjoining the survey areas were geo-referenced. All Triturus staff are certified in 'Good fieldwork practice: slowing the spread of invasive non-native species' by the University of Leeds.

Table 2.1 Location of *n*=33 survey sites in the vicinity of Coolglass wind farm, Co. Laois

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1	Fallowbeg Upper Stream	14F06	Fallowbeg Upper	656707	687902
A2	Crooked River	14C02	Local road crossing, Luggacurreen	658211	689541
A3	Unnamed stream	n/a	Fallowbeg Upper	656788	688433
A4	Honey Stream	14H01	L38401 road crossing, Fossy Upper	655208	689315
A5	Honey Stream North	14H21	Proposed GCR crossing, L3838	655099	692723
A6	Crooked River	14C02	Timogue Bridge	655370	693764
A7	Aghoney Stream	14A08	Proposed GCR crossing, R426	654051	687536
A8	Fossy Lower Stream	14F10	Proposed GCR crossing, Fossy Upper	654858	688621
A9	Fossy Lower Stream	14F10	Proposed GCR crossing, R426	653868	689102
A10	Timahoe Stream	14T09	Proposed GCR crossing, Fossy Lower	654764	689909
A11	Stradbally River	14S02	Proposed GCR crossing, R426	653558	690506
A12	Cremorgan Stream	14C24	Proposed GCR crossing, R426	653153	691145
A13	Unnamed stream	n/a	Proposed GCR crossing, L3838	654951	692751
A14	Stradbally River	14S02	Bauteogue Bridge	655141	693888
A15	Stradbally River	14S02	Stradbally Bridge, N80	657185	696352
B1	Scotland Stream	15S06	Proposed GCR crossing, L3851	655422	687083
B2	Owveg River	15O01	Knocklead	654720	686814
B3	Owveg River	15O01	L7792 road crossing	653312	685554
B4	Cleanagh Stream	15C58	L7792 road crossing	653016	684528
B5	Garrintaggart Stream	15G30	L7792 road crossing	653083	683731
B6	Garrintaggart Stream	15G30	R430 road crossing	652727	683607
B7	Owveg River	15O01	Spink Bridge	652536	683673
B8	Owveg River	15O01	R430 road crossing, Garrintaggart	651827	683752
B9	Graiguenahown Stream	15G29	Graiguenahown	651287	683688
B10	Owveg River	15O01	Graiguenasmuttan Bridge	650631	684829
C1	Knocklead Stream	15K21	R426 road crossing	654950	685010
C2	Clogh River	15C03	Coolglass	656127	685555
C3	Brennanshill River	15B51	Coolglass	656927	684329
C4	Clogh River	15C03	Moyadd	656502	683555
C5	Moyadd Stream	15M22	Kylenabehy	656765	683282
C6	Clogh River	15C03	Swan Bridge	656345	682442
C7	Clogh River	15C03	Clogh Bridge	656513	679057
D1	Douglas River	15D03	Shanragh Bridge	660818	684702

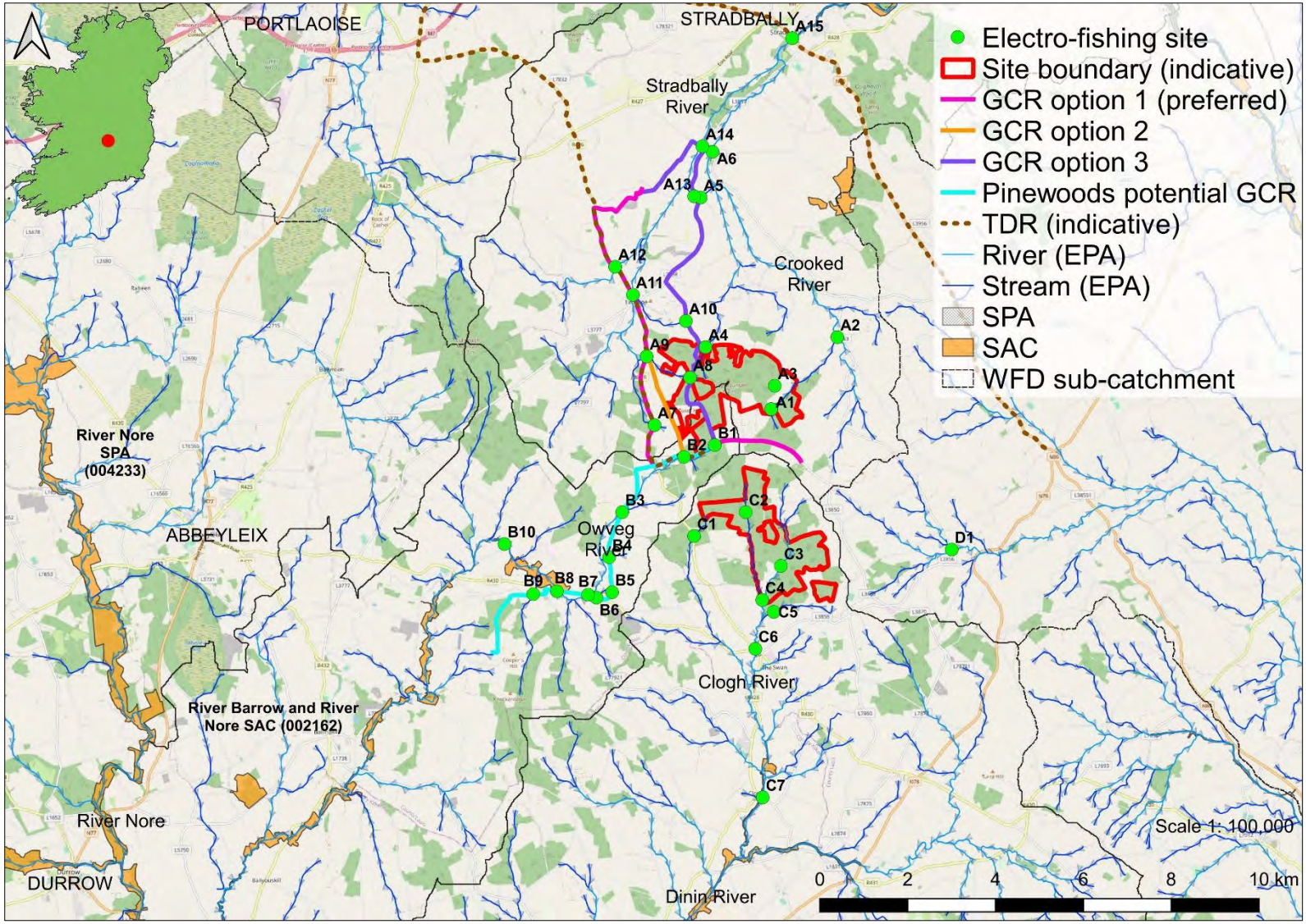

Figure 2.1 Overview of the *n*=33 electro-fishing survey site locations in the vicinity of Coolglass wind farm, Co. Laois

3. Results

A catchment-wide electro-fishing survey of *n*=33 riverine sites in the vicinity of the proposed Coolglass wind farm was conducted between the 31st August and 3rd September 2022 following notification to Inland Fisheries Ireland. The results of the survey are discussed below in terms of fish population structure, population size and the suitability and value of the surveyed areas as nursery and spawning habitat for salmonids, European eel and lamprey species. Scientific names are provided at first mention only.

3.1 Fish stock assessment (electro-fishing)

3.1.1 Site A1 – Fallowbeg Upper Stream, Fallowbeg Upper

No fish were recorded via electro-fishing at site A1. Despite some physical suitability for salmonids and European eel, the site did not support fish at the time of survey. This reflected low seasonal flows and also high natural gradients which would reduce the inherent fisheries value of the stream at this location.

Plate 3.1 Representative image of site A1 on the upper reaches of the Fallowbeg Upper Stream, September 2022

3.1.2 Site A2 – Crooked River, Luggacurreen

Site A2 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Given the dry nature of the site, it was not possible to undertake electro-fishing at this site at the time of survey.

Plate 3.2 Representative image of site A2 on the upper reaches of the Crooked River, September 2022 (dry, ephemeral channel)

3.1.3 Site A3 – Unnamed stream, Fallowbeg Upper

Site A3 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Given the dry nature of the site, it was not possible to undertake electro-fishing at this site at the time of survey. Its location in the upper reaches of the stream, with high natural gradients downstream, would likely prelude fish populations during wetted periods.

Plate 3.3 Representative image of site A3 on an unnamed Crooked River tributary, September 2022

3.1.4 Site A4 – Honey Stream, Fossy Upper

No fish were recorded via electro-fishing at site A4. This reflected low seasonal flows, its likely ephemeral nature and poor connectivity with downstream habitats which would reduce the inherent fisheries value of the stream at this location.

Plate 3.4 Representative image of site A4 on the Honey Stream, September 2022

3.1.5 Site A5 – Honey Stream North, Timogue

No fish were recorded via electro-fishing at site A5. This reflected low seasonal flows, its ephemeral nature and poor connectivity with downstream habitats which would reduce the inherent fisheries value of the stream at this location. The stream would have some improved (although still low) fisheries value during higher flow periods given the proximity of the Crooked River.

Plate 3.5 Representative image of site A5 on the Honey North Stream, September 2022 (semi-dry channel)

3.1.6 Site A6 – Crooked River, Timogue Bridge

Brown trout (*Salmo trutta*) (*n*=25), lamprey (*Lampetra* sp.) (*n*=5), stone loach (*Barbatula barbatula*) (*n*=1) and three-spined stickleback (*Gasterosteus aculeatus*) (*n*=1) were recorded via electro-fishing at site A6 (**Figure 3.1**).

The site was of good value for salmonids, supporting a moderate density of mixed-cohort brown trout. Despite significant siltation and enrichment pressures, the site was of most value as a salmonid nursery. Good quality spawning habitat for both salmonids and lamprey were also present but these areas were highly localised (>40m downstream of the bridge). The pool immediately below the bridge apron (a barrier to fish at low flows only) provided good quality holding habitat for adult salmonids but suitable areas were sparse elsewhere given the generally shallow nature of the site. The site was also of good value as a lamprey nursery, with frequent soft sediment deposits supporting a low density of ammocoetes. Despite some good suitability, no European eel were recorded.

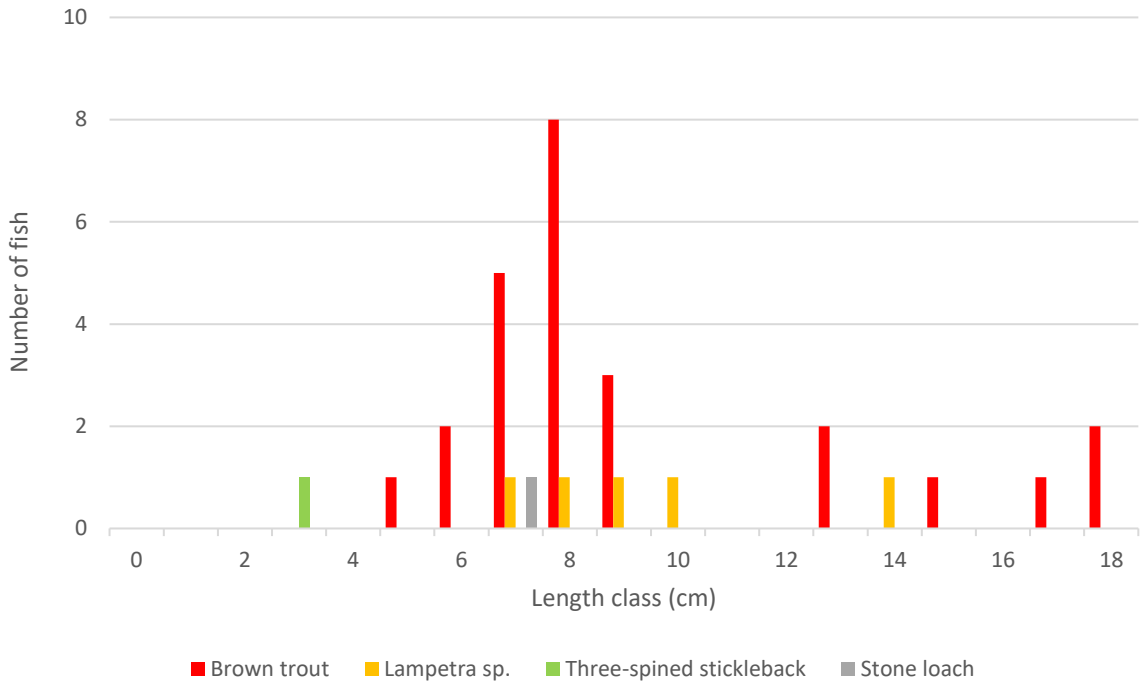

Figure 3.1 Length frequency distribution recorded via electro-fishing at site A6 on the Crooked River, September 2022

Plate 3.6 Mixed-cohort brown trout recorded at site A6 on the Crooked River at Timogue Bridge, September 2022

3.1.7 Site A7 – Aghoney Stream, Aghoney

Site A7 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Given the dry nature of the site, it was not possible to undertake electro-fishing at this site at the time of survey. Its location in the upper reaches of the stream, with high natural gradients downstream, would likely prelude fish populations during wetted periods.

Plate 3.7 Representative image of site A7 on the Aghoney Stream, September 2022 (dry, ephemeral channel)

3.1.8 Site A8 – Fossy Lower Stream, Fossy Upper

Site A8 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Given the dry nature of the site, it was not possible to undertake electro-fishing at this site at the time of survey. Its location in the upper reaches of the stream, with high natural gradients downstream, would likely prelude fish populations during wetted periods.

3.1.9 Site A9 – Fossy Lower Stream, Ballintlea Lower

No fish were recorded via electro-fishing at site A9. The site was not of fisheries value given its semi-dry, ephemeral nature containing stagnant pools only. However, given some physical suitability, the stream at this location may support a low density of fish during wetter periods.

Plate 3.8 Representative image of site A8 on the Fossy Lower Stream, September 2022 (dry, ephemeral channel)

Plate 3.9 Representative image of site A9 on the lower reaches of the Fossy Lower Stream, September 2022 (ephemeral channel)

3.1.10 Site A10 – Timahoe Stream, Fossy Lower

Site A10 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Given the dry nature of the site, it was not possible to undertake electro-fishing at this site at the time of survey. Its location in the uppermost reaches of the stream would likely prelude fish populations during wetted periods.

Plate 3.10 Representative image of site A10 on the Timahoe Stream, September 2022 (water abstraction for livestock evident)

3.1.11 Site A11 – Stradbally River, Timahoe

Brown trout (*n*=6), lamprey (*Lampetra* sp.) (*n*=8) stone loach (*n*=1), minnow (*Phoxinus phoxinus*) (*n*=54) and three-spined stickleback (*n*=3) were recorded via electro-fishing at site A11 (**Figure 3.2**).

The site was of good value for salmonids but supported only a low density of juvenile brown trout, with no adults recorded via electro-fishing. This was in spite of some high physical suitability in terms of holding habitat (deep pool). The evident hydromorphological, enrichment and siltation pressures reduced the value of the site as a salmonid nursery considerably. Spawning habitat for both salmonids and lamprey was present but highly localised and significantly compromised by siltation. Some good quality lamprey habitat was present adjoining localised pool areas and supported a low density of mixed-cohort ammocoetes. Despite some moderate suitability, no European eel were recorded.

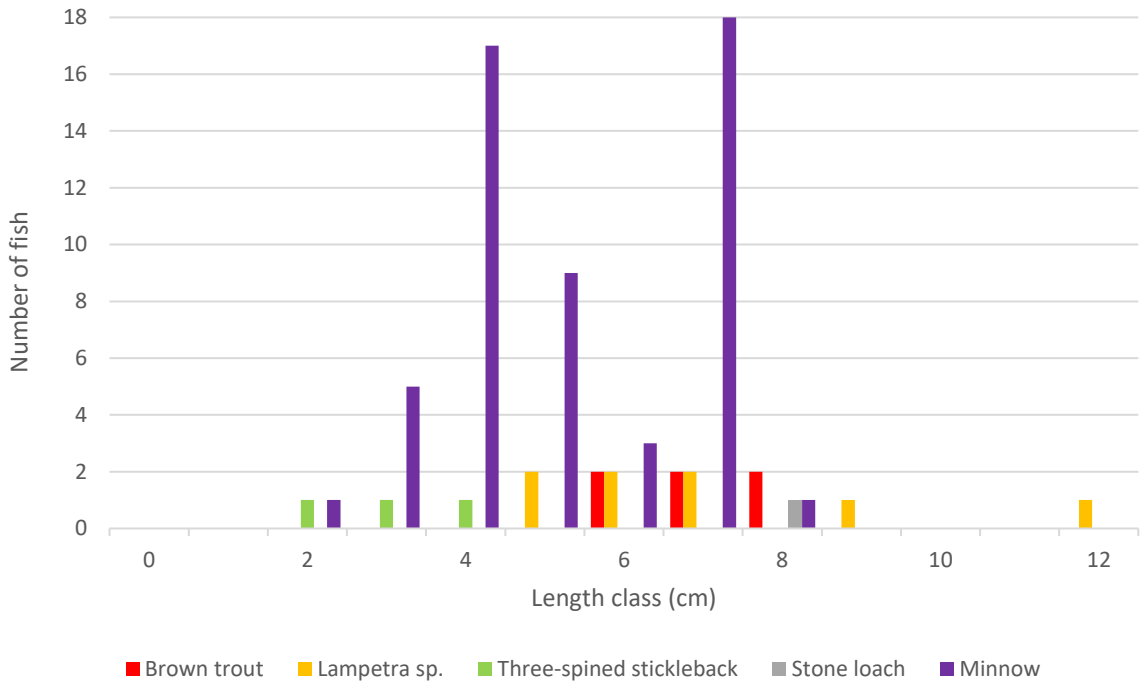

Figure 3.2 Length frequency distribution recorded via electro-fishing at site A11 on the Stradbally River, September 2022

Plate 3.11 Stone loach, brown trout and minnow recorded at site A11 on the Stradbally River, September 2022

3.1.12 Site A12 – Cremorgan Stream, Coolnabacky

Three-spined stickleback (*n*=14) was the only species recorded via electro-fishing at site A12 (**Figure 3.3**).

Despite high physical suitability for salmonids, none were recorded via electro-fishing of stagnant remnant pools. Given downstream connectivity and site attributes (high energy, hard substrata, glide and pool habitat etc.), the site likely supports salmonids (and other fish species such as European eel) at higher water levels. Stagnant pools supported low densities of three-spined stickleback only. There was no suitability (even under higher water levels) for lamprey.

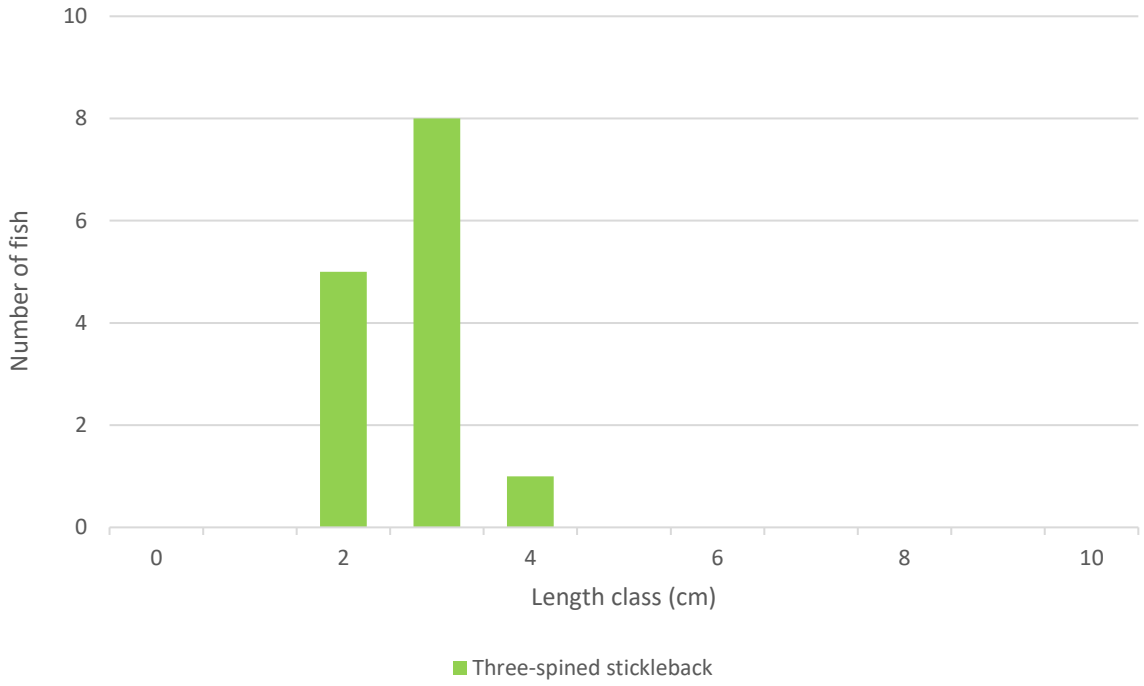

Figure 3.3 Length frequency distribution recorded via electro-fishing at site A12 on the Cremorgan Stream, September 2022

Plate 3.12 Representative image of site A12 on the Cremorgan Stream, September 2022

3.1.13 Site A13 – Unnamed stream, Timogue

Site A13 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Given the dry nature of the site, it was not possible to undertake electro-fishing at this site at the time of survey. The stream would likely have some improved (although still low) fisheries value in its lowermost reaches only during higher flow periods given the proximity of the Stradbally River.

Plate 3.13 Representative image of site A13 on an unnamed Stradbally River tributary, August 2022 (dry, ephemeral channel)

3.1.14 Site A14 – Stradbally River, Bauteogue Bridge

Brown trout (*n*=11), three-spined stickleback (*n*=19), stone loach (*n*=1) and minnow (*n*=28) were recorded via electro-fishing at site A14 (**Figure 3.4**).

Despite very low seasonal flows, site A14 was of good value for salmonids, supporting a low density of mixed-cohort brown trout. Physically, the site provided good quality nursery, spawning and holding habitat but the value was reduced significantly given very low seasonal flows and poor connectivity. The bridge apron was a significant barrier to fish passage at low flows. Better quality glide habitat was present downstream of the bridge. Overhanging macrophyte vegetation and scoured banks (including tree roots) provided valuable holding areas for salmonids. Whilst some good quality lamprey spawning habitat was present, the site was unsuitable as a nursery area given a paucity of soft sediment accumulations.

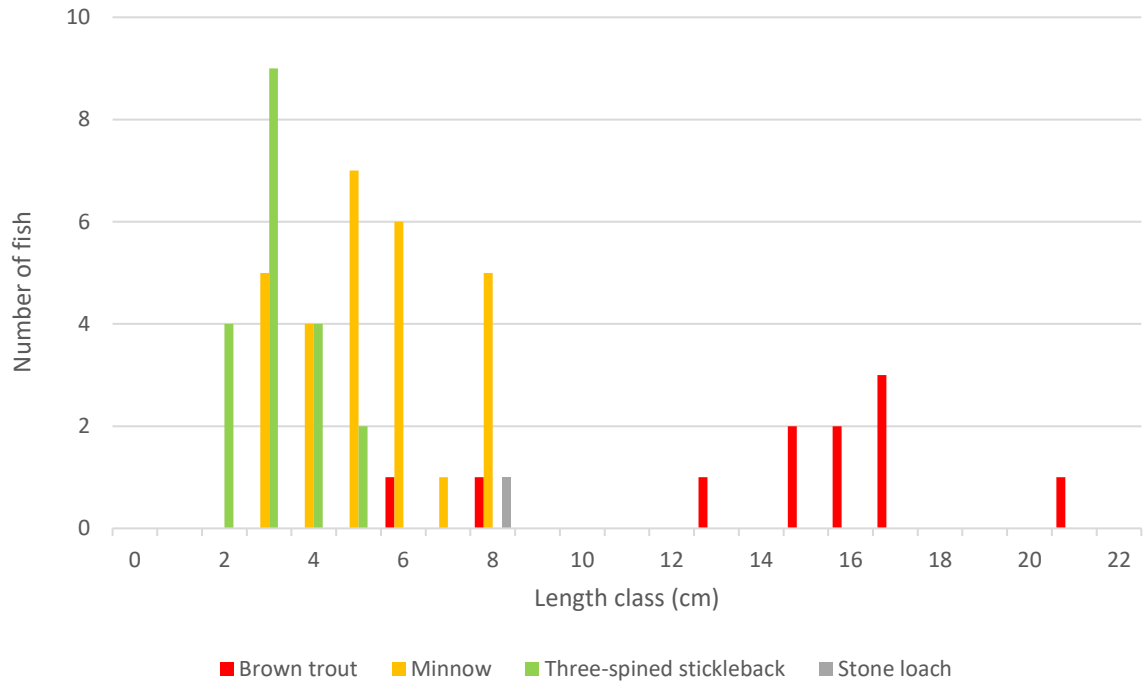

Figure 3.4 Length frequency distribution recorded via electro-fishing at site A14 on the Stradbally River, September 2022

Plate 3.14 Brown trout and minnow recorded at site A14 on the Stradbally River at Bauteogue Bridge, September 2022

3.1.15 Site A15 – Stradbally River, Stradbally Bridge

Atlantic salmon (*Salmo salar*) (*n*=9), brown trout (*n*=26), lamprey (*Lampetra* sp.) (*n*=6), minnow (*n*=38) and three-spined stickleback (*n*=25) were recorded via electro-fishing at site A15 (**Figure 3.5**).

The site was of high value for salmonids, supporting mixed-cohort populations of both Atlantic salmon and brown trout. The site was of highest value as a salmonid nursery, despite evident enrichment and siltation pressures impacting the quality of the cobble and boulder refugia. Spawning habitat for both salmonids and lamprey was present but highly localised, mostly downstream of the bridge. The shallow modified site was of poor value as a holding area although some overhanging vegetation provided valuable thermal refugia. Despite high suitability, no European eel were recorded.

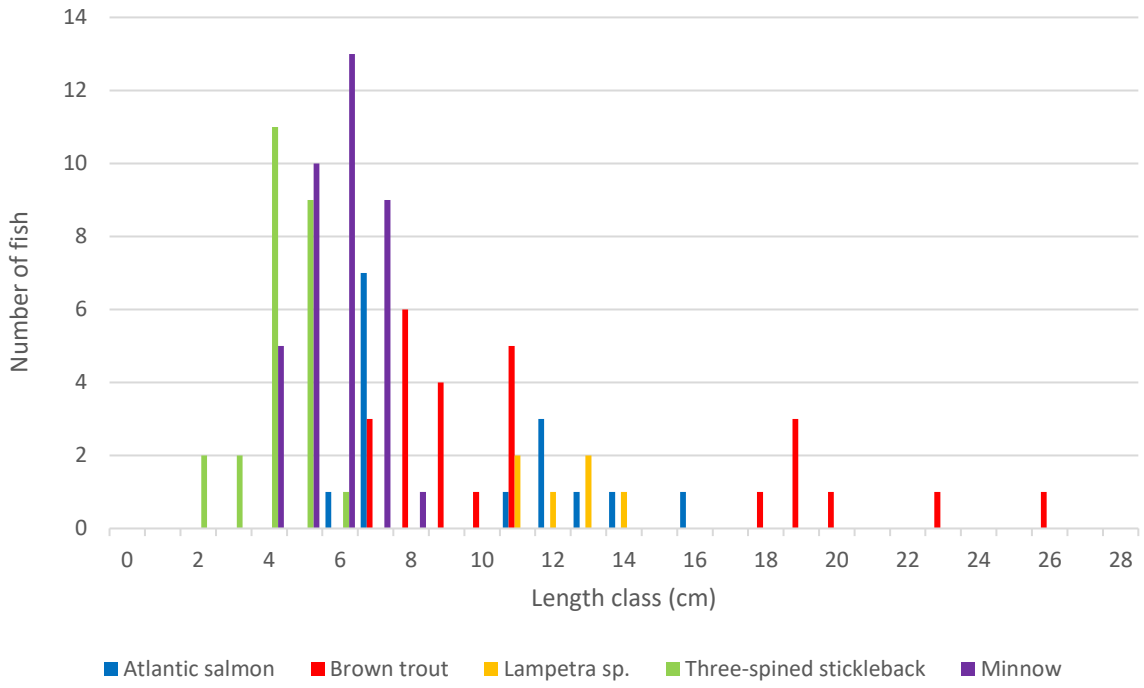

Figure 3.5 Length frequency distribution recorded via electro-fishing at site A15 on the Stradbally River, September 2022

Plate 3.15 Juvenile brown trout (top) and Atlantic salmon (bottom) recorded at site A15 on the Stradbally River at Stradbally Bridge, September 2022

3.1.16 Site B1 – Scotland Stream, Aghoney

No fish were recorded via electro-fishing at site B1. The site was not of fisheries value given its semi-dry, ephemeral nature and location in the upper reaches of the catchment. Given this, and naturally high gradients, connectivity with downstream habitats was poor and the stream is unlikely to support fish at this location even under higher water levels.

Plate 3.16 Representative image of site B1 on the Scotland Stream, September 2022

3.1.17 Site B2 – Owveg River, Knocklead

Brown trout (*n*=2) was the only fish species recorded via electro-fishing at site B2 (**Figure 3.6**).

The site was of low value for salmonids, supporting only a very low fish density. Low seasonal flows reduced the value of the habitat significantly, with intermittent flows and poor longitudinal connectivity (including an impassable bridge apron). However, the site was of some low value as a salmonid nursery and spawning habitat, with good quality holding areas for adults absent. Despite some low suitability for European eel, none were recorded. The upland eroding site was unsuitable for lamprey.

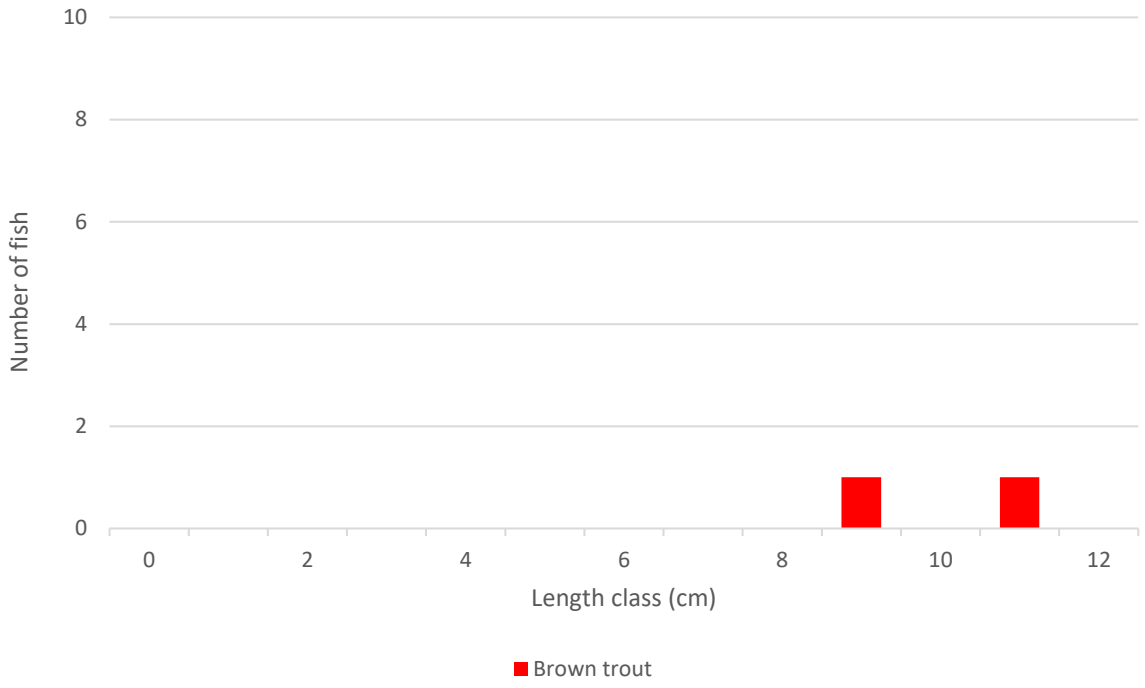

Figure 3.6 Length frequency distribution recorded via electro-fishing at site B2 on the upper reaches of the Owveg River, September 2022

Plate 3.17 Representative image of site B2 on the upper reaches of the Owveg River, September2022 (upstream of bridge)

3.1.18 Site B3 – Owveg River, Knocklead

Atlantic salmon (*n*=1), brown trout (*n*=11), minnow (*n*=30) and stone loach (*n*=3) were recorded via electro-fishing at site B3 (**Figure 3.7**).

The site was of good value for salmonids, despite very low seasonal flows, with a low density of juvenile brown trout and a single Atlantic salmon parr recorded via electro-fishing. Physically, the site was of highest value as a salmonid nursery given a predominance of cobble and boulder refugia. Spawning habitat was present but localised and compromised by siltation pressures and naturally high compaction of the bed. Holding habitat was poor in the small, shallow upland watercourse at this location although some valuable pools were associated with meanders and overhanging tree root systems (thermal refugia). Despite some suitability for European eel, none were recorded. The upland eroding site was unsuitable for lamprey.

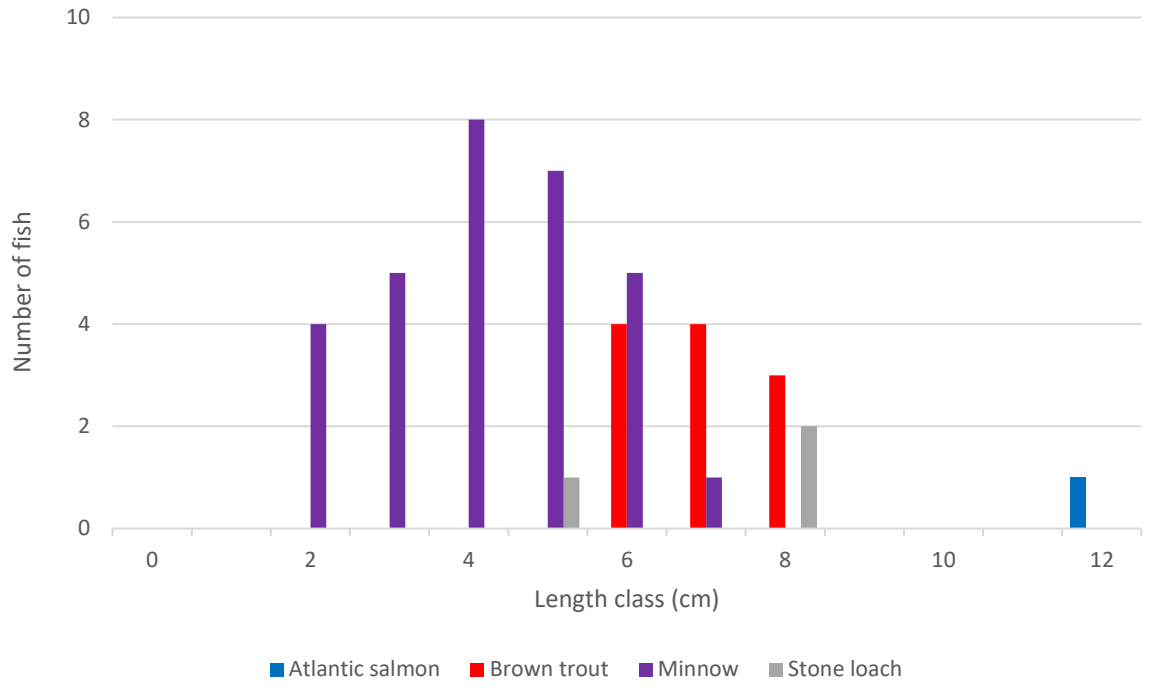

Figure 3.6 Length frequency distribution recorded via electro-fishing at site B3 on the upper reaches of the Owveg River, September 2022

Plate 3.18 Atlantic salmon, brown trout, minnow and stone loach recorded at site B3 on the upper reaches of the Owveg River, September 2022

3.1.19 Site B4 – Cleanagh Stream, Cleanagh

No fish species were recorded via electro-fishing at site B4. The site was not of fisheries value given its ephemeral nature (stagnant pools only) in addition to high natural gradients. However, given the close proximity to the downstream connecting Owveg River (<0.2km), the stream may have some low fisheries (salmonid) value during higher flow periods. The box culvert was inaccessible to fish given high gradients. The upland eroding ephemeral channel was unsuitable for lamprey.

Plate 3.19 Representative image of site B4 on the Cleanagh Stream, September 2022

3.1.20 Site B5 – Garrintaggart Stream, Knockbaun

No fish species were recorded via electro-fishing at site B5. The site was not of fisheries value given its very shallow and likely ephemeral nature, in addition to the location at the headwaters of the stream.

Plate 3.20 Representative image of site B5 on the Garrintaggart Stream, September 2022

3.1.21 Site B6 – Garrintaggart Stream, Knockbaun

No fish species were recorded via electro-fishing at site B6. The site was not of fisheries value given poor seasonal flows, high natural gradients, poor connectivity with downstream habitats and the location in the upper reaches of the stream.

Plate 3.21 Representative image of site B6 on the Garrintaggart Stream, September 2022

3.1.22 Site B7 – Owveg River, Spink Bridge

European eel (*n*=4), minnow (*n*=55) and stone loach (*n*=2) were recorded via electro-fishing at site B7 (**Figure 3.7**).

The site provided high physical suitability for salmonids. However, the dry karstic nature of the channel (other than the plunge pool) precluded the presence of brown trout or Atlantic salmon, despite their presence upstream (at site B3). The presence of salmonids upstream supports that salmonids are able to navigate this site under higher water flows. Suitability for European eel was moderate given the spate characteristic of the channel. The typically upland eroding site was unsuitable for lamprey.

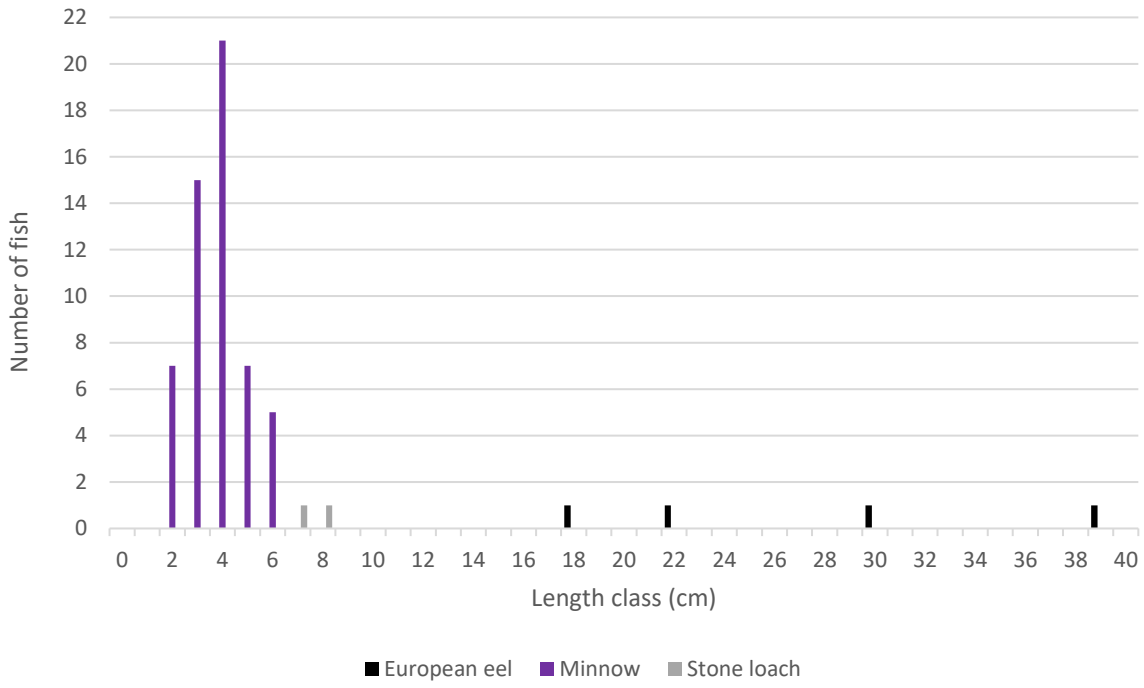

Figure 3.7 Length frequency distribution recorded via electro-fishing at site B7 on the Owveg River, September 2022

Plate 3.22 Representative image of site B7 on the Owveg River at Spink Bridge, September 2022 (deep plunge pool in an otherwise dry channel)

3.1.23 Site B8 – Owveg River, Garrintaggart

Brown trout (*n*=9), European eel (*n*=4), minnow (*n*=105) and stone loach (*n*=3) were recorded via electro-fishing at site B8 (**Figure 3.8**).

The site was of good value for salmonids, despite evident siltation and water quality issues, supporting a low density of mixed-cohort brown trout. Atlantic salmon are known from the site (IFI 2021 data). The site provided some good quality spawning and nursery habitat downstream of the bridge, although the quality of both were impacted by considerable siltation and eutrophication pressures. Marginal macrophyte beds provided valuable nursery refugia and also some limited holding habitat for adults. Holding habitat for larger adults was confined to the deeper pool underneath the bridge This boulder habitat provided high quality European eel habitat, with abundant diurnal refugia by way of boulder and retaining wall crevices. Whilst some moderate quality lamprey spawning habitat was present, no suitable nursery areas were identified (shallow & superficial where present). Minnow were abundant, reflecting the high levels of enrichment observed.

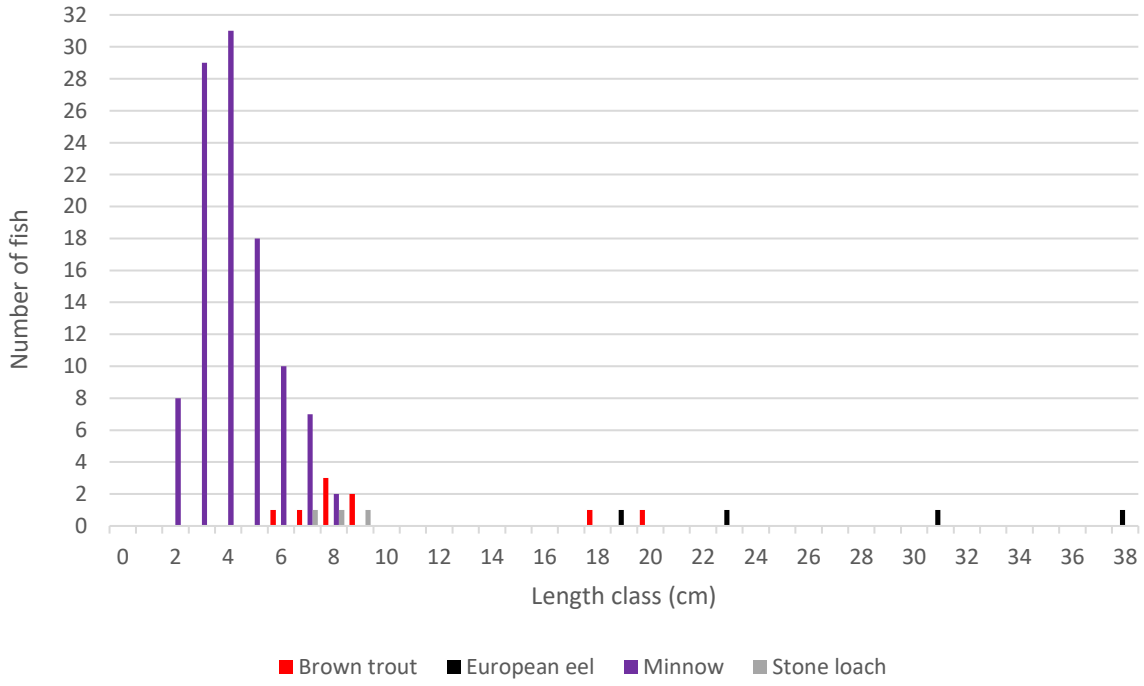

Figure 3.8 Length frequency distribution recorded via electro-fishing at site B8 on the Owveg River, September 2022

Plate 3.23 European eel recorded at site B8 on the Owveg River, September 2022

3.1.24 Site B9 – Graiguenahown Stream, Graiguenahown

No fish were recorded via electro-fishing at site B9. Whilst the site was physically suitable for salmonids the semi-dry nature caused by low seasonal water levels and poor downstream connectivity to superior fisheries habitats precluded the presence of salmonids and other fish species. Three-spined stickleback were absent, indicating the stream may dry out periodically (i.e. ephemeral).

Plate 3.24 Representative image of site B9 on the Graiguenahown Stream, September 2022 (downstream of twin pipe culvert)

3.1.25 Site B10 – Owveg River, Graiguenasmuttan Bridge

Atlantic salmon (*n*=2), brown trout (*n*=6), lamprey (*Lampetra* sp.) (*n*=14), minnow (*n*=85) and stone loach (*n*=11) were recorded via electro-fishing at site B10 (**Figure 3.9**).

The site was of good value for salmonids, despite low seasonal flows and evident siltation pressures, supporting a low density of mixed-cohort brown trout and Atlantic salmon. The heavily impacted site provided some good quality holding habitat, typically associated with meanders and large woody debris instream. However, these deeper areas supported a very low density of adult salmonids only. Whilst some physically suitable nursery and spawning habitat was present, the value was again compromised by high levels of siltation and enrichment. Shallow soft sediment accumulations along channel margins supported low densities (c.5 per m^2) of *Lampetra* sp. ammocoetes. Despite some good suitability for European eel, none were recorded.

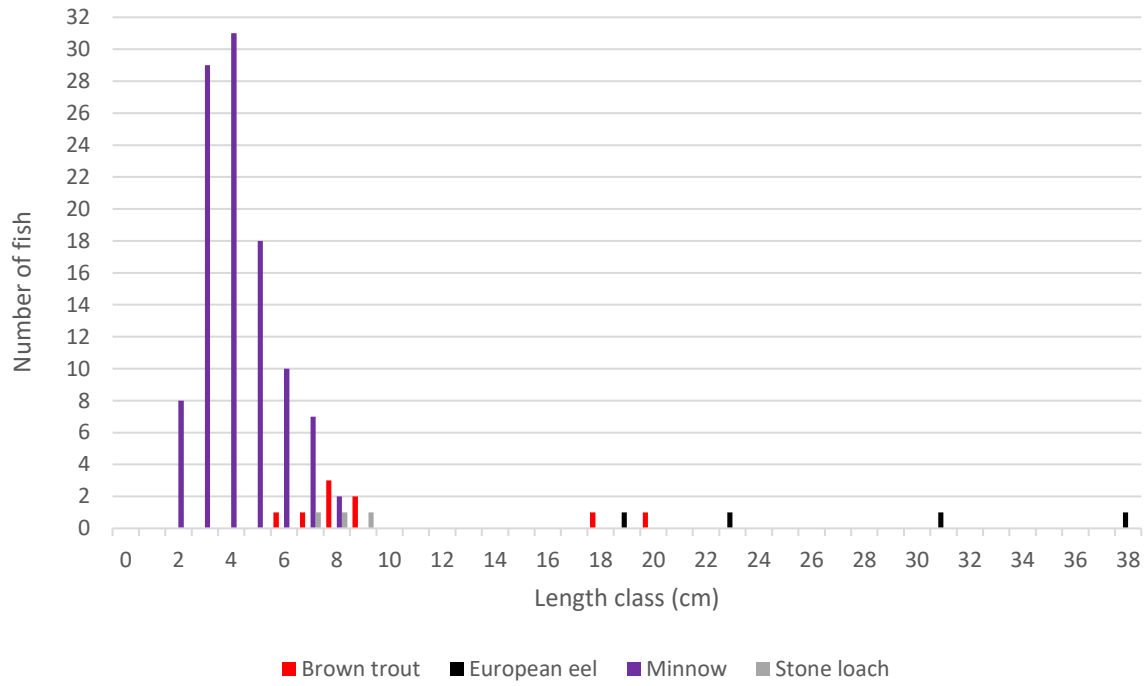

Figure 3.9 Length frequency distribution recorded via electro-fishing at site B10 on the Owveg River, September 2022

Plate 3.25 Atlantic salmon (top) and brown trout (bottom) recorded at site B10 on the Owveg River at Graiguenasmuttan Bridge, September 2022

3.1.26 Site C1 – Knocklead Stream, Knockacrin

No fish were recorded via electro-fishing at site C1. The site was not of fisheries value given its semi-dry, ephemeral nature and location in the upper reaches of the catchment. Given this, and naturally high gradients, connectivity with downstream habitats was poor and the stream had no suitability to support fish at this location even under higher water levels.

Plate 3.26 Representative image of site C1 on the Knocklead Stream, August 2022

3.1.27 Site C2 – Clogh River, Coolglass

Brown trout (*n*=2) was the only fish species recorded via electro-fishing at site C2 (**Figure 3.10**).

The site was of relatively low value for salmonids given its location in the upper reaches of the catchment and spate nature. However, the site supported a very low density of trout and some suitable spawning and holding habitat was present. The site was of poor value as a salmonid nursery. Holding areas supporting boulder and cobble provided some low suitability for European eel but none were recorded. The upland eroding channel was unsuitable for lamprey.

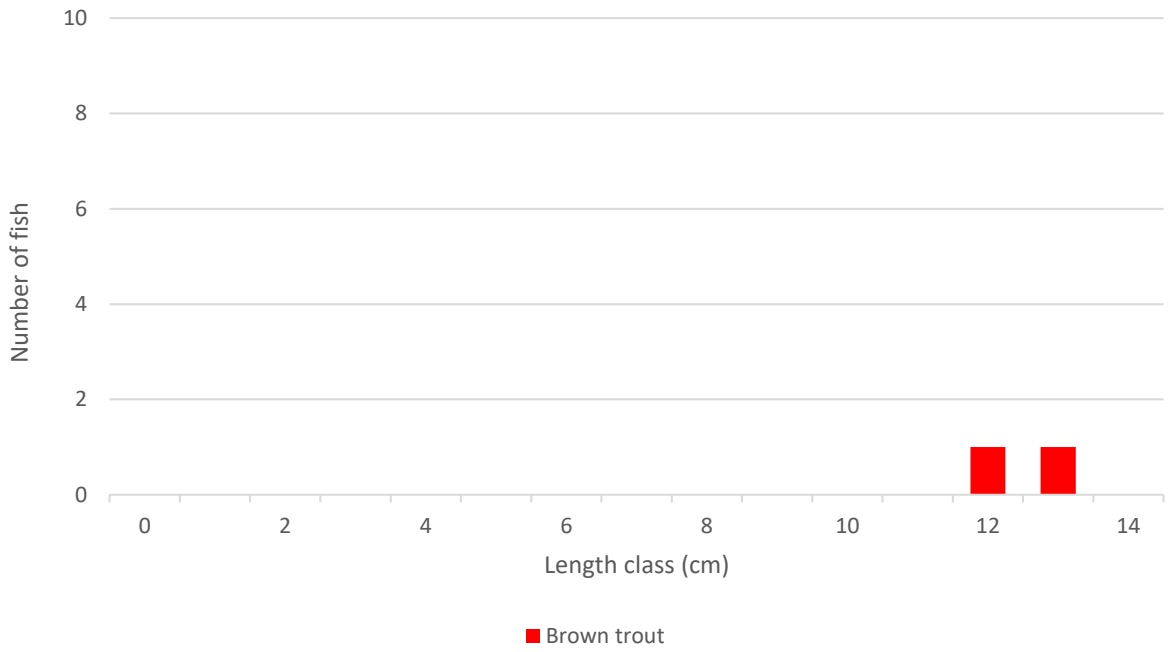

Figure 3.10 Length frequency distribution recorded via electro-fishing at site C2 on the upper reaches of the Clogh River, September 2022

Plate 3.27 Representative image of site C2 on the upper reaches of the Clogh River, August 2022

3.1.28 Site C3 – Brennanshill River, Coolglass

Brown trout (*n*=2) was the only fish species recorded via electro-fishing at site C3 (**Figure 3.11**).

The site was of moderate value for salmonids, supporting a very low density of mixed-cohort brown trout. Whilst some good quality spawning (finer gravels) and moderate quality nursery habitat (cobble & boulder) were present, low seasonal flows reduced the value of the site considerably (i.e. semi-dry). Although small pools were frequent, these provided poor quality holding habitat for adult salmonids given the small nature of the river at this location. Likewise, the shallow depth and seasonality of the spate site provided poor suitability for European eel (none recorded). The upland eroding channel was unsuitable for lamprey. The site was likely of greater fisheries value during higher flow periods (given connectivity with downstream habitats) and suitability improved considerably downstream.

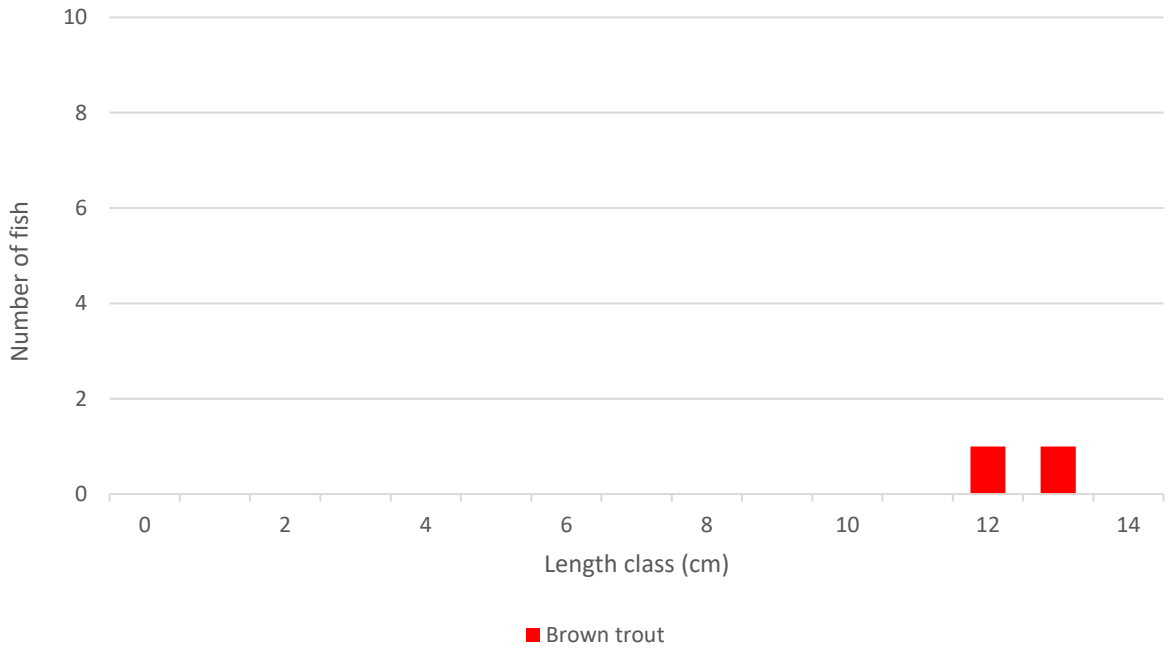

Figure 3.11 Length frequency distribution recorded via electro-fishing at site C3 on the Brennanshill River, August 2022

Plate 3.28 Juvenile brown trout recorded at site C3 on the Brennanshill River, August 2022

3.1.29 Site C4 – Clogh River, Moyadd

Brown trout (*n*=8), lamprey (*Lampetra* sp.) (*n*=14), three-spined stickleback (*n*=22), minnow (*n*=16) and stone loach (*n*=12) were recorded via electro-fishing at site C4 (**Figure 3.12**).

The site was of good value to salmonids despite low (and known regular) low seasonal flows and subsequent reduction in fisheries habitat quality. The site supported a low density of mixed-cohort brown trout (primarily adult fish). Physically, the site was of most value as spawning and nursery area although these attributes were compromised by very low seasonal water levels (i.e. a semi-dry channel with only slight flows). Good quality holding habitat was also present, with frequent small pools and scoured banks providing valuable areas for adult salmonids. These areas were especially important given evident low flows. Furthermore, the heavily shaded nature of the site likely facilitated the persistence of a small salmonid population given the presence of thermal refugia. Despite the upland eroding characteristics and presence of sub-optimal, sand-dominated soft sediment, the site supported *Lampetra* sp. ammocoetes. These were present but highly localised, with one area supporting 14 per m^2. Despite some good suitability for European eel, none were recorded via electro-fishing.

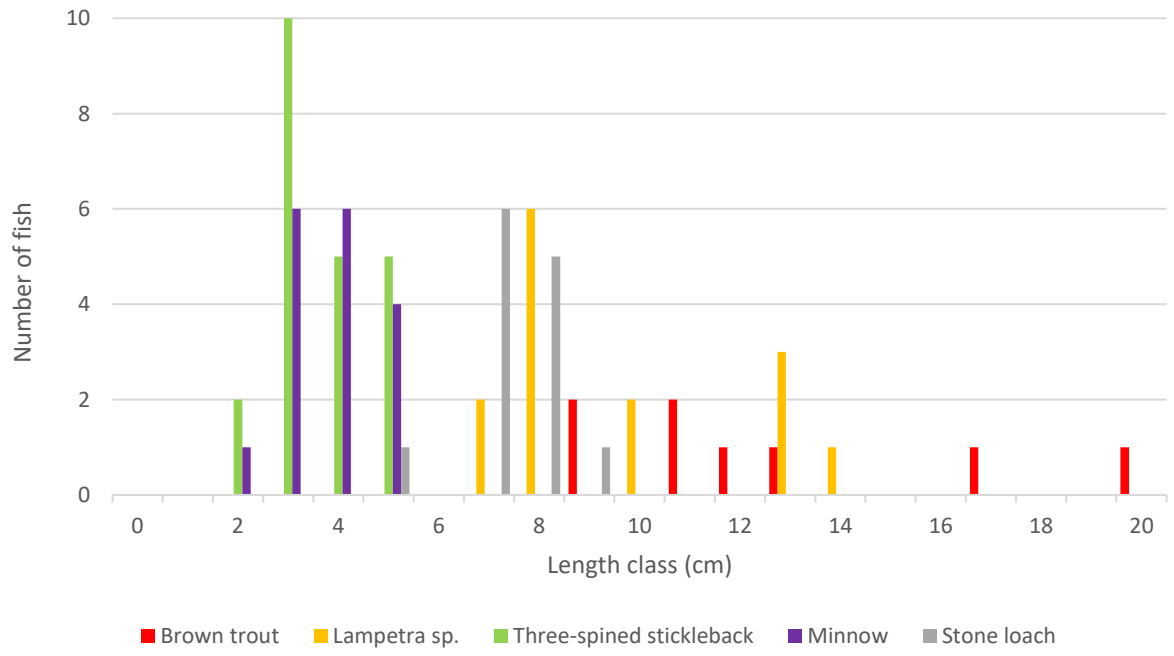

Figure 3.12 Length frequency distribution recorded via electro-fishing at site C4 on the Clogh River, August 2022

Plate 3.29 *Lampetra* sp. ammocoetes recorded at site C4 on the Clogh River, August 2022

3.1.30 Site C5 – Moyadd Stream, Kylenabehy

Site C5 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Given the dry nature of the site, it was not possible to undertake electro-fishing at this site at the time of survey. However, given some physical suitability and close proximity to the Clogh River, the stream in its lower reaches may support a low density of fish during wetter periods.

Plate 3.30 Representative image of site C5 on the Moyadd Stream, August 2022 (dry, ephemeral channel at the Clogh River confluence)

3.1.31 Site C6 – Clogh River, Swan Bridge

Brown trout (*n*=3), lamprey (*Lampetra* sp.) (*n*=39), three-spined stickleback (*n*=2), minnow (*n*=21) and stone loach (*n*=7) were recorded via electro-fishing at site C6 (**Figure 3.13**).

The site was of good value for salmonids and supported a low density of juvenile brown trout, despite low seasonal water levels and evident siltation pressures. Whilst spawning habitat was sparse and of moderate quality (at best), some good quality nursery and holding habitat was present. The semi-dry channel over bedrock and the bridge aprons created impassable barriers to salmonid migration at low flows. The site was of highest value as a *Lampetra* sp. nursery, with shallow (<5cm) organic-rich soft sediment deposits supporting a relatively high density (>c.10 per m^2) of particularly large ammocoetes (**Plate 3.31**). Lamprey spawning habitat (finer gravels) was present but limited in extent at exposed to siltation pressures. Despite some suitability for European eel (scoured banks, pool areas etc.), none were recorded.

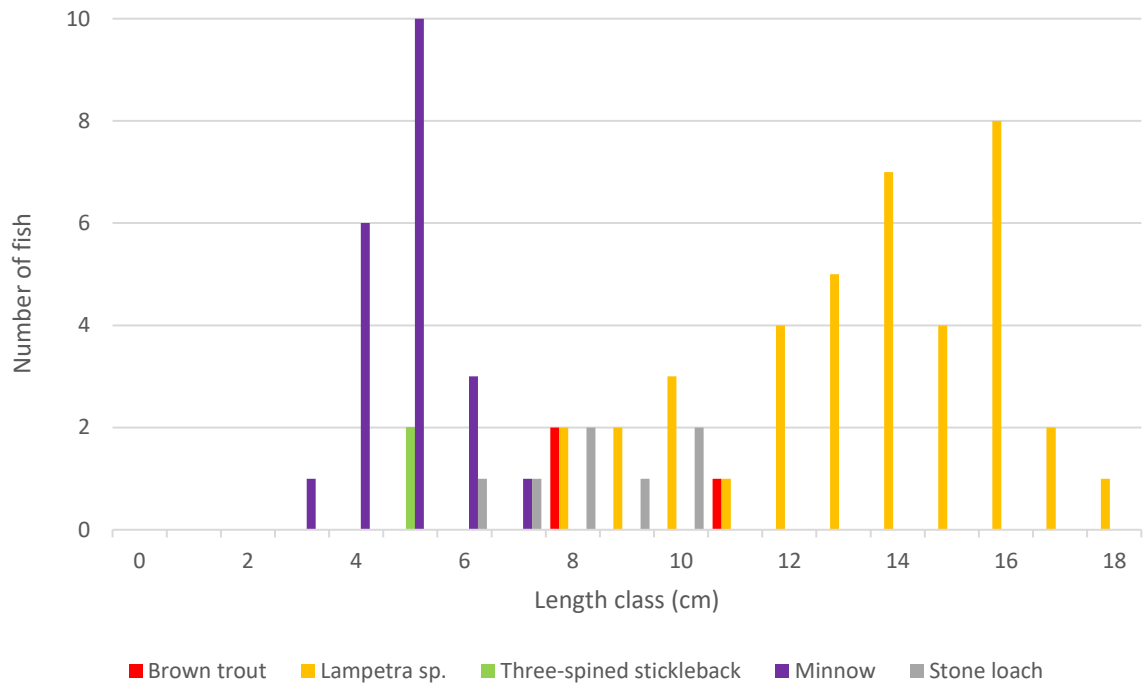

Figure 3.13 Length frequency distribution recorded via electro-fishing at site C6 on the Clogh River, August 2022

Plate 3.31 Example of particularly large *Lampetra* sp. ammocoete recorded at site C6 on the Clogh River at Swan Bridge, August 2022

3.1.32 Site C7 – Clogh River, Clogh Bridge

Brown trout (*n*=33), lamprey (*Lampetra* sp.) (*n*=4), three-spined stickleback (*n*=4), minnow (*n*=60) and perch (*Perca fluviatilis*) (*n*=3) were recorded via electro-fishing at site C7 (**Figure 3.14**).

The site was of high value to salmonids, supporting a high density of adult brown trout. The site was of most value as an adult holding habitat, with deeper glide areas and macrophyte beds providing valuable holding areas and thermal refugia in an otherwise open, shallow channel. The site was of poor value as a nursery habitat given poor seasonal flows (physically suitable but no juveniles recorded). Spawning habitat was present for both salmonids and lamprey but was limited in extent and exposed to siltation pressures. Atlantic salmon are also known from this site (IFI 2021 data). The site supported a low density of *Lampetra* sp. ammocoetes, despite apparent widespread suitability (e.g. macrophyte-related silt deposits). Despite some good suitability, no European eel were recorded.

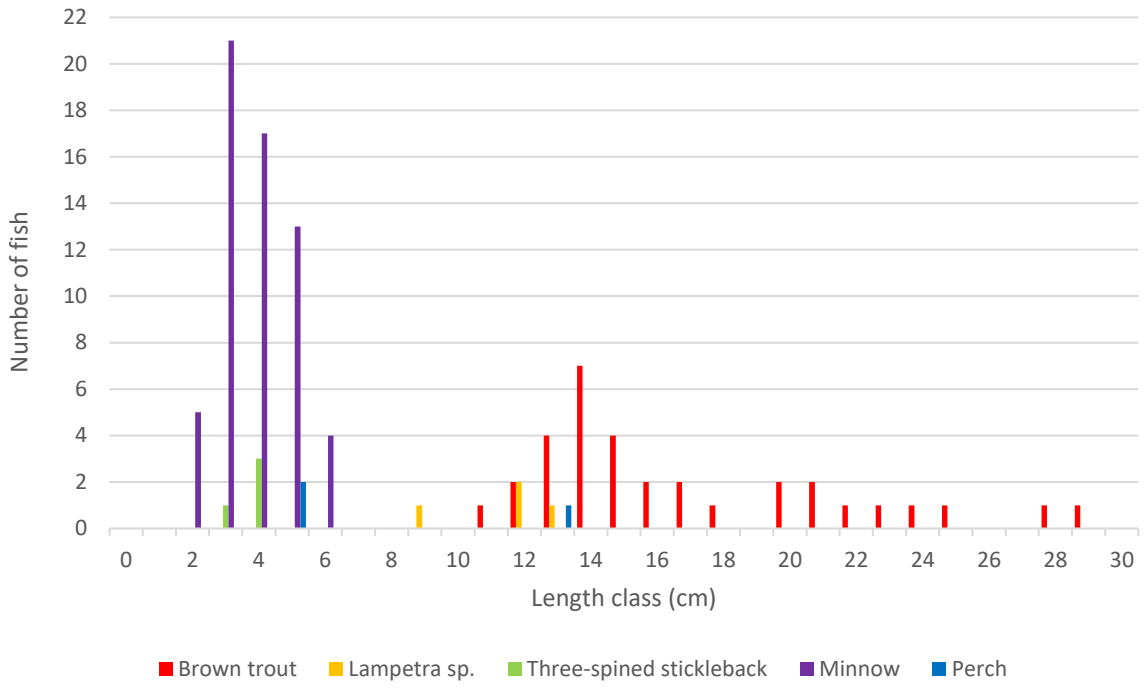

Figure 3.14 Length frequency distribution recorded via electro-fishing at site C7 on the Clogh River, August 2022

Plate 3.32 Large adult brown trout recorded at site C7 on the Clogh River at Clogh Bridge, August 2022

3.1.33 Site D1 – Douglas River, Shanragh Bridge

Brown trout (*n*=3), three-spined stickleback (*n*=3) and stone loach (*n*=1) were recorded via electro-fishing at site D1 (**Figure 3.15**).

Site D1 was of good value for salmonids. However, despite the presence of good quality nursery habitat and good quality (albeit localised) spawning substrata, the site supported only a very low density of brown trout. This was perhaps reflective of low seasonal flows (i.e. fish had perhaps dropped down the system). Frequent small pools provided some suitable holding habitat for smaller adults although the paucity of deeper areas reduced suitability for larger migratory salmonids (e.g. Atlantic salmon). The cobbled bridge apron, in addition to natural cascades, were barriers to fish passage at low flows (depth <0.05m). Despite some moderate suitability as a nursery habitat, no European eel were recorded. The upland eroding site was not suitable for lamprey.

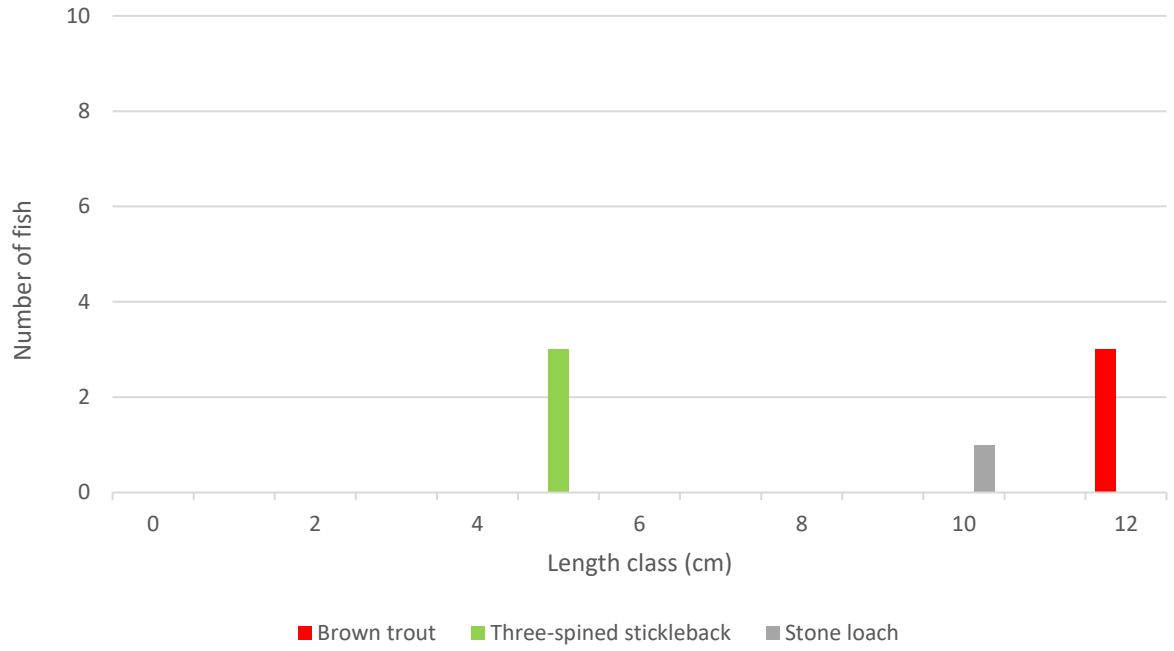

Figure 3.15 Length frequency distribution recorded via electro-fishing at site D1 on the Douglas River, August 2022

Plate 3.33 Brown trout and three-spined stickleback recorded at site D1 on the upper reaches of the Douglas River, August 2022

Table 3.1 Fish species densities per m^2 recorded at sites in the vicinity of the proposed Coolglass wind farm via electro-fishing in August-September 2022 (values in bold represent the highest densities recorded for each species, respectively)

Site	Watercourse	CPUE (elapsed time)	Approx. area fished (m^2)	Fish density (number fish per m^2)							
				Atlantic salmon	Brown trout	*Lampetra* sp.	European eel	Minnow	Stone loach	Three-spined stickleback	Perch
A1	Fallowbeg Upper Stream	Dry channel		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A2	Crooked River	Dry channel		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A3	Unnamed stream	Dry channel		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A4	Honey Stream	5	20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A5	Honey Stream North	5	10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A6	Crooked River	10	165	0.000	**0.152**	2 per m^2	0.000	0.000	0.006	0.006	0.000
A7	Aghoney Stream	Dry channel		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A8	Fossy Lower Stream	Dry channel		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A9	Fossy Lower Stream	Dry channel		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A10	Timahoe Stream	Dry channel		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A11	Stradbally River	10	150	0.000	0.040	2.67 per m^2	0.000	0.360	0.007	0.020	0.000
A12	Cremorgan Stream	5	20	0.000	0.000	0.000	0.000	0.000	0.000	**0.700**	0.000
A13	Unnamed stream	Dry channel		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A14	Stradbally River	10	180	0.000	0.061	0.000	0.000	0.156	0.006	0.106	0.000
A15	Stradbally River	10	240	**0.038**	0.108	1.5 per m^2	0.000	0.158	0.000	0.104	0.000

Site	Watercourse	CPUE (elapsed time)	Approx. area fished (m^2)	Fish density (number fish per m^2)							
				Atlantic salmon	Brown trout	*Lampetra* sp.	European eel	Minnow	Stone loach	Three-spined stickleback	Perch
B1	Scotland Stream	5	5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2	Owveg River	5	80	0.000	0.025	0.000	0.000	0.000	0.000	0.000	0.000
B3	Owveg River	5	90	0.011	0.122	0.000	0.000	0.333	0.033	0.000	0.000
B4	Cleanagh Stream	5	70	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B5	Garrintaggart Stream	5	10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B6	Garrintaggart Stream	5	60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B7	Owveg River	5	20	0.000	0.000	0.000	**0.200**	**2.750**	**0.100**	0.000	0.000
B8	Owveg River	10	195	0.000	0.046	0.000	0.021	0.538	0.015	0.000	0.000
B9	Graiguenahown Stream	5	5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B10	Owveg River	10	210	0.010	0.029	5.6 per m^2	0.000	0.405	0.052	0.000	0.000
C1	Knocklead Stream	5	15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2	Clogh River	10	150	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000
C3	Brennanshill River	10	110	0.000	0.027	0.000	0.000	0.000	0.000	0.000	0.000
C4	Clogh River	10	195	0.000	0.041	**14 per m^2**	0.000	0.082	0.062	0.113	0.000
C5	Moyadd Stream	Dry channel		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C6	Clogh River	10	220	0.000	0.014	13 per m^2	0.000	0.095	0.032	0.009	0.000
C7	Clogh River	10	240	0.000	0.138	2 per m^2	0.000	0.250	0.000	0.017	**0.013**
D1	Douglas River	10	250	0.000	0.012	0.000	0.000	0.000	0.004	0.012	0.000

Table 3.2 Summary of fish species of higher conservation value recorded via electro-fishing per survey site in the vicinity of the proposed Coolglass wind farm, August-September 2022

Site	Watercourse	Atlantic salmon	*Lampetra* sp.	Brown trout	European eel	Other species
A1	Fallowbeg Upper Stream	No fish recorded – dry channel				
A2	Crooked River	No fish recorded – dry channel				
A3	Unnamed stream	No fish recorded – dry channel				
A4	Honey Stream	No fish recorded				
A5	Honey Stream North	No fish recorded				
A6	Crooked River		✓	✓		Three-spined stickleback, stone loach
A7	Aghoney Stream	No fish recorded				
A8	Fossy Lower Stream	No fish recorded – dry channel				
A9	Fossy Lower Stream	No fish recorded				
A10	Timahoe Stream	No fish recorded – dry channel				
A11	Stradbally River		✓	✓		Three-spined stickleback, stone loach, minnow
A12	Cremorgan Stream					Three-spined stickleback
A13	Unnamed stream	No fish recorded				
A14	Stradbally River			✓		Three-spined stickleback, stone loach, minnow
A15	Stradbally River	✓	✓	✓		Three-spined stickleback, minnow
B1	Scotland Stream	No fish recorded				
B2	Owveg River			✓		
B3	Owveg River	✓		✓		Minnow, stone loach
B4	Cleanagh Stream	No fish recorded				
B5	Garrintaggart Stream	No fish recorded				
B6	Garrintaggart Stream	No fish recorded				
B7	Owveg River				✓	Minnow, stone loach
B8	Owveg River			✓	✓	Minnow, stone loach
B9	Graiguenahown Stream	No fish recorded				
B10	Owveg River	✓	✓	✓		Minnow, stone loach
C1	Knocklead Stream	No fish recorded				
C2	Clogh River			✓		
C3	Brennanshill River			✓		

Site	Watercourse	Atlantic salmon	*Lampetra* sp.	Brown trout	European eel	Other species
C4	Clogh River		✓	✓		Three-spined stickleback, stone loach, minnow
C5	Moyadd Stream	No fish recorded – dry channel				
C6	Clogh River		✓	✓		Three-spined stickleback, stone loach, minnow
C7	Clogh River		✓	✓		Perch, minnow, three-spined stickleback
D1	Douglas River			✓		Three-spined stickleback, stone loach

Conservation value: Atlantic salmon (*Salmo salar*), brook lamprey (La*mpetra planeri*) and river lamprey (*Lampetra fluviatilis*) are listed under Annex II of the Habitats Directive [92/42/EEC]. Atlantic salmon and river lamprey are also listed under Annex V of the Habitats Directive [92/42/EEC]. 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 Inland Fisheries Acts 1959 to 2017, brown trout and coarse fish species have no legal protection in Ireland.

4. Discussion

The watercourses in the vicinity of the proposed Coolglass wind farm were typically small, modified, upland eroding and lowland depositing channels (many of which were ephemeral). Historical drainage pressures (straightening & deepening), eutrophication and siltation have significantly reduced the quality and heterogeneity of aquatic habitats in the vicinity of the proposed project. Low summer water levels and ephemeral conditions are a characteristic of the Nore_SC_060, Dinin[North]_SC_10, Barrow_SC_050 and Barrow_SC_070 river sub-catchments and were evidently a major issue for fish populations in the vicinity of the proposed project. Intermittent flows resulted in degraded fisheries habitat, particularly due to high thermal stress and agricultural (siltation and eutrophication) pressures. Low water levels also exacerbated known instream barriers (AMBER Consortium, 2020) on many watercourses (**Figure 1.1; Plate 4.1**). A total of 17 no. sites did not support fish at the time of survey (i.e. dry or semi-dry channels).

4.1 Salmonids

With the exception of sites A12 on the Cremorgan Stream and B7 on the Owveg River (semi-dry spate channels), salmonids were recorded at all 15 no. sites supporting fish during the survey (**Table 3.1, 3.2**). This was in spite of widespread low water levels in addition to siltation, eutrophication and or hydromorphological pressures. Salmonid populations were typically small, where encountered. Atlantic salmon were present (in low densities) at 3 no. sites only, on the Stradbally River (A15) and Owveg River (B3 & B10). The Stradbally River and Crooked River, draining to the north of the proposed project, supported the highest densities of Atlantic salmon and brown trout, respectively (**Table 3.1**). As might be expected given they are the most significant watercourses in vicinity of the project, the Stradbally, Crooked, Owveg, Clogh, and to a lesser extent, Douglas rivers provided the best quality salmonid habitat.

In lowland rivers, Atlantic salmon density is known to be positively correlated with instream vegetation (especially *Ranunculus* sp.) and numbers of nearby upstream spawning areas (redds), whilst brown trout density is typically dependant on flow velocity heterogeneity (Marsh et al., 2020). Historical straightening and deepening of watercourses removes habitat and hydromorphological heterogeneity, encourages sediment deposition and invariably results in an irreparable reduction in fisheries potential, particularly for salmonids (O'Grady et al., 2017, O'Grady, 2006). Diffuse siltation is one of the greatest threats to salmonid populations, particularly in agricultural catchments (Evans et al., 2006) such as that of the proposed Coolglass wind farm. Sediment not only blocks interstitial spaces in substrata (colmation) and limits oxygen supply to salmonid eggs (required for healthy embryonic development & successful hatching) but can also smother substrata, thus reducing available spawning habitat and impact macro-invertebrate communities on which salmonids feed (Kelly-Quinn et al., 2020; Davis et al., 2018; Conroy et al., 2016; Cocchiglia et al., 2012; Louhi et al., 2008, 2011; Walling et al., 2003; Soulsby et al., 2001).

Eutrophication (primarily from agriculture) is considered a primary threat to the health of Irish rivers (Trodd et al., 2022) and is evidently impacting salmonid (and fisheries) habitat in the vicinity of the proposed project. The presence of more nutrient-tolerant species like minnow, and to a lesser degree stone loach, in higher abundances than salmonids is also indicative of enrichment and declining water

quality status (Kelly et al., 2007). Such shifts in fish community structure were observed on numerous watercourses, including the Stradbally, Clogh and Owveg Rivers.

4.2 Lamprey

Lamprey ammocoetes (*Lampetra* sp.) were recorded from 7 no. sites on the Crooked River (site A6), Stradbally River (A11 & A15), Owveg River (B10), Clogh River (C4, C6 & C7) (**Table 3.2**). Low numbers of early-stage transformers were also recorded from sites on the Crooked River (A6) and Clogh River (C4 & C6) but speciation in the field was not possible due to the early stage of development (Gardiner, 2003). The siltation pressures and low summer flows observed across the study area reduced the quality of lamprey habitat, in addition to the often high energy/spate characteristics of the survey watercourses. Few sites featured optimal conditions for larval *Lampetra* spp., i.e. fine, organic-rich sediment deposits ≥5cm in depth (Aronsuu & Virkkala, 2014; Goodwin et al., 2008; Gardiner, 2003). *Lampetra* spp. generally fine, clean gravels required for spawning (Dawson et al., 2015; Rooney et al., 2013; Lasne et al., 2010). The quality of lamprey spawning habitat was compromised by siltation throughout the survey area (also for salmonids).

Ammocoetes were typically in low densities due to sub-optimal and or limited nursery habitat. However, particularly high densities were present at sites C4 (14 per m^2) and C6 (13 per m^2) on the Clogh River, which was considered the most important watercourse for lamprey in the wider survey area. *Lampetra* sp. demonstrating a patchy distribution in the survey area – a pattern previously noted in the Barrow catchment (Delanty et al., 2017; King, 2006) and others (pers. obs.). Larval lamprey dispersal and settlement is passive and entirely regulated by local, dynamic hydrographical (flow) regimes (Kelly & King, 2001; Malmqvist, 1983; Potter, 1980; Hardisty & Potter 1971) and distribution is often sporadic in watercourses which suffer from low summer flows and poor fluvial connectivity (such as those in the vicinity of the proposed project). This was exemplified at several survey sites where only low densities of larvae were recorded in seemingly suitable burial habitats (e.g. sites A15, C7).

4.3 European eel

European eel are Red-listed in Ireland (King et al., 2011) and are classed as 'critically endangered' on a global scale (Pike et al., 2020). European eel were only recorded in low densities from sites B7 and B8 on the Owveg River (**Table 3.1, 3.2**), despite widespread suitability elsewhere. As outlined above, this limited distribution was considered primarily as a result of low summer flows, as well as abundant instream migration barriers within the wider Nore_SC_060, Nore_SC_080 and Dinin[North]_SC_010 river sub-catchments (**Figure 1.1**). Furthermore, as eel occurrence decreases significantly with increasing distance from the sea (Degerman et al., 2019), the paucity of eel observed can be partly explained by the distance between the survey area and marine habitats (Matondo et al., 2021; Chadwick et al., 2007) (>100-140km instream distance).

Plate 4.1 The historical weir at Clogh Bridge, an example of a significant barrier to fish passage at low flows

Plate 4.2 Example of a natural and artificial barrier to fish passage on the karstic Owveg River at Spink Bridge (site B7), where the river frequently runs dry over an excessively high & fractured bridge apron

5. References

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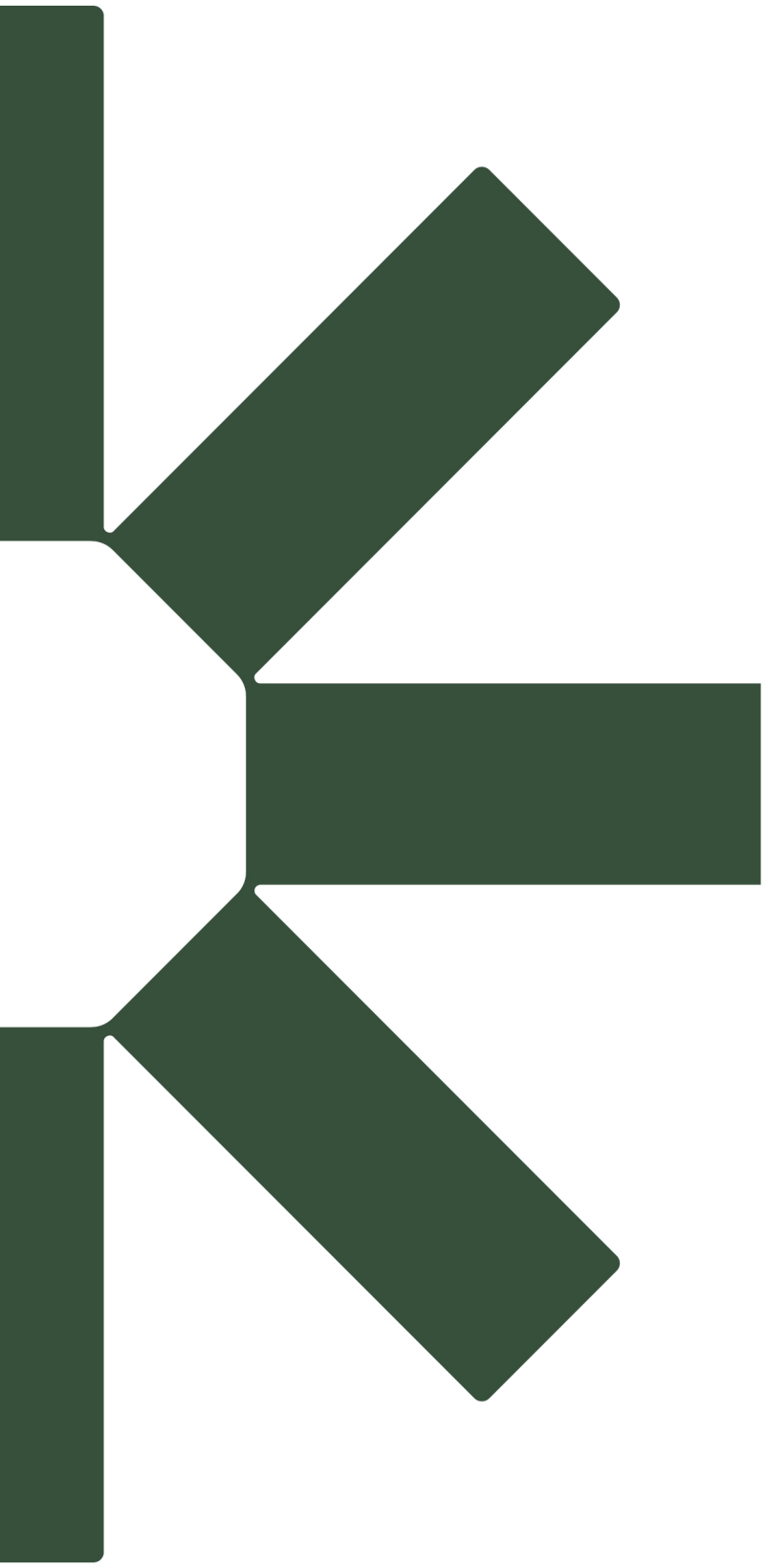

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