APPENDIX 5

AQUATIC SURVEY REPORT

Coole Wind Farm

Aquatic Ecology Assessment

July 2016

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1 AQUATIC ECOLOGY AND FISHERIES

1.1 Introduction

This chapter addresses the potential impact of the proposed Coole Wind Farm project on aquatic ecology and fisheries. This document provides an appraisal of the impact of the proposed development on aquatic habitats, aquatic ecological communities, individual aquatic species, and recreational fisheries. The aims of the aquatic ecology and fisheries assessment are: -

- To carry out a desktop study in order to determine the surface water features affected by the proposed development and surrounding area;
- To carry out a fisheries and aquatic ecological assessment of the affected aquatic areas;
- To predict the potential direct, indirect and cumulative impacts of the proposed development on aquatic species and habitats.
- To propose mitigation measures in the construction and operation of the wind farm so as to minimise potential impacts on fisheries and aquatic ecology receptors.

Field survey work to inform the current appraisal was undertaken during June 2016. Survey work was also carried out during August 2013 in relation to a larger windfarm development. Electrical fishing results from the 2013 survey were used in the current appraisal, since the current proposal is located within the area of the larger development. Figure 1 gives the location of the proposed Coole Wind Farm with respect to water regions (Hydrometric Area and catchment). This report has been prepared by ECOFACT Environmental Consultants Ltd.

1.2 Methodology

1.2.1 Relevant Guidance

The current appraisal has been prepared taking account of relevant guidance published by the Environmental Protection Agency (EPA) including '*Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002) and '*Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements)'* (EPA, 2001). In addition, the impact appraisal also takes account of the '*Guidelines for Ecological Impact Assessment*' (Institute of Ecology and Environmental Management, 2005). The Heritage Council publication '*Best Practice Guidance for Habitat Survey & Mapping'* (Smith *et al*., 2010) is also referenced.

Relevant guidance published by the National Roads Authority (NRA), and applicable to assessing watercourses in Ireland was also followed, including '*Guidelines for the Assessment of Ecological Impacts of National Road Schemes – Revision 2*' (NRA 2009a), '*Ecological surveying techniques for protected flora and fauna during the planning of National Road Schemes – Version 2*' (NRA 2009b), '*Environmental Impact Assessment of National Road Schemes – A practical guide*' (NRA 2008) and '*Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*' (NRA 2005). IFI (2016) *'Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters*' was also consulted in relation to mitigation.

1.2.2 Legislative context

A diversity of flora and fauna, rare at a national level, are protected under the provisions of the Wildlife Act, 1976 and Wildlife (Amendment) Act, 2000; which includes the Flora Protection Order (1999). The Habitats Directive 1992 has been transposed into Irish legislation as the European Union (Natural Habitats) Regulations SI 94/1997 and amended in 1998 and 2005. The Habitat Regulations have been updated in 2011 as the European Communities (Birds and Natural Habitats) Regulations (2011) to bring the Irish transposition of these regulations into line with the requirements of the EU Habitats Directive (1992).

Under the Fisheries (Consolidation) Act, 1959, it is an offence to disturb the bed of a river; therefore, it will be necessary to get written permission from Inland Fisheries Ireland to proceed with the works in any areas where disturbance to the spawning and nursery areas of both salmonids and lampreys will occur as a result of the proposed development. Salmon, all lamprey species and their habitats are further protected under the EU Habitats Directive, 1992.

Under Section 3 of the Local Government (Water Pollution) Act, 1977 (as amended by Sections 3 and 24 of the 1990 Act) it is an offence to cause or permit any polluting matter to enter waters. Suspended solids would be a key parameter here. Likewise, any visual evidence of oil/fuel in the river would constitute an offence.

Section 171 of the Fisheries (Consolidation) Act 1959 creates the offence of throwing, emptying, permitting or causing to fall onto any waters deleterious matter. Deleterious matter is defined as not only as any substance that is liable to injure fish but is also liable to damage their spawning grounds or the food of any fish or to injure fish in their value as human food or to impair the usefulness of the bed and soil of any waters as spawning grounds or other capacity to produce the food of fish.

These European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009) and (Amendment) Regulations 2012 (S.I. No. 327 of 2012) establish legally binding quality objectives for all surface waters and environmental quality standards for pollutants for purposes of implementing provisions of E.U. legislation on protection of surface waters. These regulations clarify the role of public authorities in the protection of surface waters also concern the protection of designated habitats.

1.2.3 Selection of watercourses for appraisal

All watercourses / water bodies which could be affected directly (i.e. within the site) or indirectly (i.e. lie within 500 m of the site boundary) were considered as part of the current appraisal. Generally only streams and other watercourses shown on the 1:50,000 Discovery Series Maps were examined, as watercourses smaller than this are not normally of fisheries or aquatic ecological significance. The River Inny is the largest and most important watercourse in the study area. This river was assessed at several locations within the study area.

The watercourses selected for appraisal are given in Table 1 and are shown in Figure 2.

The surveys completed at each site were at a level required to make an evaluation of biological water quality, fisheries value, aquatic habitat value, and presence of rare / protected / notable aquatic species at each site. Surveying was carried out on the 9th June 2016.

1.2.4 Desktop review

A desktop review was carried out to collate information on fish and protected aquatic species in and to identify features of aquatic ecological importance within the study area. Natura 2000 sites and records of protected species in the vicinity of the proposed development were identified. This information was obtained by accessing the website of the National Parks & Wildlife Service (NPWS) of the Department of the Environment, Heritage and Local Government. The database of the National Biodiversity Data Centre (NBDC) was also consulted to assess the presence of rare plant and faunal species and records of protected species from records of the study area. The websites of the Environmental Protection Agency (EPA) and Inland Fisheries Ireland (IFI) were accessed to collate information on surface water quality and fish respectively.

1.2.5 Aquatic habitat appraisals

Habitat appraisal was carried out at the selected watercourses on the site using 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). In June 2016, all the affected watercourses were assessed in terms of:

- Stream width and depth and other physical characteristics;
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc;
- Flow type, listing percentage of riffle, glide and pool in the sampling area;
- Instream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site (as applicable) and on the bankside;
- Estimated cover by bankside vegetation, giving percentage shade of the sampling site.

Table 1: Location of the aquatic sites assessed for the proposed Coole wind farm site during June 2016.

Site	EPA code	River	Tributary	Segment code	Location
1	26I01	Inny	-	26_892	Bridge near Shrubbywood
2			-	26_625 13281	Float Bridge
3			-	26_1160	Camagh Bridge
4	26M92	Inny	Mayne	26_2450	Ballin
5	26G02	Inny	Glore	26_2976	Doon (d/s Monktown Stream confluence)
6			Glore	26_13411	Newcastle (u/s Monktown Stream confluence)
7			Glore	26_3579	Bridge at Rockbrook
8	26M78	Inny, Glore	Monktown	26_2975	Newcastle

1.2.5.1 Aquatic invertebrates

Qualitative sampling of benthic (or bottom dwelling) macroinvertebrates was undertaken at survey sites using kick-sampling (Toner *et al.*, 2005) in 2013. All samples of invertebrates were combined for each site and live sorted on the river bank and fixed in ethanol for subsequent laboratory identification. The relative abundance of macroinvertebrates was recorded on-site at each site. This procedure involved the use of a 'D' shaped hand net (mesh size 0.5 mm; 350 mm diameter) which was submerged on the river bed with its mouth directed upstream. The substrate upstream of the net was then kicked for one minute in order to dislodge invertebrates, which were subsequently caught in the net. Where possible, this procedure was undertaken at three points along/across the watercourse. Stone washings and vegetation sweeps were also undertaken to ensure a representative sample of the fauna present at each site was collected.

An appraisal of the occurrence of rare protected species (e.g. white-clawed crayfish) and of non-native invasive species was assessed at sampling sites using underwater visual observation (bathyscopes and snorkeling - see section 1.2.6.3). Methodology for White-clawed Crayfish surveying followed recognised procedures given in the manual 'A technical manual for monitoring white-clawed crayfish *Austropotamobius pallipes* in Irish lakes' by Reynolds *et al.* (2010).

1.2.6 Fish appraisals

Habitat and watercourse size has a key influence on fish communities. Electrical fishing results (Ecofact, 2013) were used in combination with physical habitat appraisals to evaluate the watercourses affected by the proposed development.

1.2.6.1 Visual surveys

Habitat suitability for salmonids was assessed in 2016 with reference to the leaflet 'The Evaluation of habitat for Salmon and Trout' (DANI Advisory Leaflet No. 1) and 'Ecology of the Atlantic Salmon' (Hendry & Cragg-Hine, 2003). An opinion of lamprey habitats was formed at survey sites and at Salmon Point with reference to Ecology of the River, Brook and Sea Lamprey by Maitland (2003).

1.2.6.2 Electrical fishing surveys

An electrical fishing survey was undertaken in 2013 at all selected sites under authorisation from the Department of Communication, Energy and Natural Resources under Section 14 of the Fisheries Act (1980). It is noted that some of the watercourses were too small to complete a full survey, but all were checked for presence / absence of fish. Sites were surveyed following the methodology outlined in the CFB (2008) guidance "*Methods for the Water Framework Directive - Electric fishing in wadable reaches*". A portable electrical fishing unit (Smith Root-LR 24 backpack or Marine Electrics Safari Researcher 660D) was used during the assessments. Fishing was carried out continuously for 20 minutes at each of the sites located on the larger watercourses, and for at

least 5 minutes at the smaller stream sites. Stop nets were used at suitable sites. Captured fish were collected into a container of river water using dip nets. On completion of the survey fish were then anaesthetised using a solution of 2-phenoxyethanol, identified, and measured to the nearest mm using a measuring board. Subsequent to this the fish were allowed to recover in a container of river water and were the released alive and spread evenly over the sampling area. No mortalities were recorded.

Electrical fishing for juvenile lampreys was carried out in the most suitable juvenile lamprey habitats that could be found habitat taking cognisance of habitat suitability outlined in O'Connor (2006). Identification followed the manual 'Identifying Lamprey. A Field key for Sea, River and Brook Lamprey' by Gardiner (2003).

1.2.6.3 Snorkeling surveys

Snorkel surveys are widely used to monitor fish populations in streams and to estimate both relative and total abundance (Slaney and Martin, 1987). Snorkeling was carried out in June 2016 with the aid of a snorkel and face mask to qualitatively assess fish and macroinvertebrate distribution, presence/absence, species assemblages (i.e., diversity) and habitat use. A wet suit and diving boots were worn during this survey to provide insulation. A waterproof camera was used to capture underwater images.

Snorkeling is often feasible in places where other methods are not; for example, deep clear water with low conductivity makes electrofishing prohibitive (Johnson *et al*., 2007). In the current assessment, snorkeling was suitable in the River Inny and River Glore with respect to depth and soft substrates. Snorkeling was not feasible in the remainder of the watercourses due to poor visibility (peat stained water) and extent of shading.

Fish were identified with reference to the 'Key to British Freshwater Fish with notes on their ecology and distribution' by Maitland (2004).

1.2.7 Biological Water Quality

Benthic macroinvertebrates, or aquatic insects were used as an indicator of water quality at the study sites using the Quality Rating (Q) System (Toner *et al*, 2005). This is the standard biotic index which is used by the Environmental Protection Agency. This method categorises invertebrates into one of five groups, depending on their sensitivity to pollution. Where possible, Q-ratings were derived for sites. Further details on the Q-rating system and its relationship to the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009) are provided in Table 2.

Table 2: Relationship between Q-Value and ecological status for macroinvertebrates.

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

** These values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.*

*** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses*

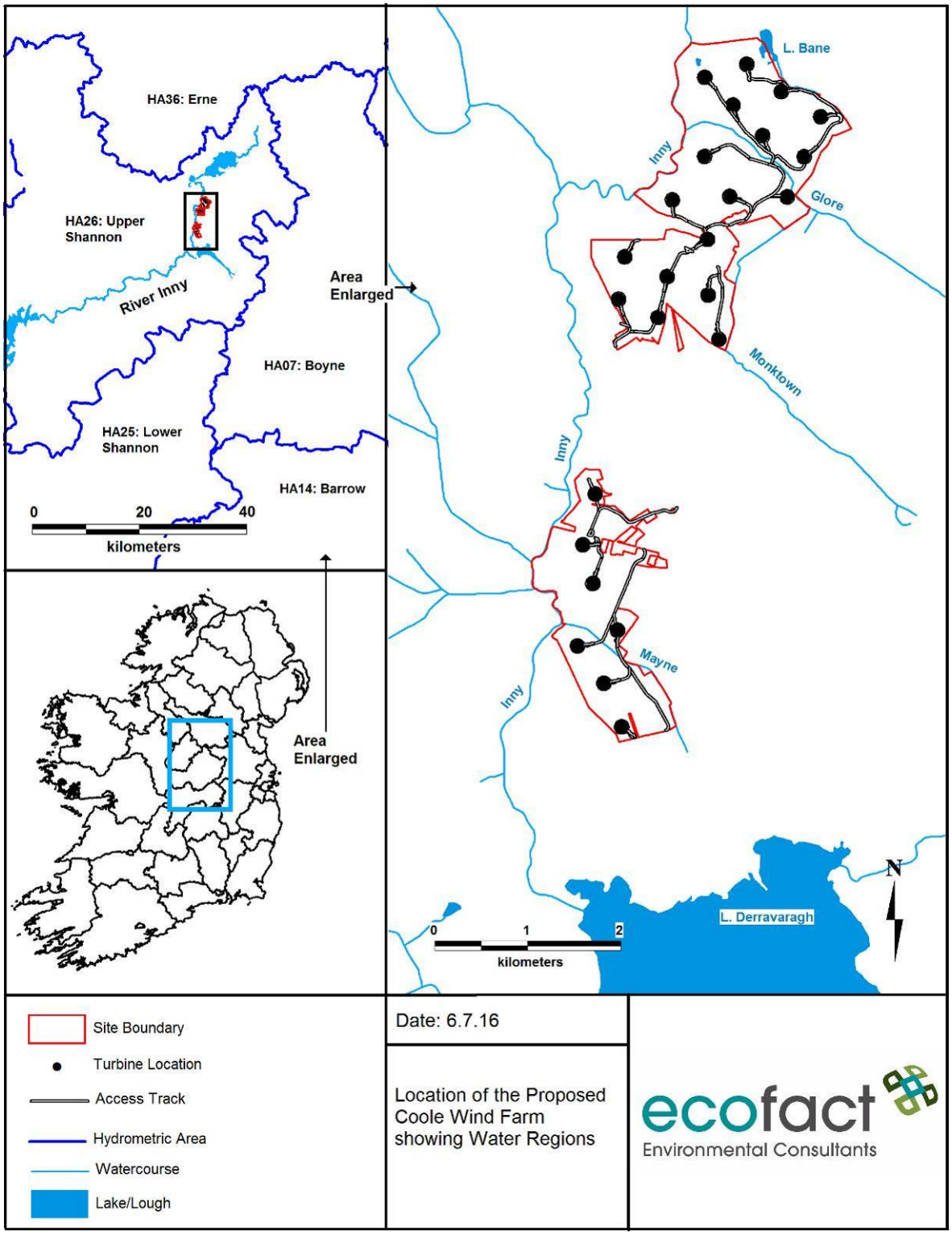

Figure 1 Location of the proposed Coole Wind Farm showing water regions.

1.2.8 Evaluation Criteria

The evaluation criteria used in the current appraisal follows the '*Guidelines for the Assessment of Ecological Impacts of National Realignments – Revision 2*' (NRA, 2009). The evaluation of impact significance is a combined function of the value of the affected feature (its ecological importance), the type of impact and the magnitude of the impact. It is therefore necessary to identify the value of ecological features within the study area in order to evaluate the significance and magnitude of possible impacts.

Following the guidance set out by the NRA (2009) the study area has been evaluated based on an identified zone of influence with regard to the potential for pathways for impacts affecting aquatic ecological features of interest (habitats, flora and fauna).

Ecological features are assessed on a scale ranging from international-national-county-local (see Table 3). The local scale is taken as corresponding to the zone of influence of the development and extending to a parish area. The evaluation criteria are presented below. Watercourses, evaluated following the NRA (2009) criteria were evaluated on the basis of a number of characteristics and features defined as follows:

- Aquatic habitat refers to the in-water conditions of any watercourse; including substrate and stream structure (i.e. proportion of riffles, runs and pools).
- The fisheries value of a watercourse refers to its suitability for fish, primarily salmonids (salmon and trout), and to the associated value for recreational angling purposes.
- Annex II species are those that are listed under the EU Habitats Directive (92/43/EEC).
- Annex I habitats are those that are listed under the EU Habitats Directive, including Priority Habitats.
- The evaluation of water quality uses a five-point biotic index (Q-value) based on the presence and relative abundance of various invertebrates using the Environmental Protection Agency's (EPA) standard technique.

Table 3: Criteria used to determine the value of ecological resources (NRA 2009)

Importance	Criteria
International Importance	'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. Proposed Special Protection Area (SPA). Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended). Features essential to maintaining the coherence of the Natura 2000 Network Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972). Biosphere Reserve (UNESCO Man & The Biosphere Programme) Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). Biogenetic Reserve under the Council of Europe. European Diploma Site under the Council of Europe. Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).

Importance	Criteria
National Importance	Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park. Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive.
County Importance	Area of Special Amenity. Area subject to a Tree Preservation Order. Area of High Amenity, or equivalent, designated under the County Development Plan. Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. County important populations of species; or viable areas of semi-natural habitats; or natural heritage features identified in the National or Local BAP; if this has been prepared. Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
Local Importance (higher value)	Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (lower value)	Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; Sites or features containing non-native species that are of some importance in maintaining habitat links.

- *SAC = Special Area of Conservation; SPA = Special Protection Area; NHA = Natural Heritage Area.

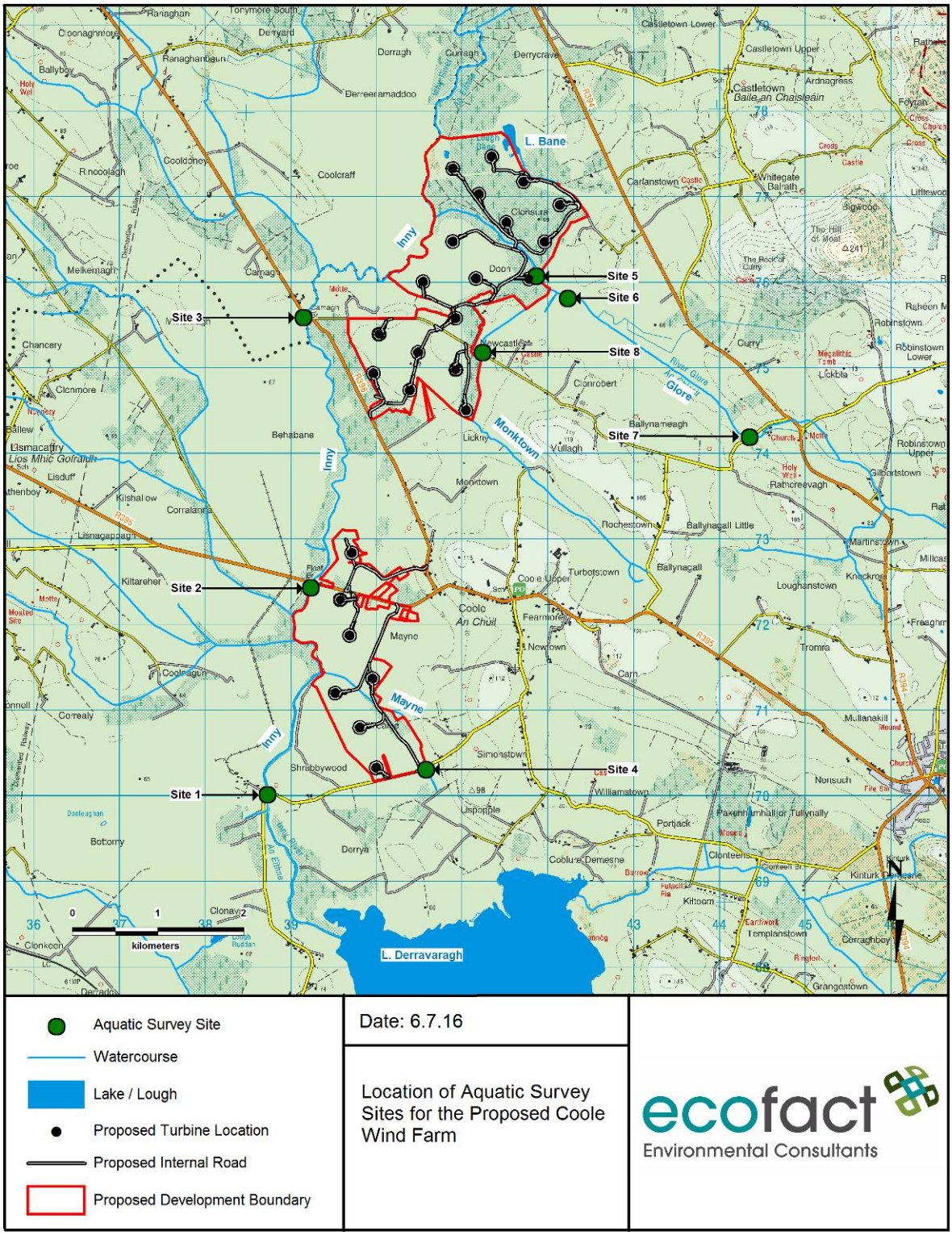

Figure 2 Coole aquatic ecology and fish survey sites.

1.3 Existing Environment

A variety of sites were evaluated with regard to their potential to support protected aquatic species, fish and macroinvertebrates using a combination of visual surveys and instream surveying. Table 3 presents the results of the physical habitat appraisals at survey sites, Table 4 presents the results of the River Corridor Survey appraisals, Table 5 presents the results of the fisheries habitat appraisals and Table 6 presents the biological water quality and WFD status at the survey sites. The results of the aquatic ecology and fisheries survey are also presented on Figure 4.

The study area is described below in section 1.3.1 and 1.3.2 in terms of surface water hydrology, designated sites with aquatic dependant key conservation interests, waterbody types in the study area, protected aquatic flora and fauna, fish communities and fisheries, biological water quality.

1.3.1 Overview of watercourses in the study area

The proposed development is located in Hydrometric Area 26 - the upper Shannon catchment.

Only one sub-catchment, the Inny sub-catchment, is affected by the current proposal. This major tributary of the River Shannon flows from Lough Sheelin to join the Shannon at Lough Ree. The catchment is generally underlain by calcareous limestone and also drains large areas of midlands peat bogs, many of which are still being worked commercially.

The Inny River itself is almost 90km long and drains a catchment area of 782 km^2. It rises near Oldcastle. Co Meath, and drains several important midland lakes, including Lough Sheelin. It has a number of tributaries including the Tang which joins the Inny downstream of Ballymahon, Co. Westmeath; the Rath River, which joins it upstream of Ballymahon; and its largest tributary is the River Glore which feeds the River Inny upstream of Lough Derravaragh.

As with many other Irish river catchments, the Inny catchment was also subjected to a major arterial drainage programme in the 1960s. This scheme resulted in the channelisation of the main channels such as the Inny and Glore, and the lowering of water levels in the lakes in the catchment.

1.3.2 Description of watercourses in the study area

Figures 1-3 show the principal watercourses in the study area. These water features correspond with rivers and streams shown on the EPA map viewer and OSI mapping. The 4th order River Inny is the largest and most important watercourse in the study area. Much of the western boundary of the proposed development site is formed by the River Inny and all components of the proposed development are within the Inny catchment (to the east of the main channel of the Inny). The Inny catchment includes numerous lakes. From upstream to downstream, these include Lough Sheelin, Lough Kinale, Lough Derragh, Lough Derravaragh and Lough Iron. The River Inny discharges into Lough Ree (River Shannon).

The southern extent of the proposed development is drained by the Mayne Stream. The Mayne Stream is a minor 1st order low gradient watercourse. It is a highly modified channel with a bed consisting almost entirely of peat silt. It has a channel length of ca. 2km and flows into the River Inny ca. 3.5km upstream of Lough Derravaragh.

The 3rd order River Glore drains part of the northern extent of the proposed development. The River Glore rises ca. 6km east of Castlepollard in Co. Westmeath and flows northwest over a distance of ca. 12.3km. Lough Glore is a small waterbody of ca. 0.24km^2 that occurs in the upper part of the Glore sub-catchment. It is noted that only the lower reach of the River Glore, a stretch of ca. 1.8km downstream of the Monktown Stream confluence could be affected by the proposed development. The River Glore has been drained and channelised. It has a medium gradient with the exception of the lower reach where gradient is low.

The Monktown Stream is a 2nd order watercourse with a channel length of ca. 4.6km. The Monktown Stream drains a portion of the proposed development. It flows into the River Glore from the south ca. 1.8km upstream of the River Inny - Glore confluence.

The Mayne and Monktown Streams are highly modified waterbodies corresponding to the habitat 'Drainage ditch' (FW4) and/or 'Depositing river' (FW2). These channels have been subjected to severe modifications in part as a result of arterial drainage schemes and some stretches appear to be regularly maintained and entirely artificial. A long stretch of the River Glore has been channelised upstream of the proposed Coole Wind Farm, as evident by deepening and straightening.

Lough Bane and its feeder stream occurs at the northern extent of the proposed development. This waterbody has no efferent stream.

Table 3: Results of the physical habitat appraisals of the aquatic ecology and fisheries survey sites at proposed Coole wind farm site.

Site	Watercourse Name	Wetted width (m)	Mean Depth (cm)	Max Depth (cm)	Instream vegetation (%)	Bank Height (m)	Bank slope (°)	Bank Cover (%)	Canopy Cover (%)	Riffle (%)	Glide (%)	Pool (%)	Flow Velocity (m/s)	Rock (%)	Cobble (%)	Gravel (%)	Fine (%)	Shade (%)
1-3	Inny	28	1	2.5	40	1	75	95	0	0	20	80	0.2	0	0	20	80	10
4	Mayne	1.5	20	25	10	0.7	90	100	70	0	100	0	0.01	0	0	0	100	90
5	Glore	3	20	60	50	3	45	80	10	40	30	30	0.4	0	10	70	20	10
6	Glore	2.5	20	25	90	0.5	80	100	0	10	90	0	0.05	0	0	20	80	0
7	Glore	2.5	35	50	40	0.9	55	100	5	30	40	30	0.1	20	30	25	25	0
8	Monktown	1.5	10	30	15	1	80	80	45	25	25	50	0.2	0	0	0	100	45

1.3.3 Designated sites

1.3.3.1 SACs designated for aquatic organisms

The location of the proposed development in relation to water quality dependent Natura 2000 sites is indicated in Figure 3. The proposed development is located in the surface water catchment of the Inny sub-catchment within the upper Shannon catchment. The only Natura 2000 sites with aquatic interests potentially affected are those within the Inny sub-catchment. There is no Natura 2000 river system in the study area. Lough Derravaragh SPA (4043) is located approximately 1.3km to the south of the proposed development. Lough Derravaragh is connected to the proposed development via the River Inny and its tributaries within and bordering the proposed development.

Lough Derravaragh SPA is located ca. 3.4km and 11.3km downstream of the Mayne Stream and River Glore confluence with the River Inny respectively. The River Inny is the main inflowing and outflowing river. Lough Derravaragh is a medium to large-sized lake of relatively shallow water (maximum depth 23 m). It extends along a SE-NW axis for approximately 8 km. It is a typical limestone lake with water of high hardness and alkaline pH. It is classified as a mesotrophic system. A notable feature is the range of charophytes that occur in the lake. The features of interest of Lough Derravaragh are: Whooper Swan *Cygnus cygnus* [A038], Pochard *Aythya ferina* [A059], Tufted Duck *Aythya fuligula* [A061], Coot *Fulica atra* [A125] as well as Wetland and Waterbirds [A999] (NPWS, 2015).

Enrichment of the lake, mainly by agricultural run-off, is listed as a threat and could affect the bird populations and especially diving ducks.

Lough Iron SPA is another waterbody on the Inny located downstream of the proposed development where the features of interest are dependent on water quality. This site is located ca. 8.2km downstream of Lough Derravaragh, or ca. 13.5km downstream of the proposed development.

Lough Ree SAC (00440) is located over 40km southwest of the proposed development and a considerably longer distance via the surface water pathway i.e. via the River Inny and its lakes. Lough Ree is an excellent example of a natural eutrophic system. The Otter *Lutra lutra* is the only species listed as a conservation interest of this site. There are no designated salmonid waters within 40km downstream of the proposed development.

Table 4: Results of the River Corridor Survey appraisals of survey sites at proposed Coole wind farm site.

Site	River	Tributary	Segment code	EPA code	Order	Wetted width (m)	Drained (Y/N)	Gradient (Low/Med/High)	Siltation (Heavy/Moderate/Normal/Free)	Filamentous algae (Y/N)	Eroding banks (Y/N)	Braided channel (Y/N)
1-3	Inny	-	07_1712	07M03	4	28	Y	L	H	Y	N	N
4	Inny	Mayne	26_2450	26M92	1	1.5	Y	L	H	Y	N	N
5	Inny	Glore	26_2976	26G02	3	3	Y	L	M	Y	Y	N
6	Inny	Glore	26_13411	26G02	3	2.5	Y	M	M	Y	Y	N
7	Inny	Glore	26_3579	26G02	3	2.5	Y	M	N	Y	Y	N
8	Inny	Glore, Monktown	26_2975	26M78	2	1.5	Y	L	H	Y	N	N

Table 5: Results of the aquatic ecological appraisals of survey sites for proposed Coole wind farm site (P=present, L=likely, A=absent).

Site	Watercourse Name	Salmonid nursery (Y/N)	Salmonid fishery (Y/N)	Coarse nursery (Y/N)	Coarse fishery (Y/N)	Salmon (P/A)	Trout (P/A/L)	Coarse fish (P/A)	Eel (P/A/L)	Juvenile lamprey habitat (P/A)	Lamprey (P/A)	Crayfish (P/A)	FPM (P/A)	Floating river vegetation (Y/N)
1-3	Inny	A	A	Y	Y	A	A	A	A	P	A	A	A	A
4	Mayne	A	A	N	A	A	L	L	P	P	P	A	A	A
5	Glore	A	A	Y	A	A	P	A	P	P	L	A	A	A
6	Glore	Y	A	Y	A	A	P	P	P	P	P	A	A	Y
7	Glore	Y	A	Y	A	A	P	P	P	P	P	A	A	A
8	Monktown	A	A	A	A	A	L	L	A	A	A	A	A	A

Table 6: Biological water quality and WFD status at survey sites (High / Good / Moderate / Poor / Bad).

Site	Watercourse Name	Q-value	Biological Status (Macroinvertebrates)	Morphological Status	Fish Status
1-3	Inny	Q4/Q3-4	G/M	P	P/B
4	Mayne	Q3	P	P	B
5	Glore	Q3-4	M	P	P/B
6	Glore	Q3-4	M	M	P/B
7	Glore	Q3-4	M	M/P	P
8	Monktown	Q3	P	P/B	B

1.3.4 Protected aquatic flora and fauna

1.3.4.1 Atlantic salmon

The Atlantic salmon (*Salmo salar*) is listed under Annexes II and V of the EU Habitats Directive and Appendix III of the Bern Convention. It an economically important species and salmon recreational and commercial fisheries occur throughout Ireland. Atlantic salmon are an anadromous species, meaning they are spawned in freshwater habitats and then migrate to the sea. Salmon habitats are usually fast flowing riffle and glide habitats with cobble or gravel substrates. The gravels at these sites must be clean and well oxygenated for successful hatching. Crisp (2000) notes that salmon spawning site selection is governed by a complex of environmental factors including intra-gravel flow, gravel size, water depth as well as stream velocity and cover, which are all essential for successful spawning, egg survival and hatching. One of the most important factors for salmon egg survival is oxygen supply, which is dependent upon dissolved oxygen concentration and inter-gravel flow. High concentrations of suspended solids in the river are undesirable as they are likely to result in infilling of the gravel pores with fine material (Cowx and Fraser, 2003). Juvenile salmon require fast flowing clean water and the cover of instream rocks, plants and banks to thrive. Adult salmon require pool habitat to rest before in the interval between entering the river and reaching spawning grounds and the act of spawning. Salmon angling areas are usually located on main river channels or small rivers in deep glides of 1.5m depth or more.

The dams on the lower reaches of the River Shannon (Ardnacrusha hydroelectric station, Parteen Weir) represent obstacles for upstream migrating adult salmon. In McGinnity *et al.* (2005), which gives the distribution of salmon in Ireland, the reaches of the River Shannon and its tributaries above the aforementioned barriers, including the River Inny, are indicated as non-self sustaining with regard to salmon. This is because salmon cannot negotiate the dams on the river downstream of Lough Derg. Salmon populations in the River Inny, Brosna and Little Brosna catchments are supported primarily by stocking of juvenile salmon produced in the ESB's Parteen salmon hatchery. The Inny catchment was formerly an important salmon fishery, but currently very few salmon occur. Any salmon populations in this catchment are now the progeny of stocking programmes. Up to the early 1990's naturally spawned salmon did occur on the River Inny and its tributary the Rath River (ESB, 1994). During the most recent Inland Fisheries Ireland survey of the main Inny channel at Shrule Bridge (IFI Code 26I011350) no 0+ (young of the year) salmon were recorded and 1+ and older salmon were recorded at a very low density (0.001/m^2) (Kelly *et al.* 2015).

With the exception of the River Glore, the watercourses in the study area of the proposed Coole Wind Farm are unsuitable / marginal with regard to the requirements of the early life stages of salmon due to the peaty nature of their substrates and low gradient. Parts of the River Glore

upstream of the proposed development site are considered suitable for salmon spawning and as salmonid nursery areas.

Atlantic salmon populations in Ireland have been recently assessed as being 'unfavourable - inadequate' by NPWS in the 2013 Article 17 Conservation Status Assessments (2013).

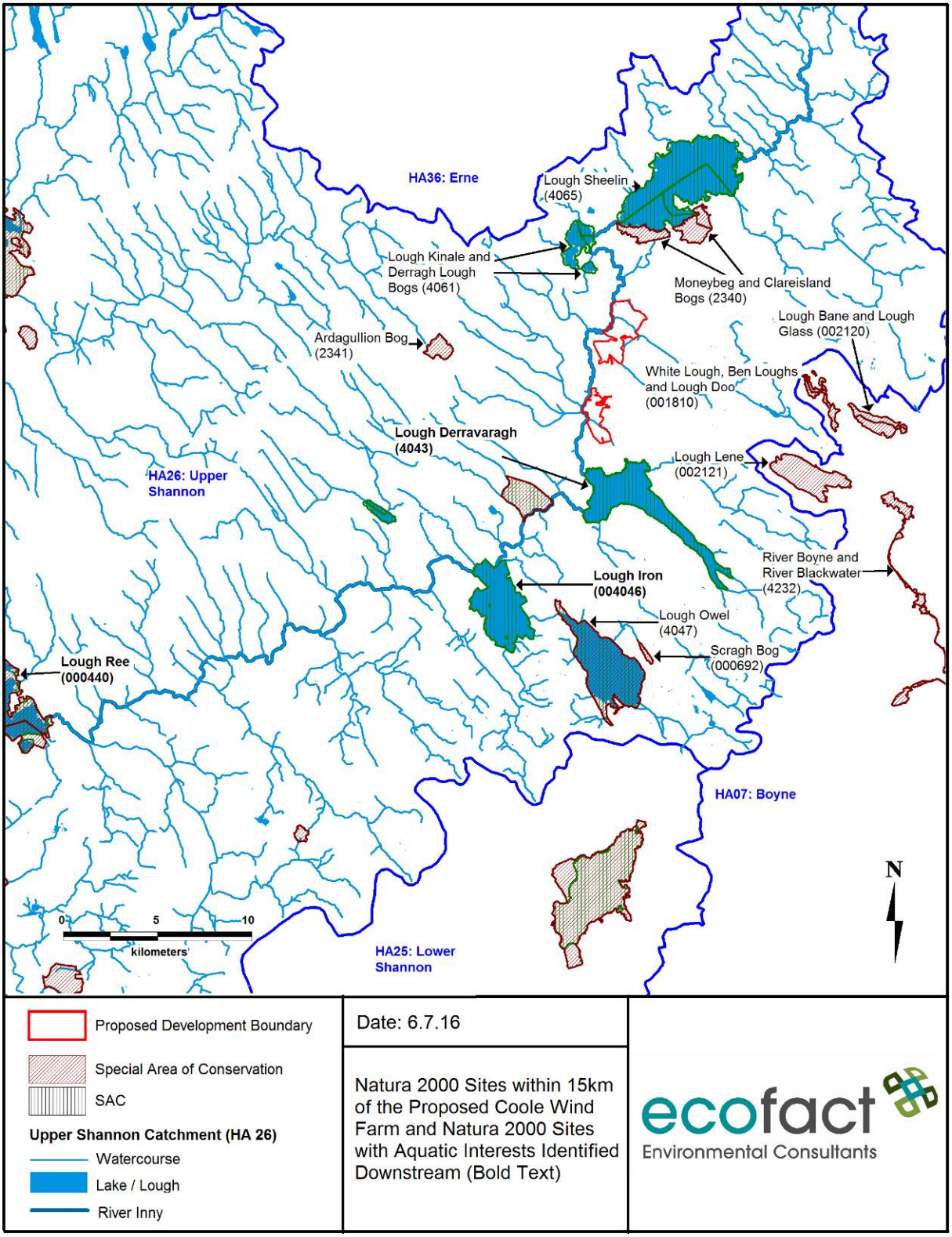

Figure 3 Special Areas of Conservation with aquatic interests within the study area of the proposed Coole Wind Farm.

1.3.4.2 Freshwater Pearl Mussel

The freshwater pearl mussel (*Margaritifera margaritifera* (L.)) is a large bivalve species found in oligotrophic, soft to neutral waters of rivers and, occasionally, in lakes. In Ireland, the species is concentrated along the western sea-board, but also occurs in the south and east where geology allows. The biology and ecology of the species are particularly notable in that individuals can grow to very large sizes relative to other freshwater molluscs, building up thick calcareous valves, in rivers with relatively soft water and low levels of calcium. Their shell building is consequently very slow, and individuals in natural conditions live to over a hundred years of age.

The Freshwater Pearl Mussel does not occur in the study area and there are no previous records from Hydrometric Area 26 (Upper Shannon). The nearest freshwater pearl mussel catchment is the Erne -Annalee catchment located in excess of 20km northeast of the proposed development.

Freshwater Pearl Mussel populations in Ireland have been recently assessed as being 'unfavourable - bad' by NPWS in the 2013 Article 17 Conservation Status Assessments (2013).

1.3.4.3 White-clawed crayfish

The white-clawed crayfish is the only freshwater crayfish recorded in Ireland. Populations of the species in the rest of Europe have declined dramatically and Ireland is seen as a unique stronghold for this species in a European context (Reynolds 1998).

The white-clawed crayfish is protected under both European and Irish legislation. It is protected by the Wildlife Act, 1976 and has been classified as endangered in the IUCN Red List. It is also listed under Appendix III of the Bern Convention and Annexes II and V of the EU Habitats Directive (1992). The white-clawed crayfish is Ireland's only crayfish species. Ireland is understood to hold some of the best European stocks of this species, under least threat from external factors. Irish stocks are therefore of substantial conservation importance (Reynolds, 1998). Throughout its natural range across Western Europe, the distribution and abundance of white-clawed crayfish has been dramatically reduced in the last 150 years due to human disturbances such as overfishing, habitat destruction, pollution and the introduction of foreign crayfish species (Reynolds, 1998). In Britain, the North American signal crayfish (*Pacifastacus leniusculus*) was introduced for aquaculture and subsequently escaped into the wild, where it has had a devastating effect on white-clawed crayfish populations. While this species has not been recorded in Ireland, there is a real threat that this alien crayfish species will reach this country. The crayfish plague, which was transmitted by introduced crayfish species and is caused by the fungus *Aphanomyces astaci*, has been found in Ireland since the late 1980s.

White-clawed crayfish is widespread in areas which are underlain by Carboniferous limestone, or its derivative - glacial drift (Reynolds, 1998). It is generally considered to be widespread in lowland rivers such as the Kells, Blackwater, Boyne, and tributaries. Demers *et al.* (2005) reported that white-clawed crayfish are still widespread in the rivers of the Irish midlands, where the geology is predominantly limestone. However, these authors also report that the distribution of white-clawed crayfish in rivers has been restricted since the mid-1980s. This was attributed in part to an outbreak of the crayfish plague. Demers *et al*. (2005) also reported that crayfish populations in the lakes and rivers of the Boyne catchment were likely to have been affected by crayfish plague. However, this effect is geographically isolated (Gallagher *et al*., 2006). Large unexplained mortalities of crayfish have occurred in waterbodies including Lough Owel (Demers *et al*., 2005). Recent data from the EPA suggests a decline in crayfish populations in the north midlands (Reynolds, 2006).

According to Reynolds (1998), the main threats to the White-clawed Crayfish in Ireland are stream drainage, pollution and the introduction of predators, competitors or diseases. Ongoing drainage maintenance on arterially drained rivers in Ireland has also been identified as having a significant adverse effect of this species (O'Connor & McDonnell, 2008).

White-clawed crayfish were recorded in the study area during (Ecofact, 2013) when it was concluded that this species occurs in the River Glore in low densities. This species was not recorded in the River Glore adjacent to the proposed development site during hand searching carried out in 2016. White-clawed Crayfish is considered likely to occur in the River Inny.

White-clawed crayfish populations in Ireland have been recently assessed as being 'inadequate' by NPWS in the 2013 Article 17 Conservation Status Assessments (2013).

1.3.4.4 Brook lamprey

The brook lamprey is the smallest of the three lampreys native to Ireland and it is the only one of the three species that is non-parasitic and spends all its life in freshwater (Maitland & Campbell 1992). Brook lamprey is listed in Annex II of the EU Habitats Directive (92:43: EEC) and in Appendix III of the Bern Convention. Brook lampreys are the most common and widespread of the three Irish lamprey species (Kurtz & Costello, 1999). Brook Lampreys live for up to five years burrowed into silt deposits in rivers. They metamorphose into adults and spawn in the early spring in fast flowing streams with gravel substrates. Unlike the other two Irish lamprey species they are not parasitic as adults, and undertake only localised migrations.

Although still common in Ireland they are under significant threat from drainage and navigation maintenance works and also from water quality deterioration. Brook lampreys are also doing less well across the rest of the European Union. In this regard Irish populations of Brook Lampreys are of International Importance in Ireland. Ireland has failed to protect lampreys with a close season for instream works during their spawning season so they are vulnerable due to the lack of this type of protection. Responsibility for protecting lampreys in Ireland falls within the remit of Inland Fisheries Ireland; although there are none and never have been any fisheries for this species in Ireland.

Brook Lamprey occurs in the River Inny and River Glore as well as in the Mayne Stream as observed in 2013 (Ecofact, 2013). Based on recent visual observations, habitat for juvenile lampreys in these watercourses is considered to support the species in these watercourses. The general lack of suitable spawning areas in the subject watercourses is considered a limiting factor with regard to Brook Lamprey populations in the study area.

Brook lamprey populations in Ireland have been recently assessed as being 'favourable' by NPWS in the 2013 Article 17 Conservation Status Assessments (2013).

1.3.4.5 River and Sea Lamprey

The River Lamprey *Lampetra fluviatilis* and Sea Lamprey *Petromyzon marinus* are larger in size than the brook lamprey and exhibit an anadromous life cycle. Both species are listed in Annex II and IV of the Habitats Directive (92:43: EEC), and also in Appendix III of the Bern Convention. Lampreys are poor swimmers and cannot jump or climb (Reinhardt *et al.*, 2009), so are considered limited to the lower reaches of the River Shannon - well downstream of the study area of the currently proposed wind energy development.

River lamprey populations in Ireland have been recently assessed as being 'favourable' by NPWS in the 2013 Article 17 Conservation Status Assessments (2013). However, this has been based on the fact that they have been grouped together with Brook lamprey populations due to identification difficulties. Sea Lamprey populations in Ireland have been recently assessed as being 'unfavourable' by NPWS in the 2013 Article 17 Conservation Status Assessments.

1.3.4.6 Floating river vegetation

The plants characteristic of this habitat includes a number of *Ranunculus* species and all *Callitriche* species, including other submerged aquatic plants. The community Callitricho–Batrachion includes species of the *Ranunculus* subgenus *Batrachium* and two species of *Callitriche*, *C. hamulata* and *C. platycarpa* as diagnostic species. There are few published records for descriptions of this habitat in Ireland and no comprehensive island-wide descriptions.

According to NPWS (2013) the EU definition of this habitat is very broad, especially when the presence of aquatic mosses is taken into account. Using this broad definition, the habitat will be found in most watercourses in Ireland. There is to date no satisfactory definition of the habitat and its sub-types or their distribution in Ireland. Consequently, there is a lack of relevant monitoring data concerning the habitat. What is clear is that the habitat can occur over a wide range of physical conditions, from acid, oligotrophic, flashy upland streams dominated by bryophytes to more eutrophic, slow flowing streams dominated by *Ranunculus* and *Callitriche* species. While the

former will be sensitive to diffuse pollution the latter, especially in shallow streams, will be relatively more resistant.

Flora associated with the Annex I habitat 'Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation' (3260) includes *Ranunculus saniculifolius, Ranunculus trichophyllus, Ranunculus fluitans, Ranunculus penicillatus ssp. penicillatus, Ranunculus penicillatus* ssp. *Pseudofluitantis, Ranunculus aquatilis, Myriophyllum* spp., *Callitriche* spp., *Sium erectum* (or *Berula erecta*), *Zannichellia palustris, Potamogeton* spp., and the moss *Fontinalis antipyretica*. *Groenlandia densa* (Opposite leaved pondweed) is also included in the list.

The plant communities in the watercourses within the proposed development mainly comprises of low diversity emergent vegetation which limits instream growth during the growing season owing to its luxuriant growth, driven by eutrophication. No plants characteristic of the habitat floating river vegetation were recorded during the current study. Channel maintenance, siltation and competition from higher plants reduces the chances of such plants establishing in these watercourses.

The habitat 'Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation' in Ireland has been recently assessed as being 'inadequate' by NPWS in the 2013 Article 17 Conservation Status Assessments (2013).

1.3.5 Fish communities

Two sites on the River Inny were surveyed by Inland Fisheries Ireland (IFI) as part of Water Framework Directive (WFD) fish surveillance monitoring in 2014 (Kelley *et al.*, 2015). One site was located on the upper reach of the river at Oldcastle (upstream of Lough Sheelin) and the other was located at Shrule Bridge near Ballymahon on a lower reach of the river.

The Oldcastle survey site was located close to its source, on the downstream side of Tubride Bridge, just south of Oldcastle, Co. Meath. Three electric-fishing passes were conducted using one bank-based electric fishing unit on the 9th of September 2014, along a 40m length of channel. Glide and riffle dominated the habitat, over a mixed substrate largely composed of cobble, gravel and boulder. Brown trout density fluctuated over the three sampling occasions; the 0+ age class was dominant in 2008 and 2011, while 1+ & older fish dominated in 2014. Juvenile lamprey and Three-spined Stickleback *Gasterosteus aculeatus* were also present at the site. Table 7 and Table 8 gives the results of the IFI investigations at Oldcastle and Shrule Bridge respectively.

Table 7: Density of fish (no./m^2), River Inny (Bridge 1 km S of Oldcastle). From Kelly *et al.*, (2015).

Species	Total minimum density		
	2008	2011	2014
Brown Trout	0.492	0.346	0.468
0+ Brown Trout	0.331	0.208	0.190
1+ & older Brown Trout	0.161	0.138	0.278
Lamprey sp.	-	0.023	-
3-spined Stickleback	0.018	0.154	0.008
All fish	0.510	0.523	0.476

The Shrule Bridge survey site was located downstream of Shrule Br., about 3km upstream of Ballymahon, Co. Longford. One electric-fishing pass was conducted using four boat-based electric fishing units (two boats electric fished parallel to each bank separately) on the 8th of September 2014, along a 380m length of channel. Glide dominated the habitat, over a mixed substrate of sand, cobble and gravel. Minnow and perch were the two most abundant species encountered. Perch density was higher in 2014 than in 2008, with a wide range of length classes present. Brown trout were also recorded across a wide range of length classes but their density was lower in 2014. Roach x bream hybrids and chub were absent from the latest survey.

This site was located at Boyne Bridge, close to the river's source, approximately 1.5km north of Edenderry. Three fish species were recorded in the River Boyne at Boyne Bridge: Brown Trout (0.0089/m^2), Three-spined Stickleback (0.004/m^2) and Stone Loach (0.002/m^2). It is noted that

the stretch of the River Boyne surveyed during 2014 (Kelley *et al.*, 2015) was drained, corresponding to channel characteristics of some watercourses in the current survey area. The growth category of Brown Trout at this site was rated 'Moderate' based on a new classification scheme developed using length at age data (Matson and Kelly, in prep). With respect to fish, the ecological status of the sites at Oldcaslte and Shrule Bridge were rated 'Good and Moderate' based on the results obtained by IFI, in that order.

The drained nature of all watercourses within and adjoining the proposed Coole Wind Farm site has significantly reduced the ecological and fisheries value of these watercourses, with deepening and channelisation leading to reduced cover for young fish, excessive instream vegetation growth and deposition of fine material.

A number of watercourses in the study area were investigated during 2013 by Ecofact (Ecofact, 2013). At this time, the Glore River was surveyed at two locations upstream of the proposed development site, the River Inny was surveyed at two locations within the study area (Float Bridge and Camagh Bridge) while the upper reach of the Mayne Stream was surveyed. These locations and the fish species recorded are illustrated in Figure 4 and listed in Table 9.

Fish species recorded at both locations were Brown Trout and Brook Lamprey, with European Eel *Anguilla anguilla* and Salmon *S. salar* also recorded at the upstream location. During the 2016 study, Three-spined Stickleback *Gasterosteus aculeatus* were recorded in all watercourses with the exception of the Rossmeen Stream and the Drakerath Stream. Stone Loach *Barbatula barbatula* were also recorded during the 2016 survey (Site 1, 2, 7, 16).

The Inny River is evaluated as being of county importance with regard to its fisheries value and presence of European eel. It is noted that European eel is listed as 'Critically endangered' and is now 'Red Listed' according to the recently published '*Red List No. 5: Amphibians, Reptiles & Freshwater Fish*' (King *et al*., 2011). The River Glore is evaluated as being of local importance (higher value) due to the presence of salmonid spawning and nursery areas.

The minor watercourses within the study area (Mayne and Monktown Streams) are first and second order channels found to be modified and generally evaluated as being of poor ecological and hydrogeomorphological status; these are evaluated as being of local importance (lower - value).

Table 8: Density of fish (no./m²), River Inny (Shrule Bridge). From Kelly *et al.*, (2015).

Species	Total minimum density	
	2008	2014
Brown Trout	0.014	0.006
0+ Brown Trout	0.009	0.001
1+ & older brown trout	0.006	0.005
Chub	0.0001	-
European Eel	0.001	-
Gudgeon	0.007	0.003
Minnow	0.011	0.007
Perch	0.002	0.007
Pike	0.001	0.001
Roach	0.004	0.004
Roach x bream hybrid	0.0001	-
Salmon	-	0.001
+ salmon	-	-
1+ & older salmon	-	0.001
Stone loach	0.001	0.0004
All Fish	0.041	0.029

Table 9: Fish and notable macroinvertebrate species recorded during surveys carried out on watercourses draining the proposed Coole Wind Farm. Based on electrical fishing assessments from Ecofact (2013) and snorkeling surveys (2016).

Species		Watercourse			
		River Inny	River Glore	Monktown Stream	Mayne Stream
Fish	Brown trout	✓	✓	✓	✓
	European eel	✓	✓		✓
	Brook lamprey	✓	✓		✓
	Pike	✓	✓		
	Perch	✓			
	Roach	✓			
Macro-invertebrate	*Anodonta* sp.	✓			
	Zebra Mussel	✓			
	White-clawed Crayfish	✓	✓		

1.3.5.1 Salmonid habitats and fisheries

Atlantic salmon are discussed in detail in Section 1.3.4.1. As well as salmon, brown trout also occur in the study area. Brown trout occur in virtually every catchment in Ireland with suitable water quality and spawning grounds, and are one of the most common and recognisable fish species in Ireland. Indeed, they have less protection in Ireland from anglers than non-native invasive cyprinid fish species such as the dace and roach, presumably due to their abundance.

Brown trout occur as resident 'brown trout' and also as an anadromous form, the 'sea trout'. In many catchments throughout Ireland trout make extensive migrations between spawning grounds in streams and feeding grounds in lakes or larger rivers.

The Inny catchment and its major tributaries were severely affected by drainage which degraded habitats for species such as trout. In many cases trout populations were more affected than salmon, with the removal of features such as undercut banks and large woody debris etc. from these channels. Ongoing peat harvesting in the study area is considered a persistent impact on salmonid habitats due to accumulations of peat silt in watercourse beds and thereby reducing available spawning areas and habitats for the macroinvertebrates upon which juvenile salmoids feed.

The River Inny is still considered an important trout fishery, especially the lower reaches of the river and the lakes it flows through, e.g. Lough Sheelin is still noted for the quality and size of brown trout that it produces. As for salmon, the habitats for Brown trout in the study area are limited by lack of suitable habitat (low gradient), water quality problems and drainage maintenance.

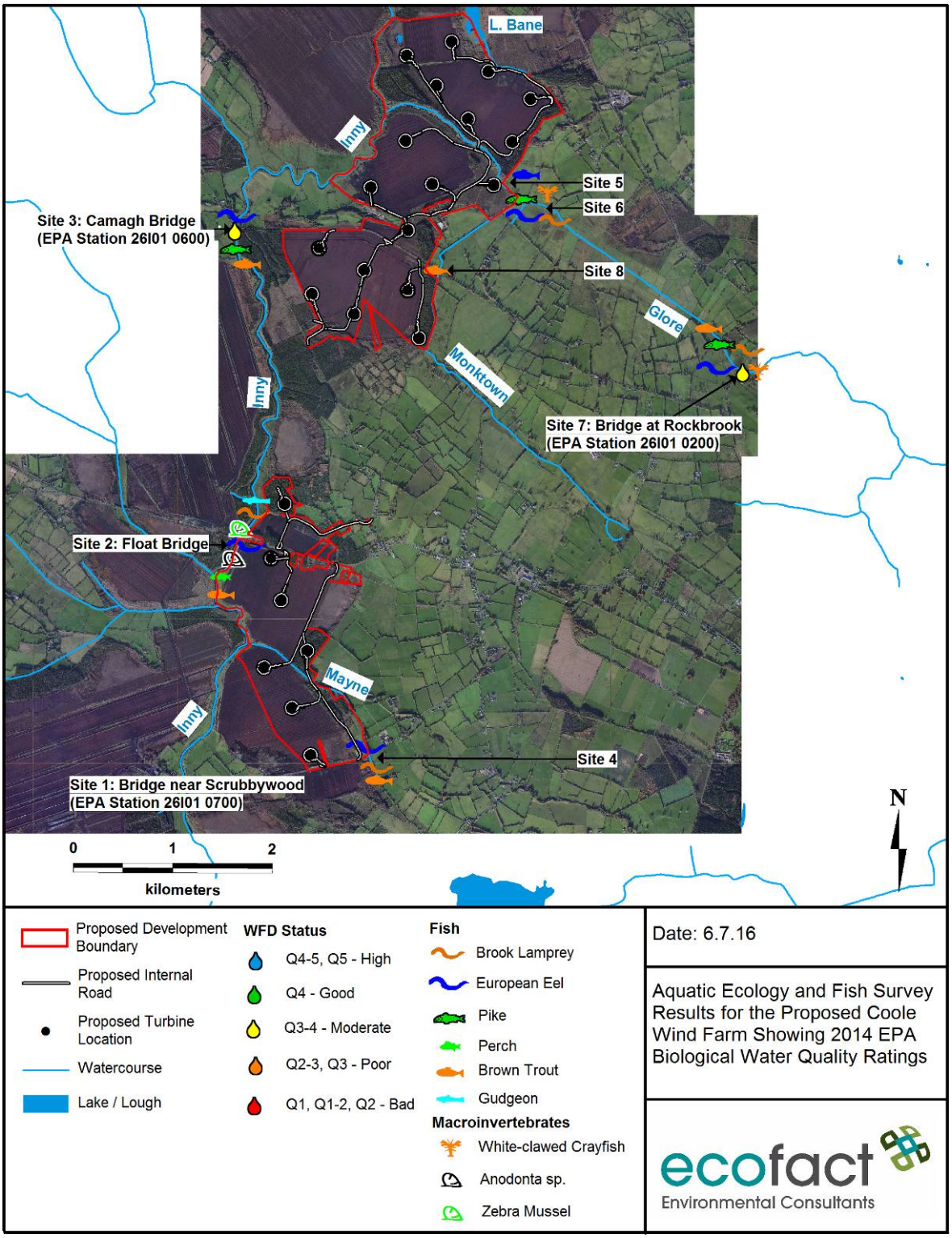

Figure 4 Coole Wind Farm aquatic ecology and fisheries survey results.

1.3.5.2 Coarse fish habitats and fisheries

Coarse fish are essentially any freshwater fish other than salmon and trout and generally include members of the cyprinidae family (i.e. roach, dace, rudd, bream, and tench), pike and perch. The term coarse fishing originated in the United Kingdom in the early 19th century. Prior to that time, recreational fishing was a sport of the gentry, who fished for salmon and trout which they called game fish. Other fish were disdained as coarse fish.

Almost all coarse fish in Ireland are considered to be non-native species. However, there is recent evidence that pike may be native to Ireland (Pedreschi *et al.*, 2013). Coarse fish in Ireland are afforded a higher level of protection in Ireland than native brown trout, with strict limits on the number and sizes of these fish that can be killed by anglers.

Coarse fisheries are of significant economic value in Ireland, particularly for tourist angers. Coarse fisheries and coarse fish spawning areas are generally located in large lowland rivers and lakes. The main channel of Inny is important in this regard. From upstream of Lough Derravaragh to Lough Ree, IFI note that the river varies in depth from approximately 1.5 metres to over 3 metres in normal water levels. The best fishing stretches are at Coolnagun, Inny Bridge and Ballycorkey Bridge. Lough Iron is fringed with dense weed beds and holds large Pike. Angling access is provided at the bridges and in most cases extensive bank fishing is available upstream and downstream from the bridges. There is a large stock of Pike in many locations throughout the length of the River with numerous hot spots.

Lough Derraravagh is regarded as a mixed fishery - it supports brown trout population but is better known for its very good pike fishing.

1.3.5.3 Eel habitats

The European eel *Anguilla anguilla* is a native fish of significant ecological importance. In recent decades, this species has undergone a dramatic decline throughout its range. In response to the decline in European eel populations European Council Regulation 1100/2007 “Establishing measures for the recovery of the stock of European eel” has now been adopted in member states. European eel is listed as ‘Critically endangered’ and is now ‘Red Listed’ according to the recently published ‘Red List No. 5: Amphibians, Reptiles & Freshwater Fish’ (King *et al.*, 2011).

Eels are considered present throughout the study area, but are generally only found in larger watercourses, rivers and lakes. Eels have a catadromous life cycle, which means they spawn in the sea and migrate into freshwater to feed and grow. This is opposite of the life cycle of the salmon, for example. The upstream migration of eels in rivers is restricted by weirs and their obstacles. However unlike lampreys they are able to climb over weirs. Despite the international decline in this species, they occur in the Inny and Glore Rivers in the study area.

1.3.5.4 Lamprey habitats

Lampreys are discussed above in Sections 1.3.4.4, 1.3.4.5, and 1.3.4.6. The study area is considered to support only Brook lamprey. This species is generally common throughout Ireland.

1.3.5.5 Others

The majority of the watercourses within the proposed wind farm site are small fish populations dominated by species such as the Three-spined stickleback and Gudgeon. These small fish communities are not of significant ecological or economic importance. These small fish populations, and particularly ones dominated by sticklebacks, can be present in even small drains that have permanent water.

1.3.6 Aquatic macroinvertebrates

The River Inny and the River Glore are evaluated as being of local value (higher importance) with regard to macroinvertebrates, due to the presence of *Anodonta* sp. and White-clawed Crayfish, respectively.

Based on the physical characteristics of the watercourses in the study area, the habitat suitability for macroinvertebrates is by and large suboptimal in the case of the Inny and Glore Rivers and marginal with respect to the Monktown and Mayne Streams. All watercourses within / adjacent to the proposed development site score low on the range of physical attributes that contribute to favourable conditions for macroinvertebrate diversity and abundance, including bottom substrate (substrates dominated by silt), habitat complexity (monotonous habitat with little diversity), pool quality (pools small/shallow and/or absent), bank stability (banks unstable and contributing sediment to the stream/denuded areas eroded during high floods) and shading.

Biological/kick sampling carried out on watercourses in the study area and the results are discussed hereunder. The mayflies *Baetis* spp., *Ephemerella ignita*, and *Caenis* spp. were found to be generally common. The Trichopterans were a well represented group with cased caddisfly larvae of. and *Agapetus* spp. inhabiting faster flowing areas with stony substrates in the River Glore. Case building families (classified as Group B, less tolerant) such as Limnephilidae, Lepidostomatidae, and Sericostomatidae along with *Phryganea bipunctata* were mostly confined to the slower parts of rivers in the study area (River Inny). Caseless caddisfly larvae (Group C, pollution tolerant) of *Hydropsyche* spp., *Rhyacophila* spp., and *Polycentropus* spp. were also found in the study area.

The most common Coleopterans in the study area were *Haliplus* spp., whirligig beetle *Gyrinus* sp., *Ilybius quadriguttatus* and *Brychius elevatus*. Hemipterans such as water boatman (*Notonecta* sp., *Sigara* sp.), bugs *(Hydrometra stagnorum*, *Velia caprai, Nepa cinerea, Notonecta* sp. *Gerris sp.*) were found in slow areas, particularly at the margins of the River Inny. Other slow-flowing fauna in the study area included dragonflies such as *Aeshna* spp. and damselfly larvae of *Calopteryx* spp.

The macroinvertebrates communities in the study area were dominated by pollution tolerant taxa. Other macroinvertebrates signifying polluted conditions that were recorded included Bloodworm *Chironomous sp*., Freshwater shrimp *Gammarus duebeni, Asellus aquaticus* and *Erpobdella testacea.*

The only large bivalve recorded was *Anodonta* sp*.* This species was recorded in the River Inny at Float Bridge. *A. anatina* is typically a lowland species (Kerney, 1999). Its habitat in Ireland is lowland lake, slow moving rivers and canals. Microhabitat for this species in Ireland comprises muddy or silty beds in areas of still or slow flow. There are a total of 31 Irish non-marine molluscan species that either have a threat status or are important Irish populations (Moorkens, 2006), including *Anodonta*. The IUCN status of *Anodonta* is 'Vulnerable' (Byrne *et al*., 2009) and its threat status is 'Vulnerable' (Moorkens, 2006).

1.3.7 Biological water quality

The River Inny (28I01) and its tributaries were most recently surveyed by the EPA in 2014. Good ecological condition was found at four out of eleven sites surveyed on the Inny in 2014. Sites in the upper reaches (0060-0600) are not reaching their ecological potential, with sensitive macroinvertebrate taxa noticeably absent. Ballinrink Bridge (0300) returned to unsatisfactory condition after an improvement in 2011. The lower reaches exhibited high macroinvertebrate diversity and were of satisfactory ecological condition in 2014 with the exception of site 0800 which had deteriorated to moderate ecological condition.

The Glore (Westmeath) was once again found to be slightly polluted/eutrophic below Glore lake (0100), as characterised by a paucity of sensitive macroinvertebrate fauna. The lower reaches (0200) were in moderate condition in 2014 after previously returning to highly satisfactory ecological condition in 2011.

1.3.8 Aquatic plant communities

Plants recorded during the current surveys consisted of *Sparganium erectum*, *Apium nodiflorum*, *Rorippa nasturtium-aquaticum*, *Glyceria maxima*, *Phragmites australis, Phalaris arundinacea, Mentha aquatica*, *Myosotis scorpioides, Iris pseudacorus, Schloenoplectus lacustris, Nuphar lutea, Callitriche* spp., *Lemna* spp. and *Potamegeton* sp. The filamentous green algae *Cladophora glomerata* was common in the enriched lower reaches of the Glore River and also in the River Inny.

1.3.9 Amphibians

The Mayne and Monktown Streams as well as Lough Bane and its feeder stream may support a small population of frog and/or newt.