APPENDIX 6-3

AQUATIC BASELINE REPORT

Aquatic baseline report for Clonberne wind farm, Co. Galway

Prepared by Triturus Environmental Ltd. for MKO

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1. Introduction

1.1 Background

Triturus Environmental Ltd. were commissioned by MKO to conduct baseline aquatic surveys to inform EIAR preparation for the proposed Clonberne wind farm project. 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 Clonberne wind farm, located near Clonberne, Co. Galway.

Undertaken on a catchment-wide scale, the baseline surveys focused on aquatic habitats in relation to fisheries potential (including both salmonid and lamprey habitat), white-clawed crayfish (*Austropotamobious pallipes*), otter (*Lutra lutra*), macro-invertebrates, macrophytes, aquatic bryophytes, aquatic invasive species and fish of conservation value which may use the watercourses in the vicinity of the proposed project (**Figure 2.1**). Aquatic surveys were undertaken in August 2021.

The *n*=8 aquatic survey sites were located within the Sinking_SC_010 and Clare [Galway]_SC_040 river sub-catchments. Whilst not located within a European site, the proposed wind farm site (via several watercourses) shared downstream hydrological connectivity with the Lough Corrib SAC (000297).

1.2 Project description

A full description of the proposed project is provided in the accompanying 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[1] were considered as part of the current assessment. A total of *n*=8 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 Levally Stream (EPA code: 30L07), Lomaunaghroe Stream (30L35) and an unnamed tributary of the Sinking River (no EPA code) (**Table 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

Surveys of the watercourses within the vicinity of the proposed wind farm project were conducted in August 2021. Survey effort focused on both instream and riparian habitats at each sampling point (see **Figure 2.1** above). Surveys at each survey location included a fisheries assessment (electro-fishing, habitat appraisal), and (where suitable) biological water quality sampling (Q-sampling) (**Figure 2.1**). White-clawed crayfish (sweep netting & hand searching) surveys were also undertaken at each site, in addition to macrophyte & aquatic bryophyte and otter surveys. This holistic approach informed the overall aquatic ecological evaluation of each site in context of the proposed wind farm project. The survey approach 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 each 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

[1] Please note that a grid cable route (GCR) was not available at the time of survey and slight changes to the site boundary and proposed turbine array have also occurred since the surveys were undertaken in August 2021

Table 2.1 Location of *n*=8 aquatic survey sites in the vicinity of Clonberne wind farm near Clonberne, Co. Galway

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1	Unnamed stream	n/a	Kilmurry	554383	757815
A2	Unnamed stream	n/a	Killavoher	555167	758854
A3	Unnamed river	n/a	Addergoole More	551853	761481
B1	Levally Stream	30L07	Killavoher	555555	757071
B2	Levally Stream	30L07	Cloonarkan	554326	756653
B3	Lomaunaghroe Stream	30L35	Gortagarraun	553742	756575
B4	Levally Stream	30L07	Cloonarkan	554039	755754
B5*	Levally Stream	30L07	Mahanagh Bridge	555941	754209

* eDNA sampling for white-clawed crayfish, crayfish plague & freshwater pearl mussel

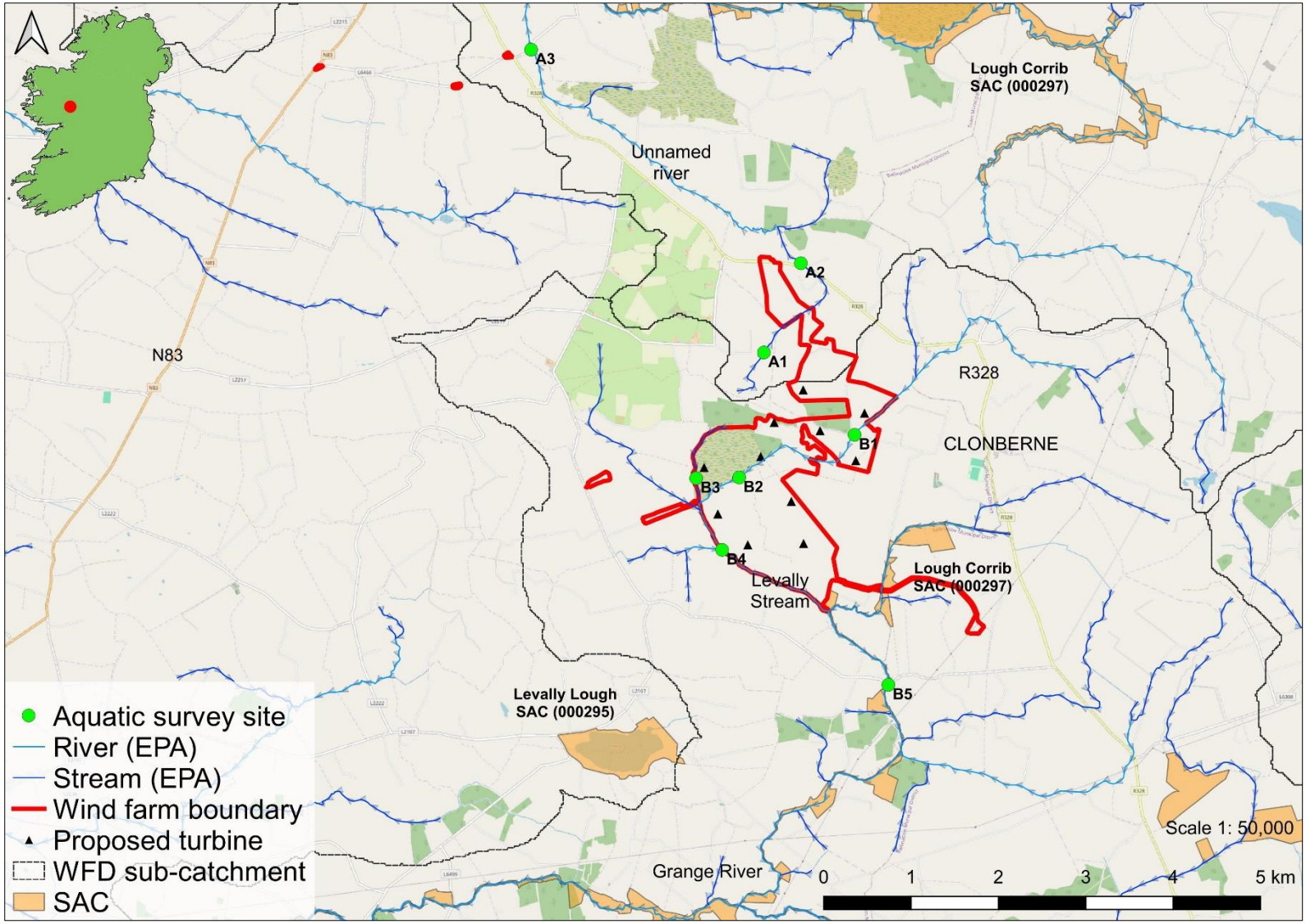

Figure 2.1 Overview of the *n*=8 aquatic survey sites for the proposed Clonberne wind farm project, Co. Galway, 2021

2.3 Catchment-wide electro-fishing

A catchment-wide electro-fishing (CWEF) survey of the watercourses within the vicinity of the proposed wind farm (*n*=8 sites, **Figure 2.1**) was conducted on the 18-19th August 2021, under the conditions of a Department of Communications, Climate Action & Environment (DCCAE) licence. The survey was undertaken in accordance with best practice and Section 14 licencing requirements.

Furthermore, a fisheries habitat appraisal of the watercourses in the vicinity of the proposed wind farm project (**Figure 2.1**) 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 2021 under a National Parks and Wildlife (NPWS) open licence (no. C145/2021), 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). Trapping of crayfish was not feasible given the small nature of most aquatic survey sites sampled. 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 Clonberne wind farm survey area was completed.

2.5 eDNA analysis

To validate traditional surveys (outlined above) and to detect potentially cryptically-low populations within the study area, a composite water sample was collected from the Levally Stream at survey site B5 (Mahanagh Bridge) and analysed for white-clawed crayfish environmental DNA (eDNA) (**Figure 2.1**). Furthermore, the sample was also analysed for crayfish plague given the known occurrence in the wider Clare River catchment. The water sample was collected in August 2021, with the site strategically chosen to maximise longitudinal (instream) coverage within the catchment (i.e. facilitating a greater likelihood of 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 does not provide quantitative data with regards to species abundance, it is an invaluable tool in clarifying a species' presence or absence. 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.

2.6 Biological water quality (Q-sampling)

The *n*=8 aquatic survey sites were assessed for biological water quality through Q-sampling in August 2021 (**Figure 2.1**). Some sites were largely unsuitable for Q-sampling during the survey period given low water levels/flows. Thus, results from samples taken at sites A1 (unnamed stream), B1 (Levally Stream), B2 (Levally Stream), B3 (Lomaunaghroe Stream) and B4 (Levally Stream) were considered as tentative only.

Macro-invertebrate samples were converted to Q-ratings as per Toner et al. (2005). All riverine samples were taken with a standard kick sampling hand net (250mm width, 500µm mesh size) from areas of riffle/glide utilising a three-minute sample. Large cobble was also washed at each site where present and samples were elutriated and fixed in 70% ethanol for subsequent laboratory identification. Any rare invertebrate species were identified from the NPWS Red List publications for beetles (Foster et al., 2009), mayflies (Kelly-Quinn & Regan, 2012), stoneflies (Feeley et al., 2020) and other relevant taxa (i.e. Byrne et al., 2009; Nelson et al., 2011).

Table 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

2.7 Macrophytes and aquatic bryophytes

Surveys of the macrophyte and aquatic bryophyte community were conducted by instream wading at each of the *n*=8 survey sites, 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 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]' (more commonly referred to as 'floating river vegetation'). Similarly, herb-rich communities in the margins of riverine habitats corresponding to the Annex I habitat 'Hydrophilous tall herb [6430]' were recorded where present.

2.8 Otter signs

The presence of otter (*Lutra lutra*) at each aquatic survey site was determined through the recording of otter signs, if encountered incidentally during surveys. 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.).

2.9 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).

2.10 Biosecurity

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

3. Desktop review

3.1 Survey area description

The proposed Clonberne wind farm is located in an area of cutover blanket bog within the townlands of Killavoher, Gortagarraun, Cloonarkan and Clonberne in east County Galway, approximately 7km south-east of Dunmore (**Figure 2.1**). The proposed wind farm site is within the Western River Basin District and within hydrometric area 30 (Corrib). The aquatic survey sites were located were located within the Sinking_SC_010 and Clare [Galway]_SC_040 river sub-catchments (**Figure 2.1**). The proposed wind farm site was drained by the Levally Stream (30L07), Lomaunaghroe Stream (30L35) and a number of unnamed tributaries of the Sinking River (**Table 2.1**).

The watercourses and aquatic surveys sites in the vicinity of Clonberne wind farm were typically small, lowland depositing channels (FW2; Fossitt, 2000) and peat drainage ditches (FW4) (see **section 4** for more details). Land use practices in the wider survey area were primarily peat bogs (CORINE 412) bordered by pastures (231) and land principally occupied by agriculture, with significant areas of natural vegetation (243). Predominantly, the watercourses flowed over areas of Carboniferous limestone and calcareous shale (Geological Survey of Ireland data).

3.2 Fisheries

Fisheries data for the watercourses within the survey area was not available at the time of survey. However, the wider Sinking River sub-catchment is known to support Atlantic salmon (*Salmo salar*), brown trout, (*Salmo trutta*), pike (*Esox lucius*), roach (*Rutilus rutilus*), stone loach (*Barbatula barbatula*) and three-spined stickleback (*Gasterosteus aculeatus*) (O'Briain et al., 2019). The Grange River, to which the Levally Stream joins downstream of the proposed wind farm site, is a key contributor to the genetic diversity of brown trout in Lough Corrib (Prodöhl, 2017). The Grange River sub-catchment is also known to support Atlantic salmon, pike, stone loach and three-spined stickleback (O'Briain et al., 2019). Both the Sinking River and Grange River are known to support *Lampetra* sp. lamprey (O'Connor, 2007).

3.3 Protected aquatic species (existing data)

A sensitive species data request was submitted (23/07/21) to the National Parks and Wildlife Service for the 10km grid squares containing and adjoining the proposed wind farm project (i.e. M44, M55, M56) and was received on the 24th September 2021. Records for a number of rare or protected species were available although most did not overlap directly with the survey area (**Figure 3.1**).

Within the wider survey area, numerous records for white-clawed crayfish (*Austropotamobius pallipes*) records were available from the Sinking River and Grange River, with a low number of records also available for the Levally Stream. These records were from the 1977-2020 period (NBDC/NPWS/NCPSP data; **Figure 3.1**). Whilst no records were available for the proposed wind farm site boundary, the nearest records were on the Levally Stream at Mahanagh Bridge (aquatic survey site B5). However, these were historical only (i.e. 1980 to 1989).

A low number of otter (*lutra lutra*) records were available for the relevant grid squares, with records from the Sinking River, Grange River and Lomaunaghroe Stream. However, these were historical only

(i.e. 1980). A low number of more contemporary records for otter were available for the Sinking River and Grange River (2012-2015 period; NBDC data).

Common frog (*Rana temporaria*) were widespread throughout 10km grid squares M44, M55, M56, although no records were available in the vicinity of the proposed wind farm. There were no records for smooth newt (*Lissotriton vulgaris*) within the 10km grid squares M44, M55 or M56 (NPWS & NBDC data).

3.4 EPA water quality (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 (i.e. after 2015) is summarised below. There were no existing EPA biological monitoring data available for the smaller watercourses surveyed, namely the Lomaunaghroe Stream or unnamed Sinking River tributary.

Please note that biological water quality analysis was undertaken as part of this study, with the results presented in the **section 4** and **Appendix B** of this report.

3.4.1 Levally Stream

The Levally River (EPA code: 30L07) flowed east to west through the centre of the wind farm site boundary before veering southwards towards the Grange River, which it joins approx. 5km downstream of the proposed site. There was a single EPA biological monitoring station that had been recently monitored on the river. The Levally Stream achieved **Q4** (good status) at station RS30L070100 in 2018, approx. 2.8km downstream of survey site B5.

The Levally Stream (Levally Stream_010 river-waterbody) was of moderate WFD status in the 2013-2018 period, with a River Waterbodies Risk score of 'at risk'. This was primarily due to both nutrients and siltation from agriculture and channel maintenance, respectively (EPA, 2019).

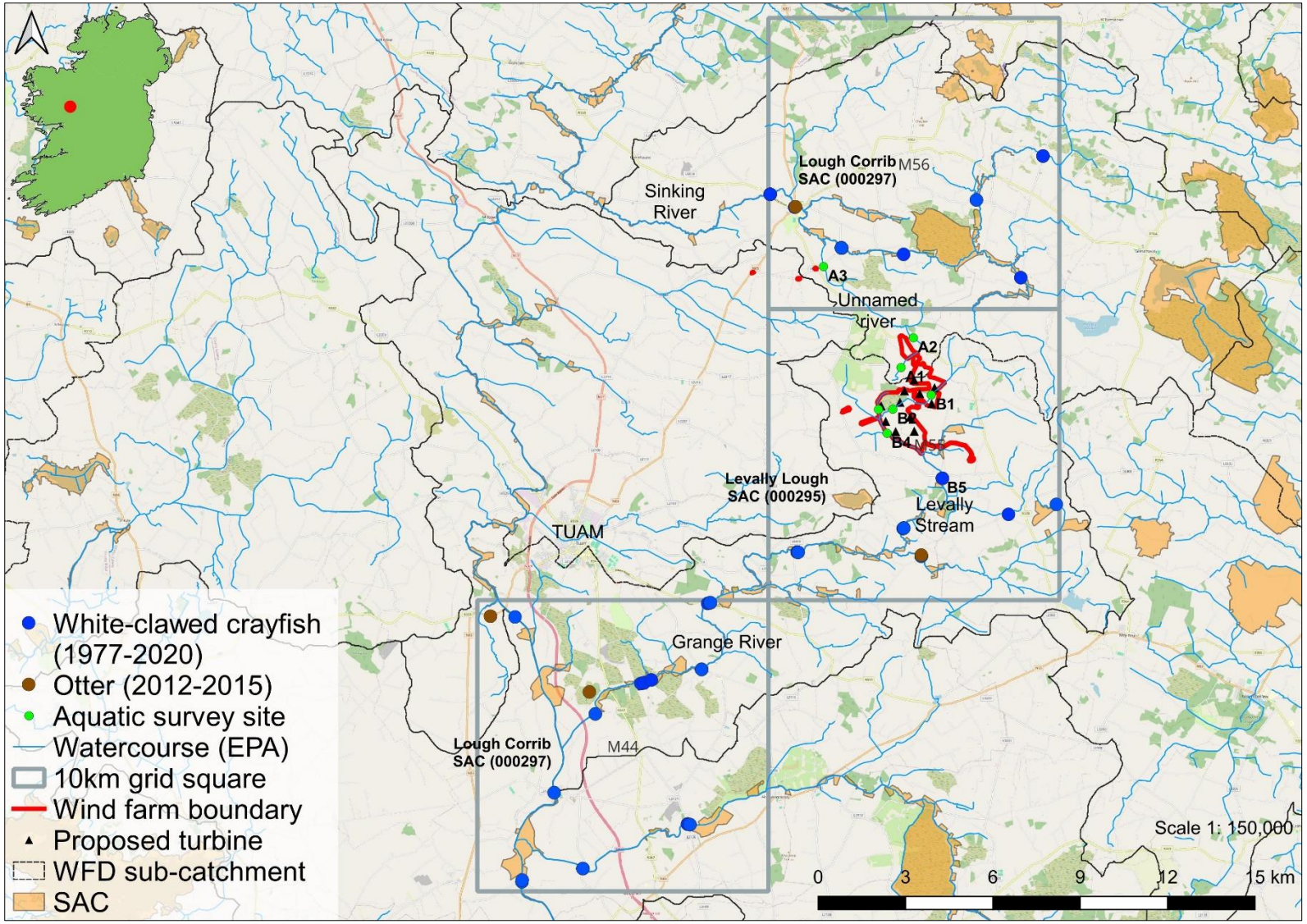

Figure 3.1 Distribution of white-clawed crayfish & otter records in the vicinity of the proposed Clonberne wind farm (source: NPWS, NBDC & NCPSP data)

4. Results of aquatic surveys

The following section summarises each of the *n*=8 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 sampling site (*n*=8) and in **Appendix B**. Habitat codes are according to Fossitt (2000). Scientific names are provided at first mention only. Sites were surveyed in August 2021. Please refer to **Appendix A** (fisheries assessment report) for more detailed fisheries results. An evaluation of the aquatic ecological importance of each survey site based on these aquatic surveys is provided and summarised in **Table 4.2**.

4.1 Aquatic survey site results

4.1.1 Site A1 – Unnamed stream, Kilmurry

Site A1 was located on the upper reaches of an unnamed Sinking River tributary (no EPA code) in an area of cutover bog (PB4). The small stream had been extensively straightened and over-deepened historically, with bankfull heights of 2-2.5m and a steep V-shaped channel. The stream represented a highly modified slow-flowing lowland depositing channel (FW2) that drained an area of cutover bog. The stream averaged <1m wide and <0.1m deep (often less). Slow-flowing glide predominated with only occasional deeper pool to 0.2m max. The substrata comprised 99% deep peat, with slumping/natural erosion of the peat banks evident in addition to peat sods within the channel. Small boulders were present but rare and very heavily bedded in peat. The site was heavily vegetated, with very high cover of watercress (*Nasturtium officinale*) and fool's watercress (*Apium nodiflorum*) (>70%), with few open areas of water. The narrow channel was also very heavily tunnelled by riparian scrub vegetation such as bramble (*Rubus fruticosus* agg.), gorse (*Ulex europaeus*), reed canary grass (*Phalaris arundinacea*) and herbaceous layers that often encroached the channel. The site was bordered by cutover bog (PB4) and scrub (WS1), with improved grassland (GA1) to the south.

Three-spined stickleback was the only fish species recorded via electro-fishing (**Appendix A**). With the exception of low densities of this species, the grossly silted channel was of very poor fisheries value, i.e. not of value to salmonids or lamprey species given the lack of flow and heavily-silted (peat) nature. The site offered no suitability for white-clawed crayfish or otter.

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.

The aquatic ecological evaluation of site A1 was of **local importance (lower value)** (**Table 4.2**).

Plate 4.1 Representative image of site A1 on an unnamed Sinking River tributary, August 2021

4.1.2 Site A2 – Unnamed stream, R328 road crossing, Kilavoher

Site A2 was located on an unnamed Sinking River tributary (no EPA code) at the R328 road crossing, approx. 1.5km downstream from site A1. The lowland depositing stream (FW2) had been straightened and deepened historically (particularly upstream of the bridge) and suffered from low flows at the time of survey. The channel averaged a homogenous 1.5-2m wide and 0.05-0.2m deep, with only very localised small, shallow pool to 0.3m. The bed featured frequent areas of fine to medium gravels with occasional cobble and small boulder. However, the substrata were heavily silted and bedded in areas of faster flows in vicinity of the bridge crossing. The bridge featured a rendered apron with only a small lip (0.15m-high) which was passable to fish at low summer flows. The channel was heavily vegetated overall, with most areas supporting heavy growth (>95% cover). In terms of macrophytes, watercress was often abundant with branched bur reed (*Sparganium erectum*) common. Water starwort (*Callitriche* sp.) was present occasionally. Filamentous algae (including *Cladophora* sp. and *Spirogyra* sp.) were present at 20% cover, indicating significant enrichment from adjoining agricultural lands. Long-beaked water feathermoss (*Platyhypnidium riparoides*) was present on the bridge apron and larger instream boulders. The semi-aquatic liverwort *Pellia endiviifolia* was present but rare on instream cobble and boulder. The narrow channel was heavily shaded by a riparian herbaceous community dominated by meadowsweet (*Filipendula ulmaria*) and great willowherb (*Epilobium hirsutum*), with isolated hawthorn (*Crataegus monoygna*) trees only. The site was adjoined by improved agricultural grassland (GA1) and hay meadows (GS2), with coniferous plantation (WD4) present downstream on the north bank.

Three-spined stickleback was the only fish species recorded via electro-fishing (**Appendix A**). Apart from moderate densities of this species, the site was of little value to salmonids or lamprey given low flow rates (at least in summer), siltation and enrichment pressures. Salmonid habitat was poor all-

round, with little spawning or holding habitat present. However, under higher flows (e.g. winter), the site was considered to provide some moderate-quality salmonid habitat. Whilst soft sediment areas were frequent, these were not accompanied by flow rates deemed necessary for lamprey ammocoetes. Despite some low suitability for European eel (primarily as a nursery), none were recorded. White-clawed crayfish were present at low densities (30 refugia searched, with two juvenile crayfish captured including a young-of-the-year hatchling; **Plate 4.3**). The overall suitability for crayfish was reduced by siltation, low flows and a general lack of accessible non-macrophyte refugia. No otter signs were recorded.

Biological water quality, based on Q-sampling, was calculated as **Q4 (good 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 white-clawed crayfish and good status water quality, the aquatic ecological evaluation of site A2 was of **local importance (higher value) (Table 4.2).**

Plate 4.2 Representative image of site A2 on an unnamed Sinking River tributary, August 2021 (facing downstream from bridge)

Plate 4.3 A white-clawed crayfish hatchling recorded from site A2 on an unnamed Sinking River tributary, August 2021

4.1.3 Site A3 – Unnamed stream, Adergoole More

Site A3 was located on an unnamed Sinking River tributary (no EPA code) at a local road crossing, approx. 4.5km downstream from site A2. The river had been extensively straightened and deepened historically, with steep bankfull heights often exceeding 3-4m. The river averaged 2.5-3m wide and 0.2-0.6m deep, with localised deeper pool areas to 1m. The site featured very slow flows at the time of survey with riffles only present in association with the rendered bridge apron (not a barrier to fish at low flows). Very slow-flowing glide habitat predominated. Whilst some mixed gravels and small cobble with occasional boulder were present in faster-flowing areas, the site mostly featured deep silt deposits and was heavily vegetated throughout (80% cover overall, with few open areas). The silt had a high clay fraction. Branched bur-reed was abundant with frequent stands of watercress. Common duckweed (*Lemna minuta*) and ivy-leaved duckweed (*Lemna trisulca*) were present throughout. Water starwort was occasional (small stands only). River water dropwort (*Oenanthe fluviatilis*) was present but rare. The moss species *Platyhypnidium riparoides* was common in faster-flowing areas near the bridge. Filamentous green algae (*Vaucheria* sp. and *Cladophora* sp.) was present (5%) cover, indicating enrichment. The channel was lined with reed canary grass and occasional iris (*Iris psuedacorus*), in addition to dense scrub (bramble and herbaceous species) which provided heavy shading, locally. Scattered willow (*Salix* sp.) and hawthorn were present on the banks. The site was adjoined by improved grassland (GA1), with livestock poaching (cattle) present upstream of the bridge.

A total of five species were recorded via electro-fishing, with brown trout (*Salmo trutta*), Atlantic salmon (*Salmo salar*), *Lampetra* sp., stone loach (*Barbatula barbatula*) and three-spined stickleback present (**Appendix A**). The site was of moderate value only to salmonids overall given high siltation rates and poor flows. However, a low density of brown trout was present (juveniles and adults), in

addition to a single Atlantic salmon parr. Despite some suitability (instream boulder and macrophyte refugia), no European eel were recorded. A very low density of *Lampetra* sp. ammocoetes was recorded (soft sediment habitat present but sub-optimal and clay-dominated where present). A low density of white-clawed crayfish were present (*n*=2 crayfish recorded from 30 refugia searched). Whilst present, refugia were generally bedded and poorly accessible. Despite suitable marking opportunities in vicinity of the bridge, no otter signs were recorded.

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 a salmonid population (including Atlantic salmon), *Lampetra* sp. and white-clawed crayfish, the aquatic ecological evaluation of site A3 was of **local importance (higher value)** (**Table 4.2**).

Plate 4.4 Representative image of site A3 on an unnamed Sinking River tributary, August 2021 (facing upstream from bridge)

4.1.4 Site B1 – Levally Stream, Kilavoher

Site B1 was located on the upper reaches of the Levally Stream (30L07) at a local road crossing. The stream had been extensively straightened and deepened historically (excavated to clay layer). The stream represented a slow-flowing lowland depositing watercourse (FW2) and averaged a homogenous 3-4m wide and 0.3-0.6m deep with localised deeper pool to >1m in a deep U-shaped channel. Slow-flowing glide predominated with localised pool. The bridge featured a rendered bridge apron which although shallower than the surrounding channel (0.1m) was also slow-flowing. Riffles were absent. The substrata were dominated by moderately silted gravels and small cobble, with localised boulder. Some minor calcification was present and the substrata were partially-bedded. Soft

sediment deposits were frequent and were comprised of high peat fractions. The site was heavily vegetated (given low flows and siltation). Branched bur-reed was abundant (60% cover) with frequent common duckweed and fool's watercress. Water mint (*Mentha aquatica*) was common along the channel margins. Aquatic bryophytes were not recorded. Filamentous green algae (*Cladophora* sp.) was present at 5% cover, indicating enrichment. Freshwater sponge (likely *Ephydatia fluviatilis*) was present on the bridge apron. Encroachment from terrestrial species such as great willowherb and meadowsweet was high, with the steep banks supporting a well-developed herbaceous layer with very few trees. The site was bordered by improved grassland (GA1), dry meadows and grassy verges (GS2) habitats with and an immature alder plantation (WS2) to the west.

A total of three fish species were recorded via electro-fishing (**Appendix A**). Low densities of brown trout (mostly juveniles with few adults) and a single Atlantic salmon parr were recorded, in addition to moderate numbers of three-spined stickleback. The site was a moderate-quality salmonid nursery (at best) given heavy siltation, low seasonal flows and evident enrichment. However, some highly localised salmonid spawning habitat was present in the vicinity of the bridge(s). Holding habitat by way of deeper pool and glide was widespread. Despite the presence of soft sediment deposits, these were shallow and had a high peat-content. This, coupled with low flows precluded the presence of lamprey from the site (none recorded). Despite some good suitability, no European eel were recorded. A single juvenile white-clawed crayfish was recorded (moderate suitability overall). A regular otter spraint – mixed age - was present on the bridge ledge (upstream side; ITM 555532, 757066). The spraint contained diving beetle remains (*Dytiscus* sp.) but no crayfish remains were visible upon inspection.

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 a salmonid population (including Atlantic salmon) and white-clawed crayfish, in addition to otter utilisation, the aquatic ecological evaluation of site B1 was of **local importance (higher value)** (**Table 4.2**).

Plate 4.5 Representative image of site B1 on the Levally Stream, August 2021 (facing downstream from bridge)

4.1.5 Site B2 – Levally Stream, Cloonarkan

Site B2 was located on the Levally Stream at a bog access track crossing, approx. 1.7km downstream from site B1 in an area of cutover bog (PB4). The stream had been historically straightened and deepened and represented a large drainage channel/canal with very little flow at the time of survey. The channel averaged 6-7m wide in a deep U-shaped channel. The depth was generally >1m apart from the immediate vicinity of the bridge where the depth was 0.2-0.3m over the rendered bridge apron. The site was 100% slow-flowing glide with low peat-staining at the time of survey. The substrata comprised cobble and occasional boulder that were heavily bedded in silt/peat/clay. Apart from some superficial deposits on the bridge apron, no gravels were present. Macrophyte cover was relatively high (albeit less so than upstream), with unbranched bur-reed (*Sparganium emersum*) frequent. Water horsetail (*Equisetum fluviatile*) and water mint were present along channel margins, with common duckweed also frequent. Common reed (*Phragmites australis*) stands were present upstream and downstream of the bridge. Water starwort was present but rare. No aquatic bryophytes were recorded. Filamentous algae (*Cladophora* sp.) was present, indicating enrichment. The narrow riparian zones supported well-developed herbaceous communities (GS2). The site was located in an extensive area of cutover bog (PB4) with adjacent coniferous plantations (WD4) present to the north.

Brown trout and three-spined stickleback were the only fish species recorded via electro-fishing (**Appendix A**). However, it should be noted that the depth of the site (often >1.2m) prevented effective electro-fishing. A single adult trout was recorded in addition to moderate densities of stickleback. The site was of poor value as a salmonid nursery or spawning habitat, with some moderate value as a holding area (under higher flows only). Higher numbers of adult trout were likely present in deeper pool/glide areas. The clay and or peat-dominated soft sediment were largely unsuitable for lamprey

ammocoetes and none were recorded. Despite some good suitability, no European eel were recorded (although these may have been present in deeper pool areas). No white-clawed crayfish were recorded although areas of exposed clay bank provided some good burrowing habitat. No otter signs were recorded under the bridge structure (only available marking 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 salmonid population, the aquatic ecological evaluation of site B2 was of **local importance (higher value)** (**Table 4.2**).

Plate 4.6 Representative image of site B2 on the Levally Stream, August 2021 (facing downstream from bridge)

4.1.6 Site B3 – Lomaunaghroe Stream, Gortgarraun

Site B3 was located on the lower reaches of the Lomaunaghroe Stream approx. 0.1km upstream of the Levally Stream confluence, in an area of cutover bog (PB4). The stream represented a peat drainage channel (FW4) with low flows at the time of survey. The channel had been extensively straightened and deepened historically with steep, peat banks 2.5-3m high. The channel averaged 2.5m wide and 0.1-0.2m deep. A narrow pipe culvert was present under the bog access track. The substrata comprised 95% flocculent peat with localised patches of exposed clay. The soft sediment was often >1m deep (gross siltation). With the exception of the lowermost reaches near the Levally Stream confluence (which had been excavated and featured surprisingly clean mixed gravels and cobble plus exposed clay), no hard substrata were present. Macrophytes were limited to occasional stands of bulrush (*Typha latifolia*) and unbranched bur-reed, with less frequent stands of water starwort. No aquatic bryophytes were recorded. The steep peat banks supported dry meadows and

grassy verges habitat (GS2), with meadowsweet, common knapweed (*Centaurea nigra*) and rank grasses. The site was located in an area of active cutover bog (PB4) with a coniferous plantation (WD4) to the south.

Three-spined stickleback were the only fish species recorded via electro-fishing (**Appendix A**). Apart from moderate densities of this species, the channel was of very poor fisheries value. The stream was not of value to salmonids, eel or lamprey given gross siltation (from peat) and limited flows. However, the lowermost reaches provided some moderate-quality spawning habitat for salmonids and lamprey (although still silted) plus some limited value crayfish habitat (none recorded). However, this short section (10m long) was not representative of the stream as a whole. Fisheries value was significantly improved in the downstream-connecting Levally Stream. Otter prints were recorded in marginal mud immediately upstream of the pipe culvert (ITM 553779, 756319). Common frog (*Rana temporaria*) were recorded in the channel.

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

Given the utilisation by otter and common frog, the aquatic ecological evaluation of site B3 was of **local importance (higher value)** (**Table 4.2**).

Plate 4.7 Representative image of site B3 on the Lomaunaghroe Stream, August 2021 (facing upstream from culvert)

4.1.7 Site B4 – Levally Stream, Cloonarkan

Site B4 was located on the Levally Stream approx. 1.2km downstream of site B2, downstream of a coniferous plantation. As per upstream, the stream had been historically straightened and deepened. The site averaged a homogenous 4-5m wide and was invariably >1-1.5m deep. Slow-flowing glide predominated in the canal-like channel, which had been excavated to the clay layer (exposed clay banks present). The site (and stream overall) was heavily silted with deposits >0.3m deep on the bed. Cattle poaching was evident at the bridge (i.e. cattle drink with gross slumping of material into the channel). Some superficial mixed gravels, cobble and boulder were present but these were heavily bedded in silt. The site was not peat-stained at the time of survey. The survey site was located at a farm access bridge with a rendered apron and small 0.5m fall downstream (representing a slight barrier to fish at low flows). This area featured a large deep pool to 2m with abundant boulder and cobble (unlike most other areas of homogenous glide). Apart from the immediate vicinity of the bridge, the stream was heavily vegetated with abundant broad-leaved pondweed (*Potamogeton natans*) and unbranched bur-reed. Frequent ivy-leaved duckweed was present. Lesser pondweed (*Potamogeton pusillus*) was present but rare. Water starwort was occasional with the aquatic moss *Leptodictyum riparium* present locally on instream boulders. The semi-aquatic liverwort *Marchantia polymorpha* was present along channel margins. The channel margins supported a diverse range of plants including pink water speedwell (*Veronica catenata*), water forget-me-not (*Myosotis scorpioides*), greater spearwort (*Ranunculus lingua*), marsh ragwort (*Jacobaea aquatica*), marsh marigold (*Caltha palustris*) and abundant water mint, in addition to great willowherb and meadowsweet. Given the presence of ≥3 indicator species (see Devaney et al., 2013), the riparian community was considered to represented the Annex I habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]'. Trees had been cleared historically with only scattered hawthorn present. The site was adjoined by improved grassland (GA1) and coniferous plantations (WD4).

Four fish species were recorded via electro-fishing (**Appendix A**). However, it should be noted that the depth of the site (often >1.2m) prevented effective electro-fishing. A low number of juvenile and adult brown trout and three-spined stickleback were recorded, with a single Atlantic salmon parr. Two *Lampetra* sp. were present in sub-optimal (clay-dominated) soft sediment downstream of the bridge pool. With the exception of the single pool and faster-flowing area in vicinity of the bridge, the site was of poor value as a salmonid nursery or spawning habitat, with some moderate value as a holding area (improved during higher flow periods). Higher numbers of adult trout were likely present in deeper pool/glide areas. The clay and or peat-dominated soft sediment were largely unsuitable for lamprey ammocoetes, with only low densities recorded. Despite some good suitability, no European eel were recorded (although these may have been present in deeper pool areas). No white-clawed crayfish were recorded although areas of clay bank provided some good-quality burrowing habitat. Despite good suitability, no otter signs were recorded under the bridge structure (only available marking 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 the Annex I habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]', the aquatic ecological evaluation of site B4 was of **county importance** (**Table 4.2**).

Plate 4.8 Representative image of site B4 on the Levally Stream, August 2021 (facing upstream from bridge)

4.1.8 Site B5 – Levally Stream, Mahanagh Bridge

Site B5 was located on the Levally Stream ay Mahanagh Bridge, within the Lough Corrib SAC (000297). The lowland depositing river (FW2) had been straightened and deepened historically but, unlike upstream areas, good instream recovery was evident. The river averaged 5-6m wide and 0.2-0.5m deep, with only localised pool areas to 0.8m (mostly upstream of bridge). The channel flowed in a deep U-shaped channel with bankfull heights of 2.5-4m. Shallow swift-flowing glide dominated the site, with localised riffle and pool. Deeper glide (>100m section) was present upstream of the survey site. The substrata were dominated by well-sorted clean gravels and cobble, with frequent small boulders. Bedrock was present locally downstream of the bridge, with boulder zones located underneath the bridge arches. Sand deposits were present but localised (e.g. immediately downstream of bridge arches). Siltation was low overall (light plumes underfoot only) and the only soft sediment deposits present were in association with profuse macrophyte growth (and shallow, where present, <5cm deep). Upstream of the bridge (slightly slower-flowing glide) supported profuse growth of broad-leaved pondweed (50% cover) with occasional water starwort and small stands of branched bur reed. Fool's watercress and water mint were present in channel margins. Cover of aquatic bryophytes was high (30%) *Leptodictyum riparium* on stable boulders and cobble and occasional *Pellia endiviifolia*. *Fontinalis antipyretica* was present on larger boulders. Given the presence of ≥3 indicator species (see EC, 2013; Devaney et al., 2013), the macrophyte and aquatic bryophyte community recorded was considered representative of the Annex I habitat 'Water courses

of plain to montane levels, with submerged or floating vegetation of *Ranunculion fluitantis* and *Callitricho-Batrachion* or aquatic mosses [3260]'. Riparian shading was low with relatively open banks supported a well-developed herbaceous layer. Mature treelines of ash (*Fraxinus excelsior*), hawthorn, elder (*Sambucus nigra*) and willow were present. The site was bordered by dry meadows and grassy verge habitat (GS2) and improved grassland (GA1).

A total of five fish species were recorded via electro-fishing (**Appendix A**). The site was dominated by very high numbers of juvenile salmonids (both 0+ & 1+ Atlantic salmon and brown trout), with small numbers of adult trout. Stone loach were also present in high numbers, with moderate densities of *Lampetra* sp. ammocoetes and low numbers of three-spined stickleback. The site was an excellent-quality salmonid nursery with very high densities of juveniles present, primarily in association with broad-leaved pondweed beds. Salmonid spawning habitat was of excellent quality (clean, loose gravels and cobbles between macrophyte beds) with some good quality holding habitat present upstream of the site. Lamprey spawning habitat was also of good quality, locally, with some moderate-good quality (sub-optimal) ammocoete habitat (sand-dominated invariably, where present, very localised but some also in association with pondweed beds). European eel habitat was good, locally (e.g. underneath bridge structure) although none were recorded. Despite some high suitability, no white-clawed crayfish were recorded (50+ refugia searched). However, white-clawed crayfish eDNA was detected from this site (see section 4.6). 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**). 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 Lough Corrib SAC (000297), the aquatic ecological evaluation of site B5 was of **international importance.**

Plate 4.9 Representative image of site B5 on the Levally Stream, August 2021 (facing downstream towards bridge)

4.2 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*=8 sites (**Figure 4.1, Appendix B**). Site A2 on an unnamed Sinking River tributary achieved **Q4 (good status)** water quality, based on Q-sampling, and thus met the good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC).

Water samples from sites A3 (unnamed Sinking River tributary) and B1 (Levally Stream) achieved **Q3-4 (moderate status)** water quality, whilst sites A1 & A3 (unnamed Sinking River tributary), B2, B4 & B5 (Levally Stream) and B3 (Lomaunaghroe Stream) achieved **Q3 (poor status)** water quality, Therefore, with the exception of site A2, all survey sites failed to meet the good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC).

Sites A1, B2, B3 (tentative rating) and B4 achieved Q3 (poor status) given the absence of EPA group A (sensitive) and group B (less sensitive) species, and a dominance of group C species such as freshwater shrimp (*Gammarus duebeni*), New Zealand mud snail (*Potamopyrgus antipodarum*) and chironomid larvae, in addition to group D (pollution tolerant) species such as freshwater hoglouse (*Asellus aquaticus*). Sites A3 and B1 were elevated to Q3-4 (moderate status) given the presence of low numbers of group B and group A and B species, respectively. Site A2 achieved Q4 (good status) given the presence of group A flattened mayfly species Autumn dun (*Ecdyonurus dispar*) in fair numbers (i.e. 8% of sample). No other group A species were recorded in the samples (**Appendix B**).

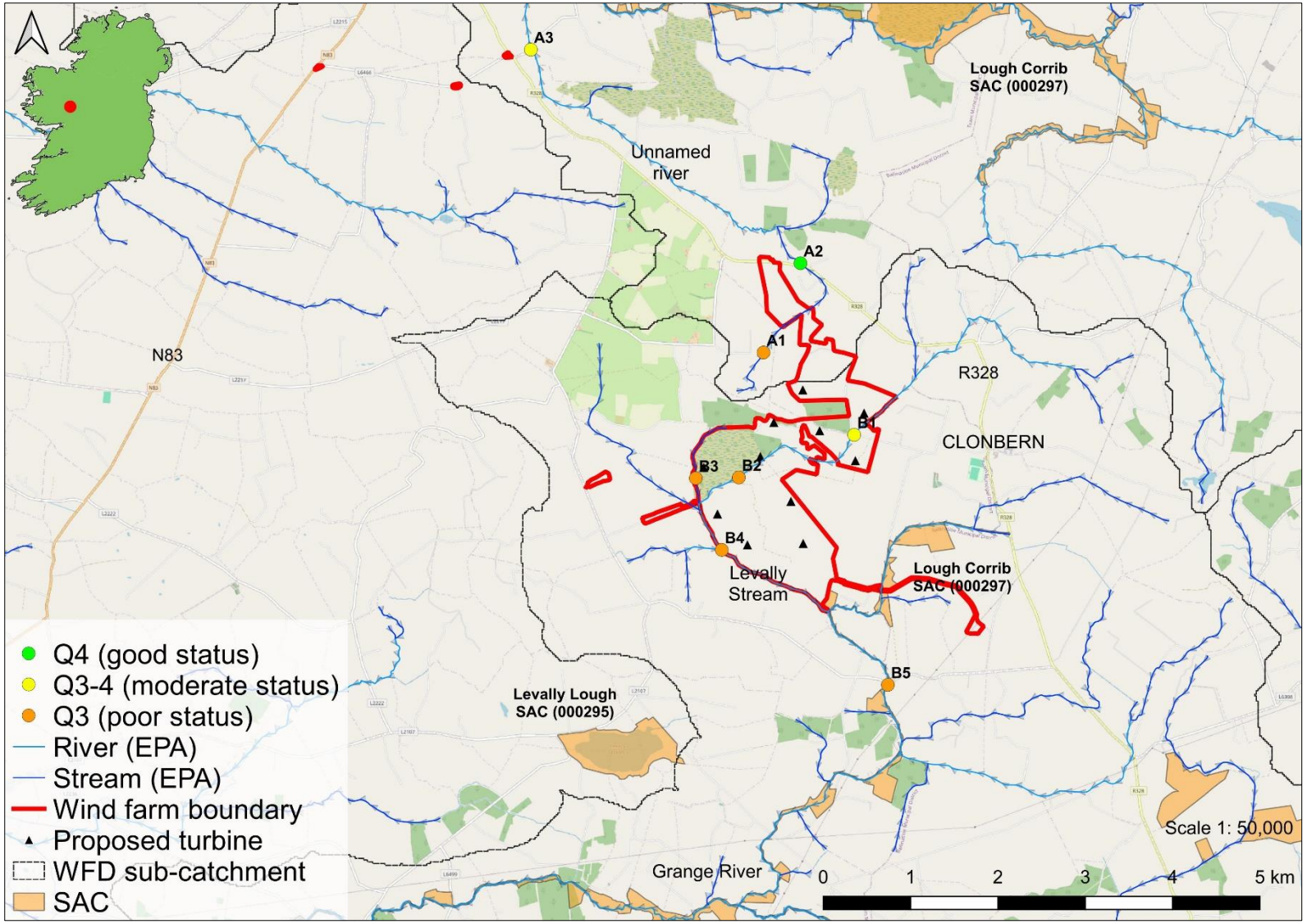

Figure 4.1 Overview of the biological water quality status in the vicinity of the proposed Clonberne wind farm project, Co. Galway, 2021

4.3 Macrophytes and aquatic bryophytes

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the

The fenced-off riparian zone of site B4 on the Levally Stream was found to support the Annex I habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]'. This was considered based on the good diversity of riparian plants at the site and the presence of ≥3 indicator species (EC, 2013; Devaney et al., 2013), including meadowsweet (*Filipendula ulmaria*), great willowherb (*Epilobium hirsutum*), water forget-me-not (*Myosotis scorpioides*) and abundant water mint (*Mentha aquatica*).

The Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation or aquatic mosses [3260]' was recorded at survey site B5 on the Levally Stream (Mahanagh Bridge). This was based on the presence of ≥3 indicator species for the habitat (EC, 2013; Weekes et al., 2018), namely broad-leaved pondweed (*Potamogeton natans*; 50% cover), water starwort (*Callitriche* sp.), fool's watercress (*Apium nodiflorum*) and a high coverage of aquatic bryophytes such as *Leptodictyum riparium* and *Fontinalis antipyretica*. Although further work to define the quality of FRV habitat in an Irish context is required, the presence of three indicator species can typically be considered more representative of the Annex I habitat '*Ranunculion fluitantis* and *Callitricho-Batrachion* or aquatic mosses [3260]' (Denyer, 2017).

4.4 White-clawed crayfish survey

White-clawed crayfish were recorded via hand-searching and sweep netting at sites A2 and A3 on an unnamed Sinking River tributary. Both sites supported very low densities of crayfish (2 per 30 refugia searched at each site).

Despite good suitability throughout the Levally Stream (particularly at site B5), white-clawed crayfish were only recorded from site B1 during the August 2021 survey period (via hand searching/sweep netting). However, crayfish eDNA was detected at site B5 (see section 4.5 below).

The known distribution of crayfish within the vicinity of the proposed wind farm site is restricted to the Sinking River and Grange River, with a low number of records also available for the Levally Stream. These records are available for the 1977-2009 period, and included Mahanagh Bridge (survey site B5) (NBDC/NPWS data; **Figure 3.1**).

4.5 eDNA analysis

A composite water sample (sample FK95) collected from the Levally Stream at Mahanagh Bridge (site B5), located c.2.7km downstream of the proposed wind farm site boundary, returned a positive result for white-clawed crayfish eDNA (8 of 12 qPCR replicates, respectively) (**Table 4.1**; **Appendix C**). This result was considered as evidence of the species' presence at and or upstream of this site.

The water sample from site B5 returned a negative result for both crayfish plague and freshwater pearl mussel (0 of 12 qPCR replicates, respectively) (**Table 4.1**; **Appendix C**), i.e. eDNA not detected or was present below the limit of detection in a series of 12 qPCR replicates. These results were considered as evidence of the species' absence at and or upstream of site B5.

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

Site	Watercourse	White-clawed crayfish	Crayfish plague	Freshwater pearl mussel
B5	Levally Stream, Mahanagh Bridge	**Positive (8/12)**	Negative (0/12)	Negative (0/12)

4.6 Invasive aquatic species

No aquatic invasive species were recorded during the survey of a total of *n*=8 sites on the Levally Stream, Lomaunaghroe Stream or an unnamed tributary of the Sinking River in August 2021.

4.7 Otter signs

A total of *n*=2 otter signs were recorded within the survey area in the August 2021 survey period. A regular spraint site was recorded at site B1 on the upper reaches of the Levally Stream, whilst a set of fresh otter prints were identified in soft marginal mud at site B3 on the Lomaunaghroe Stream. No breeding (holt) or resting areas (couches) were recorded in the vicinity of the *n*=8 survey sites.

4.8 Aquatic ecological evaluation

An aquatic ecological evaluation of each survey site was based on the results of electro-fishing, white-clawed crayfish, macrophytes and aquatic bryophytes, biological water quality and otter surveys (**Table 4.2**).

Site B5 (Levally Stream) was evaluated as **international importance** given its location within the Lough Corrib SAC (000297). This site also supported qualifying interest Atlantic salmon, *Lampetra* sp. ammocoetes and Annex I habitat 'Water courses of plain to montane levels, with submerged or floating vegetation of *Ranunculion fluitantis* and *Callitricho-Batrachion* or aquatic mosses [3260].

Site B4 on the Levally Stream was evaluated as **county importance** given the presence of the Annex I habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]'.

Site A1 (unnamed Sinking River tributary) was evaluated as **local importance (lower value)** given its very heavily silted nature, Q3 (poor status) water quality and absence of aquatic species or habitats of conservation value.

All other aquatic survey sites (i.e., A2, A3, B1, B2, B3 and B4) were evaluated as **local importance (higher value)**. Primarily, this evaluation was due to the presence of salmonids, Annex II *Lampetra* sp., Annex II white-clawed crayfish and or utilisation by Annex II otter.

Table 4.2 Aquatic ecological evaluation summary of the survey sites according to NRA (2009) criteria

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
A1	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality
A2	Unnamed stream	n/a	**Local importance (higher value)**	White-clawed crayfish recorded (juvenile only); Q4 (good status) water quality
A3	Unnamed river	n/a	**Local importance (higher value)**	Atlantic salmon, brown trout & *Lampetra* sp. recorded via electro-fishing; white-clawed crayfish recorded at low densities
B1	Levally Stream	30L07	**Local importance (higher value)**	Atlantic salmon & brown trout recorded via electro-fishing; single white-clawed crayfish recorded
B2	Levally Stream	30L07	**Local importance (higher value)**	Brown trout recorded via electro-fishing
B3	Lomaunaghroe Stream	30L35	**Local importance (higher value)**	Common frog[1] recorded
B4	Levally Stream	30L07	**County importance**	Annex I 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]' habitat present
B5	Levally Stream	30L07	**International importance**	Located within Lough Corrib SAC (002297)

[1] Common frog (*Rana temporaria*) are protected under the Wildlife Act (1976-2021). Furthermore, common frogs are protected under Annex V of the Habitats Directive [92/42/EEC]

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

5. Discussion

5.1 Most valuable areas for aquatic ecology

With the exception of site A1 on an unnamed Sinking River tributary (lower value), all *n*=8 survey sites were evaluated as at least **local importance (higher value)**, or higher. Site B5 (Levally Stream) was evaluated as **international importance** given its location within the Lough Corrib SAC (000297). This site also supported qualifying interest Annex II Atlantic salmon and *Lampetra* sp. ammocoetes, as well as Annex I habitat 'Water courses of plain to montane levels, with submerged or floating vegetation of *Ranunculion fluitantis* and *Callitricho-Batrachion* or aquatic mosses [3260]. Site B4 on the Levally Stream was of **county importance** due to the presence of hydrophilous tall herb habitat [6430]. The **local importance (higher value)** sites were present on an unnamed Sinking River tributary (sites A2 & A3), Levally Stream (B1, B2 & B4) and the Lomaunaghroe Stream (B3). Primarily, this evaluation was due to the presence of salmonids, *Lampetra* sp., white-clawed crayfish and or otter.

Atlantic salmon were recorded (via electro-fishing) from sites on an unnamed Sinking River tributary (A3) and Levally Stream (B1, B4 & B5). Site B5 (Mahanagh Bridge) supported a very high density of Atlantic salmon parr and the best-quality salmonid habitat identified during the surveys. Brown trout were also recorded from these sites, in addition to site B2 on the Levally Stream. *Lampetra* sp. ammocoetes were recorded from two sites on the Levally Stream (B4 & B5) as well as site A3 on the unnamed Sinking River tributary. A moderate density of ammocoetes was recorded from site B5 (9.3 per m^2), which also featured the best-quality lamprey spawning and nursery habitat within the survey area. Despite some moderate to good suitability across numerous survey sites, no European eel were recorded during the survey (**Appendix A**).

Despite suitability throughout the Levally Stream and the unnamed Sinking River tributary, otter signs were only recorded site B1 on the upper reaches of the Levally Stream (regular spraint site) and site B3 on the Lomaunaghroe Stream (prints in soft marginal mud). The species is known historically from the Sinking River, Grange River and Lomaunaghroe Stream (NPWS & NBDC data). However, these were historical only (i.e. 1980). A low number of more contemporary records for otter were available for the Sinking River and Grange River (2012-2015 period; NBDC data).

Despite some suitability at all survey sites on the Levally Stream (i.e. sites B1, B2, B3, B4 & B5), Annex II white-clawed crayfish were only recorded (via sweep netting & hand searching of refugia) from a single site on this watercourse (site B1), in addition to very low densities from site A2 and A3 on an unnamed Sinking River tributary. Despite high suitability and hand-searching and sweep netting of >50 instream refugia at site B5 on the Levally Stream at Mahanagh Bridge, no live crayfish were recorded. However, white-clawed crayfish eDNA (strong signature) was detected at site B5. This would indicate the presence of the species within the Levally Stream at and or upstream of the sampling point. The discrepancy in results between survey methodologies may be explained by the presence of a cryptically low crayfish population within the Levally Stream (i.e. not readily detectable by traditional surveys). Alternatively, the result may simply be an artefact of patchy crayfish distribution, a phenomenon known in other Irish catchments with water clarity issues (Demers & Reynolds, 2003; pers. obs.).

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the biological water quality samples taken from *n*=8 sites. Good status (Q4) water quality was only recorded from site A2 on an unnamed Sinking River tributary. Primarily due to peat harvesting pressures and historical modifications, all remaining survey sites achieved Q3-4 (moderate status) or Q3 (poor status) water quality and, thus, failed to meet the good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC).

A good example of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] ('floating river vegetation') was recorded at site B5 on the Levally Stream, where several *Potamogeton* sp., *Callitriche* sp. and aquatic bryophyte indicator species were present. The Annex I habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]' was present at site B4 on the Levally Stream, where several indicator species were present. No other survey sites supported these Annex I habitats.

While many of the watercourses in the vicinity of the proposed Clonberne wind farm had aquatic ecological features that can be considered of high conservation value, historical drainage pressures and ongoing peat escapement (siltation) had reduced the ecological quality of aquatic habitats. These included survey sites on the Levally Stream and Lomaunaghroe Stream (draining southwards) and, to a lesser extent, the unnamed Sinking River tributary (draining northwards). However, larger watercourses with higher flow rates, including the Levally Stream, were better able to buffer against such impacts. This watercourse supported the best quality aquatic habitat within vicinity of the proposed wind farm, despite evident pressures. With the exception of site A2 (Q4, good status), biological water quality was of Q3-4 (moderate status) or Q3 (poor status) across all survey sites sampled. This contributed to the reduction in habitat quality for salmonids, lamprey, macro-invertebrates (including white-clawed crayfish) and other aquatic species and habitats of conservation value.

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7. Appendix A – fisheries assessment report

Please see accompanying fisheries assessment report

Fisheries assessment of Clonberne wind farm, Co. Galway

Triturus

Prepared by Triturus Environmental Ltd. for MKO

February 2022

Please cite as:

Triturus (2022). Fisheries assessment for Clonberne wind farm, Co. Galway. Report prepared by Triturus Environmental Ltd. for MKO February 2022 (updated May 2024).

Table of contents

1. Introduction

1.1 Background

Triturus Environmental Ltd. were contracted by MKO to undertake a baseline fisheries assessment of numerous watercourses in the vicinity of the proposed Clonberne wind farm, located near Clonberne, Co. Galway (**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*=8 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.

Fisheries survey sites were present on the Levally Stream (EPA code: 30L07), Lomaunaghroe Stream (30L35) and an unnamed tributary of the Sinking River (**Table 2.1**). The *n*=8 survey sites were located within the Sinking_SC_010 and Clare [Galway]_SC_040 river sub-catchments. A single survey site on the Levally Stream (B5) was located within the Lough Corrib SAC (000297).

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 Clonberne wind farm. Permission was granted on Thursday 22nd July 2021 and the survey was undertaken on Wednesday 18th to Thursday 19th August 2021.

1.2 Fisheries (existing data)

Fisheries data for the watercourses within the survey area was not available at the time of survey. However, the wider Sinking River sub-catchment is known to support Atlantic salmon (*Salmo salar*), brown trout, (*Salmo trutta*), pike (*Esox lucius*), roach (*Rutilus rutilus*), stone loach (*Barbatula barbatula*) and three-spined stickleback (*Gasterosteus aculeatus*) (O'Briain et al., 2019). The Grange River, to which the Levally Stream joins, is a key contributor to the genetic diversity of brown trout in Lough Corrib (Prodöhl, 2017). The Grange River sub-catchment is also known to support Atlantic salmon, pike, stone loach and three-spined stickleback (O'Briain et al., 2019). Both the Sinking River and Grange River are also known to support *Lampetra* sp. lamprey (O'Connor, 2007).

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 Clonberne wind farm on Wednesday 18th to Thursday 19th August 2021, following notification to Inland Fisheries Ireland and under the conditions of a Department of Communications, Climate Action & Environment (DCCAE) license. Both river and holding tank water temperature was monitored continually throughout the survey to ensure temperatures of 20°C were not exceeded, thus minimising stress to the captured fish due to low dissolved oxygen levels. A portable battery-powered aerator was also used to further reduce stress to any captured fish contained in the holding tank.

Salmonids, European eel and other captured fish species were transferred to a holding container with oxygenated fresh river water following capture. To reduce fish stress levels, anaesthesia was not applied to captured fish. All fish were measured to the nearest millimetre and released in-situ following a suitable recovery period.

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

The catchment-wide electro-fishing (CWEF) survey was undertaken across *n*=8 sites (see **Table 2.1, Figure 2.1**).

Table 2.1 Location of *n*=8 proposed electro-fishing survey sites in the vicinity of Clonberne wind farm, Co. Galway

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1	Unnamed stream	n/a	Kilmurry	554383	757815
A2	Unnamed stream	n/a	Killavoher	555167	758854
A3	Unnamed river	n/a	Addergoole More	551853	761481
B1	Levally Stream	30L07	Killavoher	555555	757071
B2	Levally Stream	30L07	Cloonarkan	554326	756653
B3	Lomaunaghroe Stream	30L35	Gortagarraun	553742	756575
B4	Levally Stream	30L07	Cloonarkan	554039	755754
B5	Levally Stream	30L07	Mahanagh Bridge	555941	754209

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 noted 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 (most draining calcareous geologies) a voltage of 200-220v, frequency of 30-35Hz and pulse duration of 3.5ms 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 box quadrat-based electro-fishing (as per Harvey & Cowx, 2003) in objectively suitable areas of sand/silt, where encountered. As lamprey take longer to emerge from silts and require a more persistent approach, they were targeted at a lower frequency (30Hz) burst DC pulse setting which also allowed detection of European eel in sediment, if present. Settings for lamprey followed those recommended and used by Harvey & Cowx (2003), APEM (2004) and Niven & McAuley (2013). Using this approach, the anode was placed under the water's surface, approx. 10–15 cm above the sediment, to prevent immobilising lamprey ammocoetes within the sediment. The anode was energised with 100V of pulsed DC for 15-20 seconds and then turned off for approximately five seconds to allow ammocoetes to emerge from their burrows. The anode was switched on and off in this way for approximately two minutes. Immobilised ammocoetes were collected by a second operator using a fine-mesh hand net as they emerged.

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

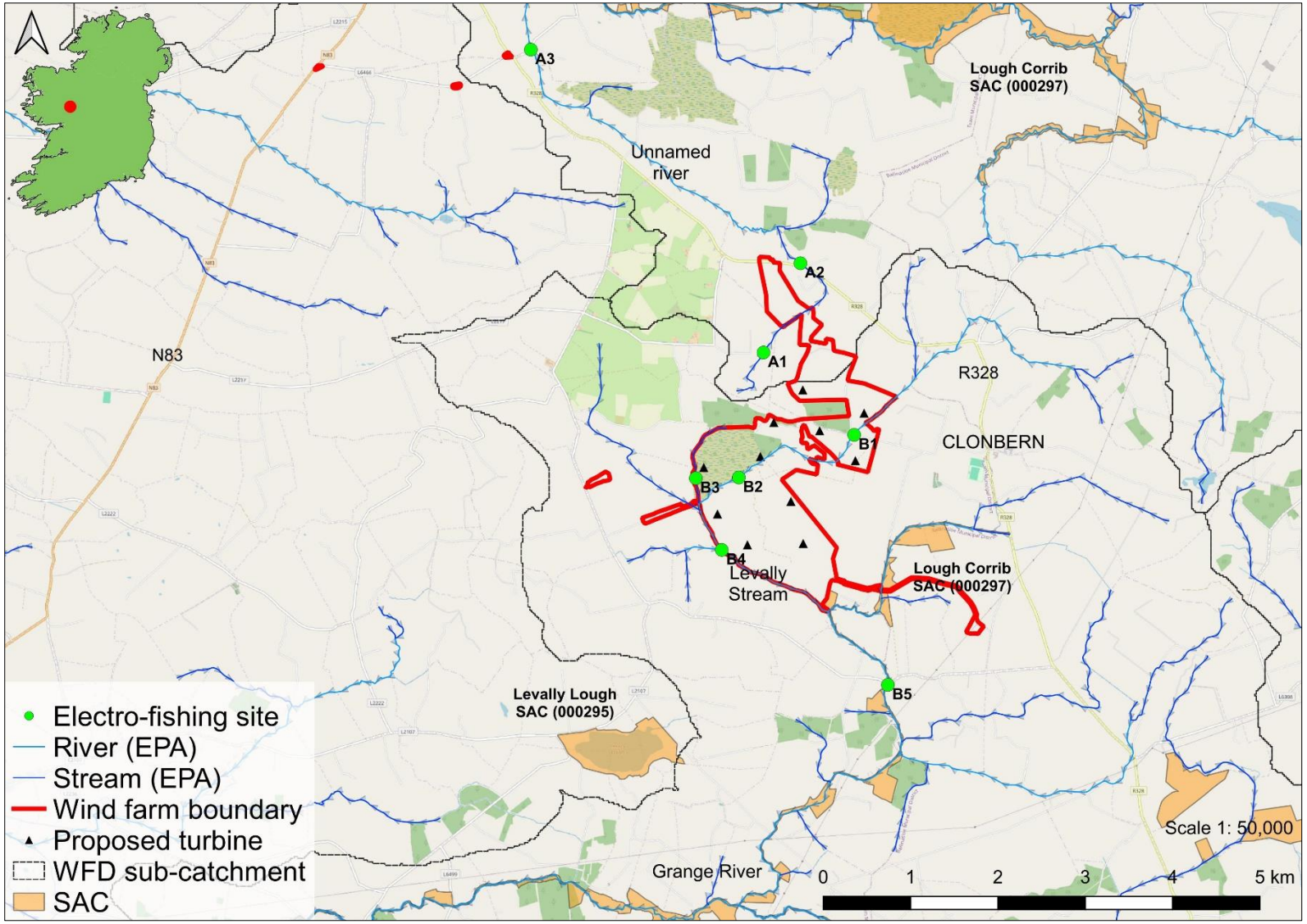

Figure 2.1 Location overview of the *n*=8 electro-fishing sites in vicinity of the proposed Clonberne wind farm, Co. Galway.

2.2 Fisheries habitat

2.2.1 General fisheries habitat

A broad appraisal 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 (EA, 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 including the Check-Clean-Dry approach was adhered to during surveys for all equipment and PPE used. Disinfection of all equipment and PPE before and after use with Virkon™ was conducted to prevent the transfer of pathogens or invasive propagules between survey sites. Surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation. Particular cognisance was given to preventing the introduction or spread of crayfish plague (*Aphanomyces astaci*) given the known presence of white-clawed crayfish in the wider survey area and the occurrence of crayfish plague in the Clare River catchment in 2018. 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.

3. Results

A catchment-wide electro-fishing survey of *n*=8 sites in the vicinity of the proposed Clonberne wind farm was conducted on Wednesday 18th to Thursday 19th August 2021 following notification to Inland Fisheries Ireland and National Parks and Wildlife Service. 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 – Unnamed stream, Kilmurry

Three-spined stickleback (*Gasterosteus aculeatus*) were the only fish species recorded via electro-fishing at site A1 (**Figure 3.1**). With the exception of low densities of this species (*n*=11), the channel was not of fisheries value at this location given the lack of flow and very heavily-silted (peat) nature.

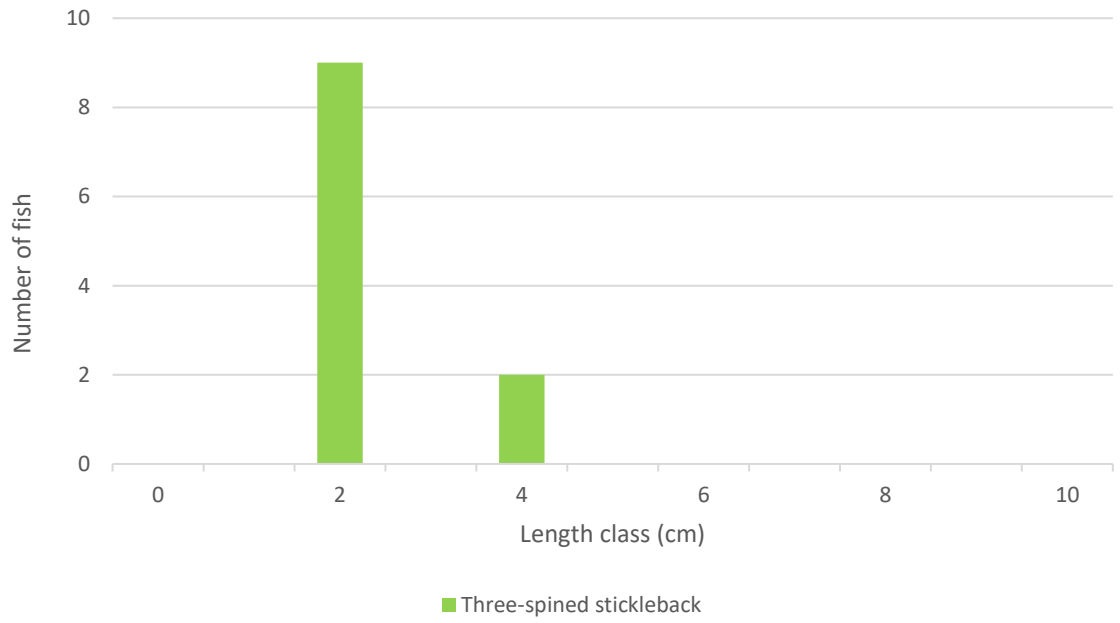

Figure 3.1 Length frequency distribution recorded via electro-fishing at site A1, August 2021

Plate 3.1 Juvenile three-spined stickleback recorded from site A1

3.1.2 Site A2 – Unnamed stream, R328 road crossing, Kilavoher

Three-spined stickleback was the only fish species recorded via electro-fishing at site A2 (**Figure 3.2**). Apart from moderate densities of this species (*n*=31), the site was of little value to salmonids or lamprey given low (seasonal) flow rates, siltation and enrichment pressures. Salmonid habitat was poor overall, with little spawning or holding habitat present. However, under higher flows (e.g., winter period), the site would provide some moderate-quality salmonid habitat. Whilst soft sediment areas were frequent, these were not accompanied by flow rates deemed necessary for lamprey ammocoetes. Despite some low suitability for European eel (primarily as a nursery), none were recorded.

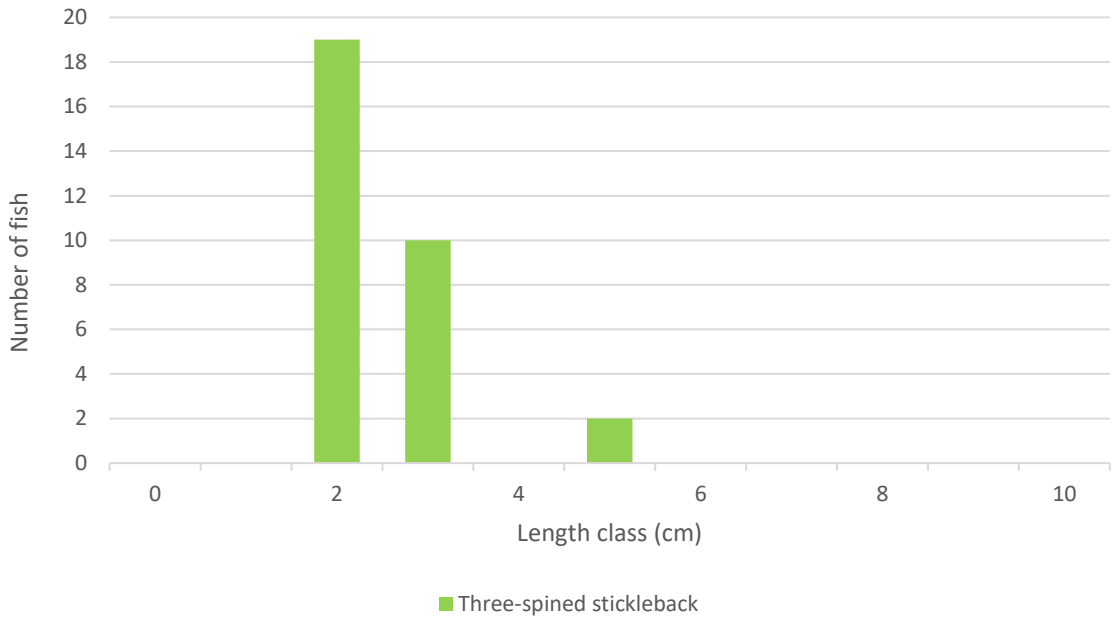

Figure 3.2 Length frequency distribution recorded via electro-fishing at site A2, August 2021

Plate 3.2 Mixed-cohort three-spined stickleback recorded from site A2

3.1.3 Site A3 – Unnamed stream, Adergoole More

A total of five species were recorded via electro-fishing at site A3, with low numbers of brown trout (*Salmo trutta*), Atlantic salmon (*Salmo salar*), *Lampetra* sp., stone loach (*Barbatula barbatula*) and moderate densities of three-spined stickleback present (**Figure 3.3**).

The site was of moderate value only to salmonids overall given high siltation rates and poor flows. However, a low density of brown trout was present (juveniles and adults), in addition to a single Atlantic salmon parr. Despite some suitability (instream boulder and macrophyte refugia), no European eel were recorded. A very low density of *Lampetra* sp. ammocoetes (2 per m^2) was recorded from sub-optimal, clay-dominated soft sediment habitat.

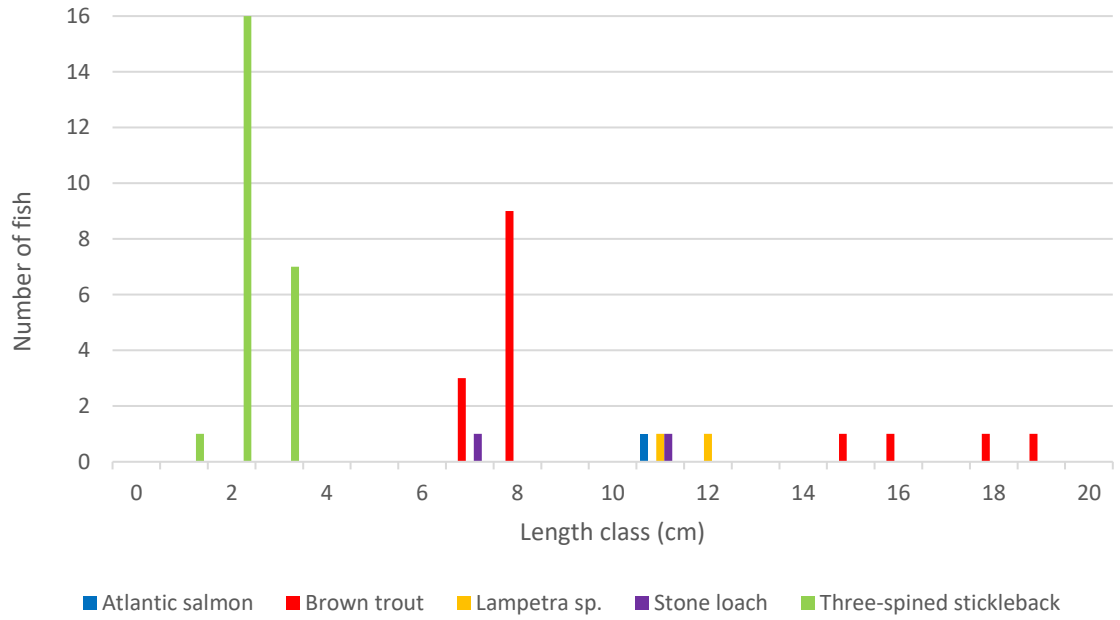

Figure 3.3 Length frequency distribution recorded via electro-fishing at site A3, August 2021

Plate 3.3 Brown trout, European eel, stone loach & Atlantic salmon recorded from site A3, August 2021

3.1.4 Site B1 – Levally Stream, Kilavoher

A total of three fish species were recorded via electro-fishing at site B1 (**Figure 3.4**). Low densities of brown trout (*n*=7; mostly juveniles with few adults) and a single Atlantic salmon parr were recorded, in addition to moderate numbers of three-spined stickleback (*n*=25). A single crayfish was also captured via electro-fishing.

The site was a moderate-quality salmonid nursery (at best) given heavy siltation, low seasonal flows and evident enrichment. However, some highly localised salmonid spawning habitat was present in the vicinity of the bridge(s). Holding habitat by way of deeper pool and glide was widespread. Despite the presence of soft sediment deposits, these were shallow and had a high peat-content. This, coupled with low flows precluded the presence of lamprey from the site (none recorded). Despite some good suitability, no European eel were recorded.

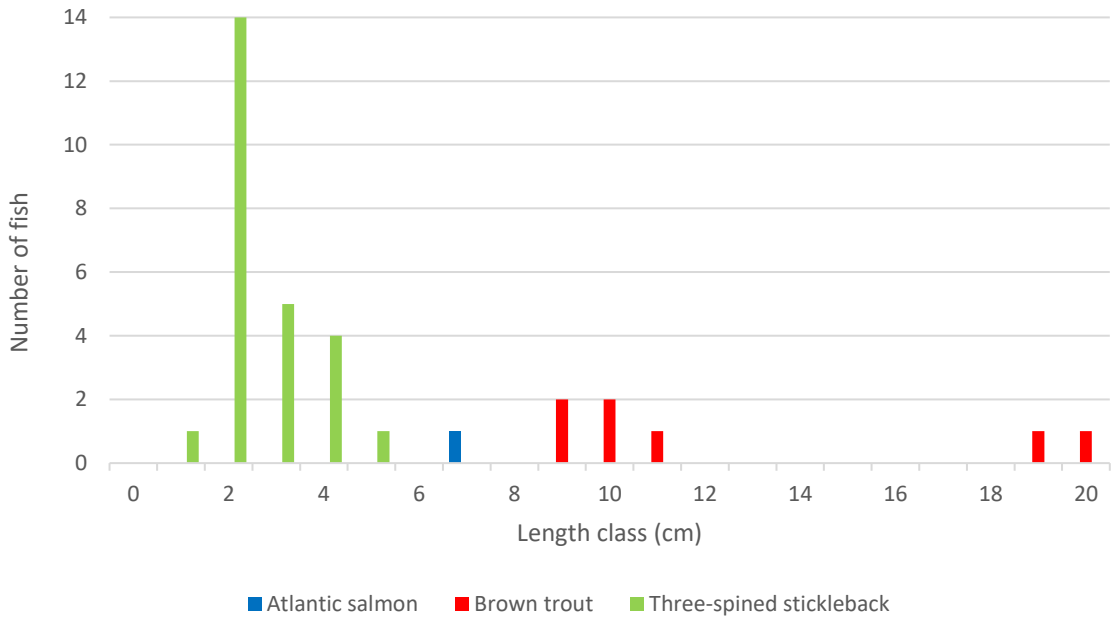

Figure 3.4 Length frequency distribution recorded via electro-fishing at site B1 on the Levally Stream, August 2021

Plate 3.4 Atlantic salmon parr (top right) and mixed-cohort brown trout recorded from site B1 on the Levally Stream, August 2021

3.1.5 Site B2 – Levally Stream, Cloonarkan

Brown trout and three-spined stickleback were the only fish species recorded via electro-fishing at site B2 (**Figure 3.5**). However, it should be noted that the considerable depth of the site (often >1.2m) prevented effective electro-fishing. A single adult trout was recorded in addition to moderate densities of stickleback (*n*=21).

The site was of poor value as a salmonid nursery or spawning habitat, with some moderate value as a holding area (under higher flows only). Higher numbers of adult trout were likely present in deeper pool/glide areas. The clay and or peat-dominated soft sediment were largely unsuitable for lamprey ammocoetes and none were recorded. Despite some good suitability, no European eel were recorded (although these may have been present in deeper pool areas outside the scope of backpack electro-fishing).

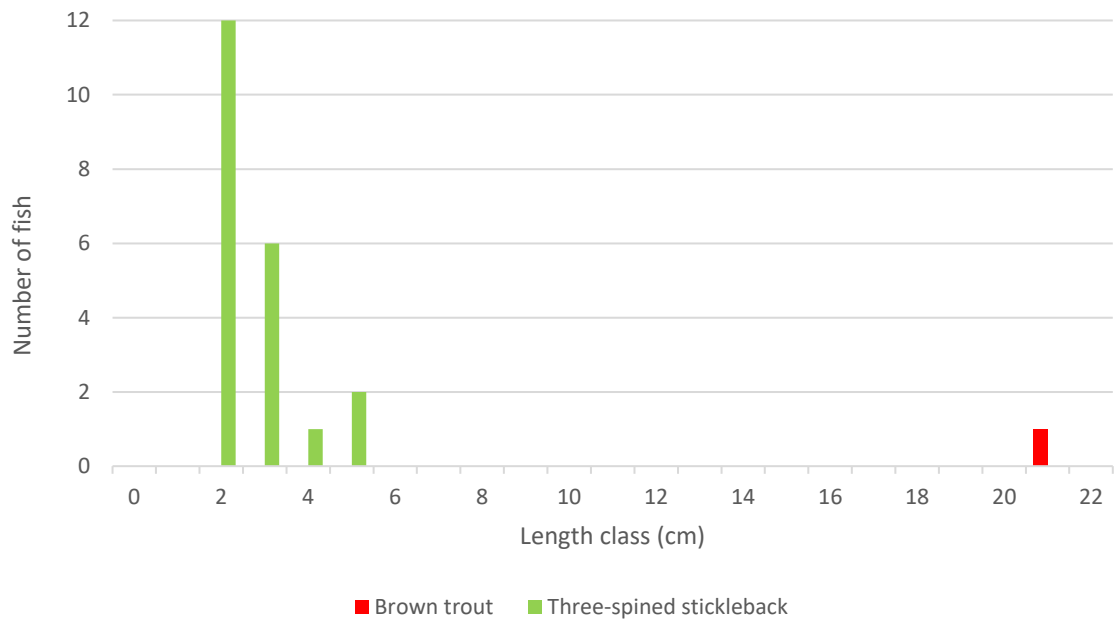

Figure 3.5 Length frequency distribution recorded via electro-fishing at site B2 on the Levally Stream, August 2021

Plate 3.5 Representative image of site B2 on the Levally Stream, August 2021

3.1.6 Site B3 – Lomaunaghroe Stream, Gortgarraun

Three-spined stickleback were the only fish species recorded via electro-fishing at site B3 (**Figure 3.6**). Apart from moderate densities of this species, the channel was of very poor fisheries value. The stream was not of value to salmonids, eel or lamprey given gross siltation (from peat) and limited flows. However, the lowermost reaches provided some moderate-quality spawning habitat for salmonids and lamprey (although still silted). However, this short section (10m long) was not representative of the stream as a whole. Fisheries value was significantly improved in the downstream-connecting Levally Stream.

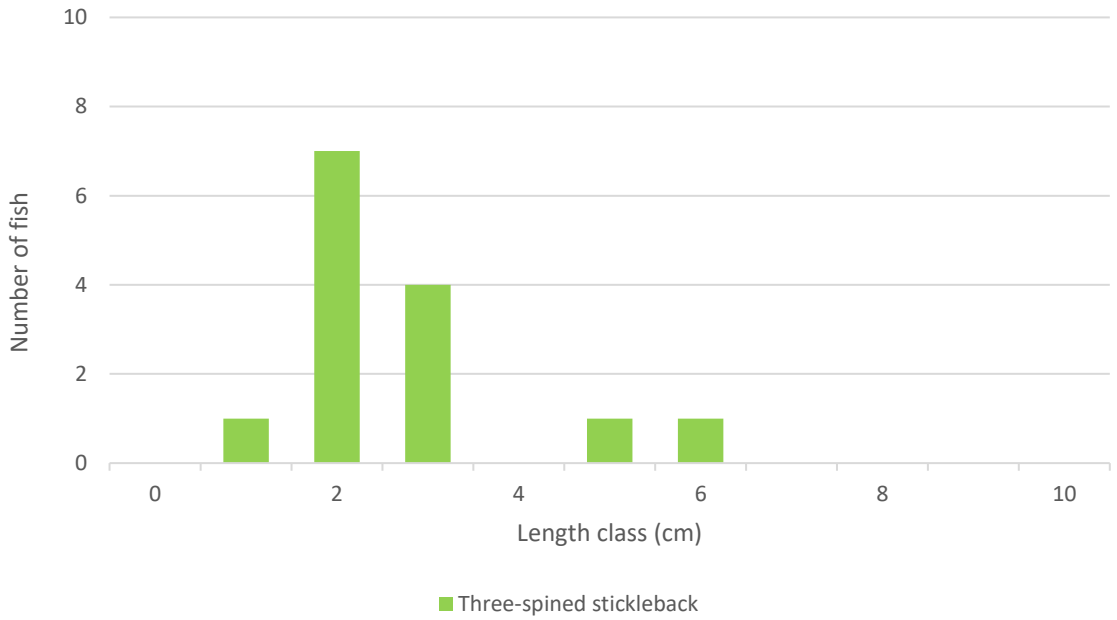

Figure 3.5 Length frequency distribution recorded via electro-fishing at site B3 on the Lomaunaghroe Stream, August 2021

Plate 3.6 Representative image of site B3 on the Lomaunaghroe Stream, August 2021

3.1.7 Site B4 – Levally Stream, Cloonarkan

Four fish species were recorded via electro-fishing at site B4 (**Figure 3.7**). However, it should be noted that the considerable depth of the site (often >1.2m) hampered electro-fishing efforts. A low number of juvenile and adult brown trout were recorded (*n*=6), with a single Atlantic salmon parr and moderate densities of three-spined stickleback (*n*=22). Two *Lampetra* sp. ammocoetes were present in sub-optimal (clay-dominated) soft sediment downstream of the bridge pool.

With the exception of the single pool and faster-flowing area in vicinity of the bridge, the site was of poor value as a salmonid nursery or spawning habitat, with some moderate value as a holding area (improved during higher flow periods). Higher numbers of adult trout were likely present in deeper pool/glide areas. The clay and or peat-dominated soft sediment were largely unsuitable for lamprey ammocoetes, with only low densities recorded. Despite some good suitability, no European eel were recorded (although these may have been present in deeper pool areas).

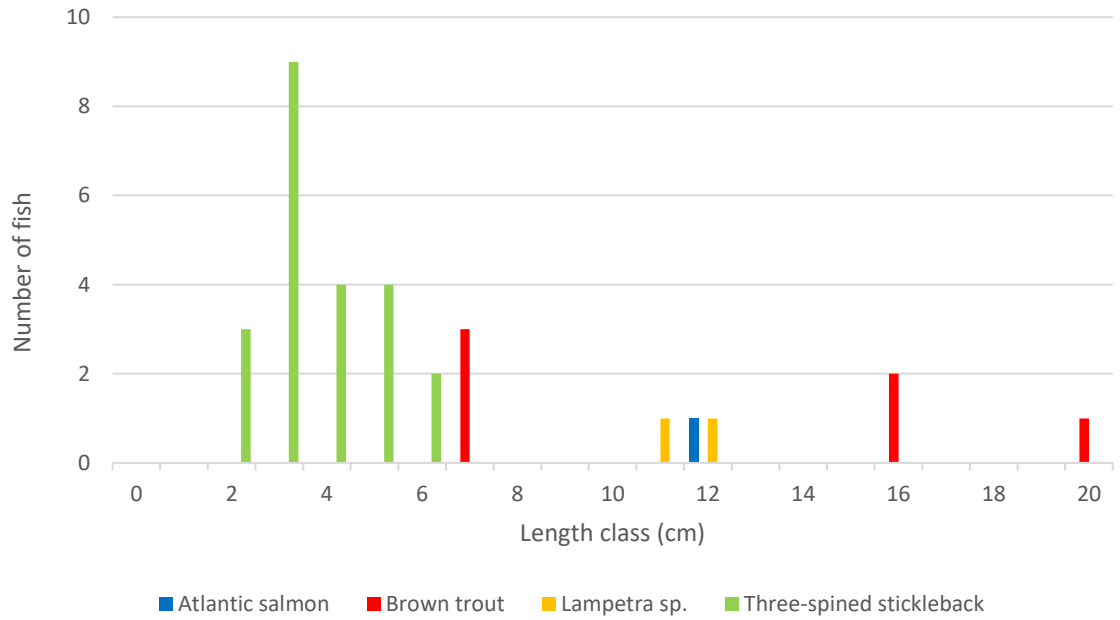

Figure 3.6 Length frequency distribution recorded via electro-fishing at site B4 on the Levally Stream, August 2021

Plate 3.7 Atlantic salmon parr and mixed-cohort brown trout recorded from site B4 on the Levally Stream, August 2021

3.1.8 Site B5 – Levally Stream, Mahanagh Bridge

A total of five fish species were recorded via electro-fishing at site B5 (**Figure 3.8**). The site was dominated by very high numbers of juvenile Atlantic salmon (0+ and 1+; *n*=81), with low numbers of brown trout present alongside low numbers of adults (total *n*=8). Stone loach were also present in high numbers (*n*=27), with moderate densities of *Lampetra* sp. ammocoetes and low numbers of three-spined stickleback. *Lampetra* sp. ammocoetes were present at an average of 9.3 per m^2 of habitat targeted.

The site was an excellent-quality salmonid nursery with very high numbers of juveniles present, primarily in association with macrophyte beds. Salmonid spawning habitat was of excellent quality (clean, loose gravels and cobbles between macrophyte beds) with some good quality holding habitat (deeper glide) present upstream of the site. Lamprey spawning habitat was also of good quality, locally, with some moderate-good quality (sub-optimal) ammocoete habitat present. This was typically sand-dominated, where present, and very localised. European eel habitat quality was good, locally (e.g., underneath bridge structure) although none were recorded.

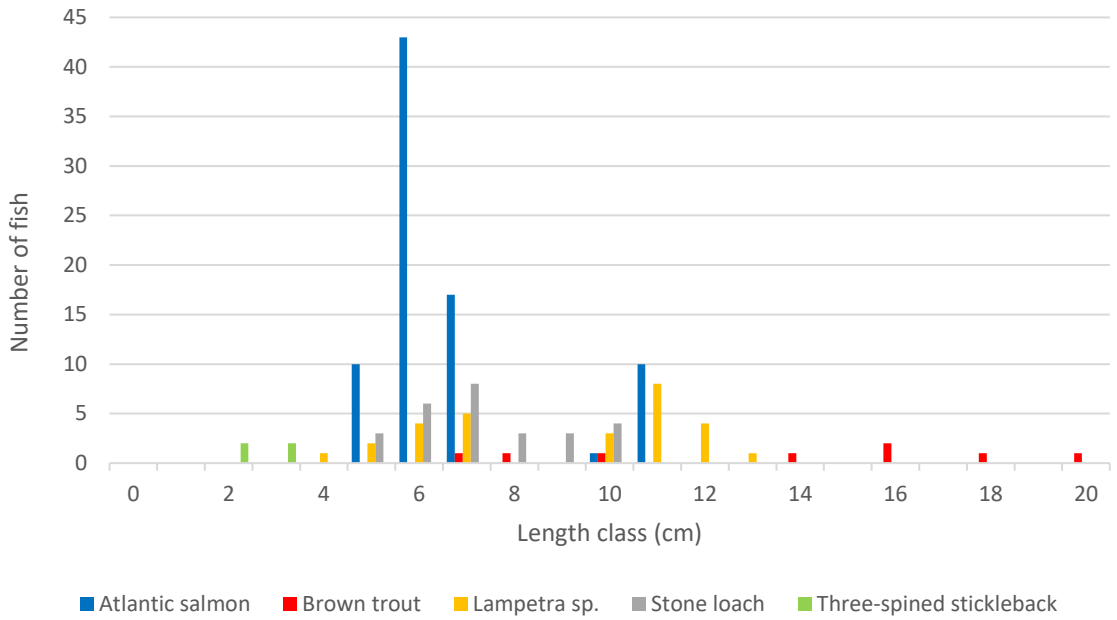

Figure 3.8 Length frequency distribution recorded via electro-fishing at site B5 on the Levally Stream at Mahanagh Bridge, August 2021

Plate 3.8 Late juvenile stage *Lampetra* sp. recorded from site B5 on the Levally Stream, August 2021 (eyes forming)

Table 3.1 Fish species densities per m^2 recorded at sites in the vicinity of Clonberne wind farm via electro-fishing in August 2021. Values in bold represent the highest densities recorded for each species, respectively. * = no. ammocoetes per m^2 of targeted habitat fished

Site	Watercourse	CPUE (elapsed time)	Approx. area fished (m^2)	Fish density (number fish per m^2)				
				Atlantic salmon	Brown trout	*Lampetra* sp.	Stone loach	Three-spined stickleback
A1	Unnamed stream	5	30	0.000	0.000	0.000	0.000	0.367
A2	Unnamed stream	5	60	0.000	0.000	0.000	0.000	**0.517**
A3	Unnamed river	10	100	0.010	**0.080**	2*	0.020	0.240
B1	Levally Stream	10	180	0.006	0.039	0.000	0.000	0.139
B2	Levally Stream	10	210	0.000	0.005	0.000	0.000	0.100
B3	Lomaunaghroe Stream	10	125	0.000	0.000	0.000	0.000	0.112
B4	Levally Stream	10	200	0.005	0.030	1.0*	0.000	0.110
B5	Levally Stream	10	360	**0.225**	0.022	**9.3***	**0.075**	0.011

4. Discussion

4.1 Most valuable sites

4.1.1 Salmonids

Atlantic salmon were recorded from a total of four survey sites namely site A3 (unnamed Sinking River tributary) and sites B1, B4 & B5 on the Levally Stream. Brown trout were also recorded from these sites, in addition to site B2 on the Levally Stream. Salmonids were absent from sites A1 and A2 on the unnamed Sinking River tributary and B3 on the Lomaunaghroe Stream, which was considered a result of low flows and considerable siltation pressures (i.e. poor quality salmonid habitat).

In general, the quality of salmonid habitat in the vicinity of the proposed Clonberne wind farm was significantly reduced due to historical drainage pressures, low or intermittent/seasonal flows and often excessive siltation (primarily from peat escapement). Diffuse siltation is one of the greatest threats to salmonid populations. Sediment not only blocks interstitial spaces in substrata and limits oxygen supply to salmonid eggs (required for healthy embryonic development and successful hatching) but can also smother substrata, thus reducing available spawning habitat and impact macro-invertebrate communities on which salmonids feed (Soulsby et al., 2001; Walling et al., 2003; Heywood & Walling, 2007; Louhi et al., 2008, 2011; Cocchiglia et al., 2012; Conroy et al., 2018; Davis et al., 2018; Kelly-Quinn et al., 2020). Sedimentation of salmonid habitat is a particular problem in Irish rivers flowing through modified catchments (Evans et al., 2006). Channels with higher proportions of peat substrata can also suffer from increased siltation of instream hard substrata necessary for salmonid spawning, further limiting local populations. Gravel compaction from sedimentation reduces the spawning capacity of a channel and it has been shown that eggs laid in clean gravels which have subsequently been silted over by peat have failed to hatch (Crisp 1993, 2000).

Better-quality salmonid habitat was only present on the lower reaches of the unnamed Sinking River tributary and the Levally Stream. Unlike other survey sites, site B5 on the Levally Stream at Mahanagh Bridge (located within the Lough Corrib SAC) provided excellent-quality salmonid spawning and nursery habitat, and supported high numbers of juvenile Atlantic salmon.

4.1.2 Lamprey

Lampetra sp. ammocoetes were recorded from two sites on the Levally Stream (B4 and B5) as well as site A3 on the unnamed Sinking River tributary. The highest density recorded were present at site B5, where an average density of 9.3 ammocoetes per m^2 of targeted larval habitat was recorded. This density was high relative to the wider Clare River catchment (i.e., a mean density of <1 per m^2; O'Connor, 2007).

However, lamprey habitat was generally poor across the survey area. Owing to their relatively small morphologies, *Lampetra* species such as brook lamprey require clean, fine gravels in which to dig their redds (Lasne et al., 2010; Rooney et al., 2013; Dawson et al., 2015) although areas may also include fractions of sand, larger gravels, and cobble (Nika & Virbickas, 2010). Spawning habitat in the vicinity of the proposed Clonberne wind farm was appreciably sparse and of poor quality due to historical

drainage and significant (peat) siltation pressures (as outlined above for salmonids). Furthermore, lamprey ammocoetes require the deposition of fine, organic-rich sediment ≥5cm in depth in which to burrow and mature (Gardiner, 2003; Goodwin et al., 2008; Aronsuu & Virkkala, 2014). Peat-dominated substrata (i.e., humic deposits), such as those typically found in the vicinity of the proposed Clonberne wind farm, do not provide suitable burial/burrowing habitat complexity or structure for ammocoetes given their invariably fine and flocculent nature (pers. obs.).

4.1.3 European eel

On both a global and Irish scale, the European eel is listed as 'critically endangered' (Pike et al., 2020; King et al., 2011). Despite some suitability across the survey area, no European eel were recorded during the current survey. This was considered primarily as a result of historical drainage (i.e., removal of instream refugia and habitat heterogeneity) in addition to siltation (peat escapement) pressures within the vicinity of the proposed wind farm. Nevertheless, even smaller channels with poor or little fisheries value overall can offer potential as European eel migratory pathways, provided they maintain downstream connectivity to larger channels. (e.g. adult migration seawards, usually from September/October onwards).

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

Table 8.1 Macro-invertebrate Q-sampling results for the aquatic survey sites, August 2021

Group	Family	Species	A1	A2	A3	B1	B2	B3	B4	B5	EPA group
Ephemeroptera	Heptageniidae	*Ecdyonurus dispar*		5		1					A
Plecoptera	Leuctridae	*Leuctra hippopus*			1						B
Trichoptera	Glossosomatidae	*Agapetus fuscipes*		1							B
Odonata	Calopterygidae	*Caloptryx splendens*				2					B
Ephemeroptera	Baetidae	*Baetis rhodani*		8						1	C
Ephemeroptera	Ephemerellidae	*Serratella ignita*		1							C
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*								1	C
Trichoptera	Polycentropodidae	*Polycentropus kingi*			2						C
Trichoptera	Unidentified	Trichoptera pupa		2						3	C
Coleoptera	Dytiscidae	*Ilybius ater*	2					1			C
Coleoptera	Dytiscidae	*Ilybius fuliginosus*		1					2		C
Coleoptera	Dytiscidae	*Dytiscus larva*					2		1		C
Coleoptera	Dytiscidae	*Hydroporus angustatus*						1			C
Coleoptera	Elmidae	*Elmis aenea*		9		1				2	C
Coleoptera	Gyrinidae	*Gyrinus caspius*		2	1						C
Coleoptera	Gyrinidae	Gyrinidae larva				1					C
Coleoptera	Halipliidae	*Haliplus lineatocollis*		1	3	2				1	C
Coleoptera	Halipliidae	*Haliplus ruficollis group*							1		C
Coleoptera	Hydrophilidae	*Helophorus grandis*	1								C
Coleoptera	Hydrophilidae	*Anacaena globulus*						1			C
Coleoptera	Hydrophilidae	*Helophorus brevipalpis*						1			C
Coleoptera	Scirtidae	Scirtidae larva						1			C
Diptera	Chironomidae	Chironomid larva	2	1		1		6		1	C
Diptera	Pediciidae	*Dicranota* sp.								1	C
Crustacea	Gammaridae	*Gammarus duebeni*	9	8		4		7		4	C

Hemiptera	Corixidae	Corixidae nymph		2		1					C
Hemiptera	Corixidae	*Corixa punctata*		2							C
Hemiptera	Corixidae	*Hesperocorixa linnaei*		1							C
Hemiptera	Corixidae	*Siagara* sp.								1	C
Hemiptera	Gerridae	Gerridae nymph	8	2		2				1	C
Hemiptera	Nepidae	*Nepa cinerea*	2		1					1	C
Mollusca	Bithnyiidae	*Bithynia tentaculata*			4				1		C
Mollusca	Lymnaeidae	*Stagnicola fuscus*			2						C
Mollusca	Planorbidae	*Planorbis planorbis*			1						C
Mollusca	Tateidae	*Potamopyrgus antipodarum*	2		7	6	14	2	2	2	C
Hirudinidae	Glossiphoniidae	*Glossiphonia complanata*			1						D
Crustacea	Asellidae	*Asellus aquaticus*	2	8	1	2	1	7	2		D
Megaloptera	Sialidae	Sialidae larva		1							D
Mollusca	Lymnaeidae	*Ampullaceana balthica*		3	1		1		8		D
Mollusca	Physidae	*Physa fontinalis*					4				D
Nematomorpha	Gordiidae	Horsehair worm			1						n/a
Abundance			**28**	**58**	**26**	**23**	**22**	**27**	**17**	**19**	
Q-rating			**Q3**	**Q4**	**Q3-4**	**Q3-4**	**Q3**	***Q3**	**Q3**	**Q3**	
WFD status			Poor	Good	Mod	Mod	Poor	Poor	Poor	Poor	

* tentative rating due to poor flows and or lack of suitable riffle areas for sampling (as per Toner et al., 2005)

9. Appendix C – eDNA analysis lab report

SureScreen Scientifics

Folio No: E12474
Report No: 1
Client: Triturus Environmental Ltd
Contact: Ross Macklin

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: 25/01/2022
Date results reported: 28/01/2022
Matters affecting result: None

TARGET SPECIES: Crayfish plague *(Aphanomyces astaci)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK95	Clonbern 1	-	Pass	Pass	Pass	Negative	0/12

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SureScreen Scientifics

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

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK95	Clonbern 1	-	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
FK95	Clonbern 1	-	Pass	Pass	Pass	Positive	8/12

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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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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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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