6 AQUATIC ECOLOGY

6.1 INTRODUCTION

This chapter assesses the impacts of the Project (**Figure 1.2**) on Aquatic Ecology. The Proposed Development refers to all elements of the application for the construction of the Firlough Wind Farm and Hydrogen Plant Sites (**Chapter 2: Project Description**). In accordance with the EIA Directive (2014/52/EU), this chapter will identify, describe and assess the direct and indirect effects of a project on "(*b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC*". Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment will consider the potential effects during the following phases of the Proposed Development:

- Construction
- Operation
- Decommissioning

Common acronyms used throughout this EIAR can be found in **Appendix 1.1**. This chapter of the EIAR is supported by Figures provided in Volume III.

A Construction and Environmental Management Plan (CEMP) is appended to the EIAR in **Appendix 2.1**. The CEMP includes an emergency spillage plan, a peat and spoil management plan, a surface water management plan, a traffic management plan and a waste management plan. The CEMP will include all of the mitigation recommended within the EIAR. A summary of the mitigation measures is included in **Appendix 16.1**. In the event that planning is granted for the Proposed Development, the CEMP will be updated prior to the commencement of construction to address the requirements of any planning conditions including any additional mitigation measures which are conditioned, and will be submitted to the planning authority for written approval.

6.1.1 Statement of Authority

This chapter has been written by Paul Murphy of EirEco Environmental Consultants who also undertook the aquatic field surveys and Freshwater Pearl Mussel surveys. He holds an MSc in Environmental Science and a Diploma in Aquatic Biology, is a Chartered Environmentalist (Society for the Environment), a full member of the Chartered Institute of Ecology and Environmental Management and a member of the Institute of Fisheries Management. Paul has been operating in the environmental field for over three decades covering a broad range of projects in a variety of countries. He has expert knowledge of the various EU Environmental

Directives and extensive experience in Environmental Impact Assessment and ecological mitigation design for numerous major infrastructural schemes (roads, bridges, power plants, wind farms, etc.).

Electro-fishing surveys were undertaken by Paul Murphy and John Brown (Stillwater's Consultancy). John is a retired Inspector of Fisheries in the Fisheries Research Centre of the Department of Fisheries and Forestry, and Head of the Stock Assessment Section in the Marine Institute. He established Stillwaters Consultancy in 1999 to provide fisheries management and water quality advice to the public and private sector.

6.1.2 Assessment Structure

In line with the revised EIA Directive and current EPA guidelines (2022) the structure of this Biodiversity chapter is as follows:

- Assessment Methodology and Significance Criteria
- Description of baseline conditions at the Site
- Identification and assessment of impacts to Biodiversity associated with the Project during the construction, operational and decommissioning phases
- Identification and assessment of cumulative impacts if and where applicable
- Mitigation measures to avoid or reduce the impacts identified
- Identification and assessment of residual impact of the Project considering mitigation measures

6.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

6.2.1 Assessment Methodology Aquatic Biodiversity

6.2.1.1 Guidance

The general approach used for the evaluation of ecological receptors and assessment of potential impacts for this current assessment is based on the '*Guidelines for Ecological Impact Assessment in the UK and Ireland*' (Chartered Institute of Ecology and Environmental Management, 2018). The evaluation of 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* (National Roads Authority, 2009).

Effects were considered to be either significant or not significant at a geographic scale equivalent to or less than the conservation importance of the ecological feature being assessed (CIEEM, 2018). Duration of impacts is considered according to Environmental Protection Agency (EPA) guidance (EPA, 2022). The magnitude of an impact will depend on the nature and sensitivity of the ecological features and will be influenced by intensity, duration

(temporary/permanent), timing, frequency and reversibility of the potential impact (Chartered Institute of Ecology and Environmental Management, 2018).

6.2.1.2 Desktop Study

A desktop study review was carried out of existing data and records for fish, protected aquatic species and habitats (including Annex II species and aquatic Annex I habitats), and invasive species listed under the Third Schedule of S.I No. 477 of 2011, European Communities (Birds and Natural Habitats) Regulations 2011) on watercourses at or hydrologically connected (i.e. downstream) to the Project on the National Biodiversity Data Centre (NBDC) and National Parks and Wildlife Service (NPWS) websites.

6.2.1.3 Consultations

A sensitive species data request was made on 31st May 2021to the NPWS for aquatic flora and fauna, including Freshwater Pearl Mussel, within 10 km grid squares G30 20, G40 20, G30 30 and G40 30. Consultations were also undertaken with Inland Fisheries Ireland in relation to existing data on fish stocks and in relation to concerns or requirements vis-a-vis the Project. A Licence application was submitted to Inland Fisheries Ireland (IFI) in relation to Electro-fishing surveys.

6.2.1.4 Field Survey

Zone of Influence

The Zone of Influence (ZOI) differs for different habitats and species. Within terrestrial habitats, the ZOI may be confined to the study area, whereas for aquatic habitats, the ZOI will be much more extensive and the surveys undertaken were scoped accordingly. In view of hydrological connectivity, this entailed establishing the baseline conditions in aquatic habitats at a range of points downstream in the various watercourses draining the site and is reflected in the range and extent of surveys undertaken. An Appropriate Assessment Screening Report and Natura Impact Statement (Biosphere Environmental Services, 2023) has been prepared for the Project which assesses potential impacts on European designated sites (the Natura 2000 network), a number of which are hydrologically connected via surface water flow.

Aquatic Habitats

Surveys of watercourses at and within a potential zone of influence of the Project and for 500 m downstream were undertaken on 8th and 9th September 2021. The surveys identified and mapped aquatic habitats, determined fisheries value and potential, and determined presence or suitability for Annex listed species or invasive alien species. The aquatic habitat assessment conducted at all sites was based on the Environment Agency's *'River Habitat Survey in Britain*

and Ireland Field Survey Guidance Manual 2003' (Environment Agency, 2003) and the Irish Heritage Council's *'A Guide to Habitats in Ireland*' (Fossitt, 2000). All sites were assessed in terms of:

- Stream width, depth and other physical characteristics
- Substrate type, listing substrate fractions in order of dominance, i.e. bedrock, boulder, cobble, gravel, sand and silt
- Flow type, listing percentage of riffle, glide and pool in the sampling area
- In-stream macrophyte, bryophytes occurring and their percentage coverage of the stream bottom at the sampling sites
- Riparian habitats and species composition

A Biosecurity protocol was rigidly followed during all surveys to avoid the potential for transfer of invasive alien species or diseases to or from the site in accordance with guidance produced by Invasive Species Ireland and Inland Fisheries Ireland (*Decontamination and Disinfection procedures for equipment and personnel*). A specific Biosecurity Method Statement was produced for the survey operation.

Electro-fishing Survey and Fisheries Habitat Assessment

The fisheries assessment entailed a quantitative assessment of fish stocks and qualitative assessment of fisheries habitat in the three streams draining the Wind Farm Site. The Dooyeaghny River which flows close to the Hydrogen Plant site was not electro-fished, but an assessment was made of its suitability for fish, in particular salmonid spawning and nursery habitat. The electro-fishing survey at the Wind Farm Site was undertaken in September 2021 by John Brown (Stillwater's Consultancy) and Paul Murphy (EirEco) using a back-pack electro-fishing unit (ELBO110) manufactured by Electracatch International (www.electracatch.com). 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, the broad characterisation of the fish community at each sampling reach was determined. Electro-fishing methodology followed accepted European standards (CEN, 2003) and adhered to best practice (e.g. Central Fisheries Board, 2008). A section of 30 m of channel was netted off at either end and fished to depletion by undertaking a series of three electro-fishing passes. All captured fish were removed from the water using dip nets with insulated handles and transferred into water filled plastic bins. All specimens fished were anesthetized to facilitate identification, age class and length measurement before being subsequently returned to the water. Photographs of each survey location were recorded.

Aquatic habitats over the lengths of the watercourses within the vicinity of the Wind Farm Site and hydrogen plant site were surveyed. The river channel morphology, substrate and flow regime was assessed to determine the suitability of the habitat for spawning or as nursery habitat by salmonids and other species including lamprey and ammocoete larvae in marginal silt beds.

Biotic Index (Q Value) Assessment of Water Quality

Water quality was assessed using the Q Value biotic index system at the three locations sampled for electro-fishing on each of the watercourses draining the Wind Farm Site. The Dooyeaghny River at the Hydrogen Plant site was unsuited for sampling due to the silty substrate and slack flow regime. The standardised approach for the biological assessment of water quality as used by the EPA is based on the composition of the macroinvertebrate community which inhabit the substratum of rivers and streams. These comprise in the main, immature aquatic stages of insects, together with crustacean (shrimps), molluscs (snails and bivalves), oligochaetes (worms) and hirudinea (leeches). Shallow, fast-flowing stretches of riffle habitat are sampled in preference to non-riffle areas as they show most clearly the water quality status and effects of pollution. For assessment purposes the invertebrate communities are divided into four groups – sensitive, less sensitive, tolerant and very tolerant forms. The relative proportions of the various organisms in a sample are determined and the water quality status is inferred by comparison with the expected ratios in unpolluted habitats of the type under investigation. The assessment procedure also takes in to account other relevant factors such as the intensity of algal and or / aquatic plant growth, water turbidity, bottom siltation, nature of the sub-stratum, speed of current, and water depth. The biological information is then condensed to readily understandable form by means of a 5-point biotic index (Q values) in which invertebrate diversity and water quality are related as outlined in **Table 6.1**. Intermediate values (e.g. Q3-4) are used to describe conditions where appropriate.

Table 6.1: EPA Water Quality and Status Summary (EPA, 2010)

Biotic Index	Quality Status	Water Quality	WFD Ecological Status
Q5	Unpolluted	Good	High
Q4-5	Unpolluted	Fair-to-Good	High
Q4	Unpolluted	Fair	Good
Q3-4	Slightly Polluted	Doubtful-to-Fair	Moderate
Q3	Moderately Polluted	Doubtful	Poor
Q2-3	Moderately Polluted	Poor-to-Doubtful	Poor
Q2	Seriously Polluted	Poor	Bad

Biotic Index	Quality Status	Water Quality	WFD Ecological Status
Q1-2	Seriously Polluted	Bad-to-Poor	Bad

Details in relation to the Water Framework Directive (WFD) 2016-2021 status and risk assigned to surface waterbodies associated with all elements of the Project are presented in **Chapter 9: Hydrology and Hydrogeology**.

6.2.1.5 Ecological Evaluation and Impact Assessment Methodology

The evaluation of the key ecological receptors and the criteria used to assess the significance of impacts are derived from the *Guidelines for Assessment of Ecological Impacts on National Road Schemes* (National Roads Authority, June 2009), *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (Environmental Protection Agency, Draft August 2017) and the *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal* (CIEEM, 2018).

The criteria used for assessment of the value of the ecological resources sets out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The guidelines provide a basis for determination of whether any particular site is of importance on the following scale:

- International Importance
- National Importance
- County Importance
- Local Importance (Higher Value)
- Local Importance (Lower Value)

Receptors of Local Importance (Lower Value) contain habitats and species that are widespread and of low ecological significance and of importance only in the local area. Internationally Important sites are either designated for conservation as part of the Natura 2000 network, i.e. Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) or provide the best examples of habitats or internationally important populations of protected flora and fauna.

The Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines define a significant effect as, "a*n effect that either supports or undermines biodiversity conservation objectives for 'important ecological features'...or for biodiversity in general*". The criteria used for assessment of impacts are as follows while the Criteria for Assessing Impact Significance are presented in **Table 6.2:**

Positive or Negative: Positive and negative impacts/effects should be determined according to whether the change is in accordance with nature conservation objectives and policy;

Extent: Extent should be predicted in a quantified manner and relates to the area over which the impact occurs;

Magnitude: Magnitude refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms e.g. amount of habitat lost, percentage change to habitat area, percentage decline in a species population;

Duration: Duration is intended to refer to the time during which the impact is predicted to continue, until recovery or re-instatement (which may be longer than the impact-causing activity). Duration should be defined in relation to ecological characteristics (such as a species' lifecycle);

Frequency and Timing: The timing of impacts in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities (and concomitant impacts) would take place can be an important determinant of the impact on receptors and should also be assessed and described;

Reversibility: An irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation.

Likelihood:

- Certain/Near Certain: >95% chance of occurring as predicted
- Probable: 50-95% chance as occurring as predicted
- Unlikely: 5-50% chance as occurring as predicted and
- Extremely Unlikely: <5% chance as occurring as predicted

Table 6.2: Criteria for Assessing Impact Significance (EPA, 2017)

Impact Magnitude	Definition
No change	No discernible change in the ecology of the affected feature

Impact Magnitude	Definition
Imperceptible Impact	An impact capable of measurement but without noticeable consequences
Slight Impact	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Impact	An impact that alters the character of the environment that is consistent with existing and emerging trends
Significant Impact	An impact which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment
Profound Impact	An impact which obliterates sensitive characteristics

6.3 BASELINE DESCRIPTION

6.3.1 Aquatic Environment

6.3.1.1 Aquatic Habitats at Wind Farm Site

The Wind Farm Site occupies approximately 445 ha in area rises gently from west to east, to a maximum elevation of 180 m. The site is largely cutover blanket bog, with some remnant areas of intact habitat, though with altered hydrology as a result of site drainage. There is an established network of roads throughout to facilitate turf cutting, and some forestry plantations in the peripheral lands to the west. The site forms the watershed between the Easkey River system which receives the drainage from the north west of the site, and the Brusna River system which receives the drainage from the south and west of the site (see **Figure 6.1**). There are three minor watercourses within the site, namely:

1. Owencam River (Tributary of Brusna River) which is a tributary of the River Moy.
2. Tributary of Glenree River which is a tributary of the Brusna River.
3. Western headwater tributary of Gowlan River which is a tributary of the Easkey River.

Owencam River Tributary

The Owencam River is a tributary of the River Brusna, which rises to the north of Carrowleagh and flows for c.18 km to the Moy River in its tidal section downstream of Ballina. The River Moy is designated as an SAC and is an internationally important salmon fishery. The Brusna River is recognised as an important salmon and trout fishery and also supports populations of lamprey (*Petromyzon marinus* & *Lampetra* sp.), which are listed in Annex II of the Habitats Directive. The Moy SAC includes the lower reaches of the Brusna/Glenree River system at a distance of approx. 6 km from the site. Within the Wind Farm Site , the tributary of the Owencam which rises on the

site is very small and of relatively low fisheries value. Immediately downstream of the site however, a number of minor tributaries join and the stream becomes more significant. In these reaches it provides moderate to good salmonid spawning and nursery habitat, with a moderate density of juvenile trout recorded during the electro-fishing survey at survey station S1 (see **Figure 6.4**).

Glenree River Tributary

The Glenree is also a tributary of the River Brusna and rises to the south of Carrowleagh at Knockasliggaun near Bunnyconnellan. It joins the Brusna approx.6 km upstream of the estuary. The tributary stream of the Glenree rising on the proposed Wind Farm Site is very small and of relatively low fisheries value. It improves downstream of the proposed Wind Farm Site and develops some salmonid spawning and nursery habitat with a moderate density of juvenile trout recorded in the present survey at survey station S2 (see **Figure 6.4**).

Western headwater tributary of Gowlan River

The main channel of the Easkey River is located c.7 km downstream of the proposed Wind Farm Site . The site drains to the Easkey River via c.4 km of small tributary stream, followed by c.3 km of the Gowlan River. The Easkey River is an important salmon and sea trout fishery. The main channel of the Easkey River (c.7 km downstream of the proposed Wind Farm Site) also has a population of Freshwater Pearl Mussel (*Margaritifera margaritifera*). While this species has protection under National and European Legislation (Wildlife Act 1976 and EC Habitats Directive 92/43/EEC), the population is not protected within a SAC. As an important salmon fishery and a river with a significant population of Freshwater Pearl Mussel, the Easkey River is rated of national importance. Approximately 2.5 km downstream of the proposed Wind Farm Site , the tributary flowing from the proposed Wind Farm Site enters the Ox Mountains Bogs SAC, through which it flows for a distance of c.3 km. The Ox Mountains Bogs SAC has extensive areas of largely intact blanket bog along with other heathland habitats, and supports Geyer's Whorl Snail (*Vertigo geyeri*) and Marsh Saxifrage (*Saxifraga hirculus*).

6.3.1.2 The Gowlan tributary on the proposed Wind Farm Site (S3) (see Figure 6.4) and the reaches downstream to the Gowlan, are little more than a bog drain with no salmonid value, and no potential value as Freshwater Pearl Mussel habitat.

Aquatic Habitats at the Hydrogen Plant Site

The Hydrogen Plant Site is located on a 6.5 ha site in the townland of Carraun and will have an access road to it from the L-66121 which will entail the construction of a

roundabout. The Dooyeaghny or Cloonloughan River, which rises a short distance upstream (c. 0.5 km), flows to the south of the site (**Figure 6.2**). The Dooyeaghny flows into the Killala Bay / Moy Estuary Moy SAC and SPA approx. 4 km downstream of the proposed site. In the vicinity of the proposed site, the river is in a steep-sided canalised cut approx. 2 m below the surrounding land with a base of width of c.1.5 m and depth of c. 30-40 cm (**Figure 6.3**). The flow regime is gentle glide with a silty substrate and occasional pockets of gravel and is not suitable for determination of Q values using macro invertebrates.

The channel is heavily vegetated with abundant Flote grass (*Glyceria fluitans*) and Brooklime (*Veronica beccabunga*), while the banks support Creeping Bent (*Agrostis stolonifera*), Buckler Fern (*Dryopteris* sp.), Moor-grass (*Molinia caerulea*) and occasional Figwort (*Scrophularia nodosa*). The stream has the potential to support small numbers of Brown Trout, Stickleback, Minnow and European Eel in the vicinity of the site, though the habitat in the vicinity of the site and upstream is unsuited for spawning by salmonids. From the N59 road downstream as far as the estuarine reaches at the confluence with the Moy, the river develops some riffle habitat which may offer potential spawning for salmonids.

6.3.1.3 Aquatic Habitats along the Grid Connection Route and Interconnector Route

The Grid Connection Route and Interconnector Route is entirely along existing road networks which will include up to six (6 No.) surface water crossings. There is sufficient depth over most existing culverts and bridges on watercourse crossings to accommodate trenching of the cable; however, the bridges over the Fiddaun River and the Glenree River (see **Figure 6.4**) have insufficient cover within the bridge deck and will require directional drilling. Both of these crossings are in stretches with extensive salmonid spawning and nursery habitat.

6.3.1.4 Aquatic Habitats along the Turbine delivery route

The turbine delivery route is along the existing road network and will require no modification to existing watercourse crossings along its length. There was resultantly no assessment made of watercourses along this route.

6.3.1.5 Electro-fishing Survey and Fisheries Habitat at the Wind Farm Site

The locations of watercourses in the vicinity of the Wind Farm Site surveyed by electro-fishing are shown in **Figure 6.5**. A description of the aquatic and riparian habitats at each site and summary of the results of the electro-fishing survey with an appraisal of their ecological value is presented below.

S 1

The Owencam River is a tributary of the River Brusna within the Moy catchment. Survey station S1 is a small stream with a base width of 1.5 to 2.0 m , and depth ranging from 15 to 40 cm. It has a meandering channel with riffle glide and occasional small pools on a sandy gravel and cobble substrate. The survey station is within an open reach between blocks of conifers and the channel is heavily over-shadowed within the plantations. The banks are low and comprised of rank acid grassland with scattered Willow (*Salix* spp.) and Birch (*Betula pendula*).

The electro-fishing survey covered an area of approx. 100 m^2 and yielded a total of 20 Trout (*Salmo trutta*) in the size range 4.6 to 12.8 cm, representing 0+ and 1+ fish (juvenile). This represents a reasonable high density of juvenile trout. No adult Trout or any other species was recorded.

S 2

Located on tributary stream of the Glenree River, a tributary of the River Brusna. Survey station S2 is a narrow linear modified channel within forestry plantation, heavily overshadowed by conifers. It has a base width of < 1 m and a depth ranging from 10 to 30 cm, with a uniform riffle flow, interrupted with occasional small steps forming pools. The substrate is gravel and small cobble and the banks are steep to vertical with abundant mosses, liverworts and ferns.

The electro-fishing survey covered an area of approx. 70 m^2 and yielded a total of 5 Trout in the size range 4.7 to 9.6 cm, representing 0+ and 1+ fish (juvenile). This represents a low density of juvenile trout and reflects the modified nature of the channel and the extensive over-shadowing forestry cover. No adult Trout or any other species was recorded.

S 3

Western headwater tributary of Gowlan River in the Easkey Catchment. Site 3 is a small shallow drainage line in open bog, with a channel width of 50-75 cm and a depth of 30-40 cm. There is very little perceptible flow and the substrate is soft peat and silts. The adjacent vegetation is acid grassland with occasional small Willow (*Salix* sp.) which overhangs the channel. This site was not suitable for electro-fishing due to the heavy vegetation cover. The uniform depth, minimal flow and soft substrate would render it unsuitable as salmonid habitat.

Table 6.3: Summary results of watercourses draining the Wind Farm Site.

Site number	Description and Results	Overview Photograph
1	Small stream with a base width of 1.5 - 2.0 m, and depth 15 – 40 cm. It has a meandering channel with riffle glide and occasional small pools on a sandy gravel and cobble substrate.	
2	Narrow linear modified channel within forestry plantation, heavily overshadowed by conifers. It has a base width of < 1 m and a depth ranging from 10 – 30 cm, with a uniform riffle flow, interspersed with occasional small steps forming pools.	
3	Small shallow drainage line in open bog, with a channel width of 50-75 cm and a depth of 30-40 cm. There is very little perceptible flow and the substrate is soft peat and silts.	

6.3.1.6 *Biotic Index (Q Value) Macro-invertebrate Assessment at Wind Farm Site*

Water quality was assessed using the Q Value biotic index system at the three locations sampled for electro-fishing (see **Figure 6.2**) on each of the watercourses draining the Wind Farm Site. The results are presented in **Table 6.4** which gives their Q Value and corresponding Water Framework Directive status.

The most recent EPA data available for the Gowlan River at a ford upstream of the confluence with the Easkey River, is Q4-5 in 2018 equating to high quality. Data from 2019 for the Glenree River 0.7 km upstream from the Brosna River confluence was Q4-5 (high quality). The most recent EPA data available for the Owencam River is from 1993 at the bridge upstream of the Brosna confluence, where it is given a Q4-5 (high quality) also, though this data is considered to be too old to be reliable.

Table 6.4: Water Quality Assessment of Watercourses (Q Value and WFD Ecological Status)

Site No.	Q Value	WFD Ecological Status	Comments
1	4	Good	No macrophytes present. Macroinvertebrate diversity good with frequent flattened mayfly, uncased caddisfly and low numbers of pollution tolerant species.
2	3-4	Moderate	No macrophytes present. Macroinvertebrate diversity moderate with small numbers of stonefly and caddisfly, but relatively high number of water louse.
3	-	-	Unsuitable for kick sampling due to slack flow and high silt levels in substrate. Apparent quality good due to lack of pollution sources.

6.3.1.7 *Freshwater Pearl Mussel*

The known distribution of Freshwater Pearl Mussel (*Margaritifera margaritifera*) (FPM) in the Easkey catchment relative to the Wind Farm Site is shown in **Figure 6.6** based on records provided by the NPWS (2021). The nearest records of FPM to the Proposed Development is on the Gowlan River approx. 3.5 km downstream of the Redline Boundary. The tributary stream feeding into the Gowlan River does not have suitable habitat for FPM and there is considered no potential habitat before the confluence with the Gowlan on account of the size of the tributary, the steep gradient and the aquatic habitats. While this population is not within a Special Area of Conservation, in view of their Annex II Listed status, their unfavourable conservation assessment (NPWS, 2013) and being listed as critically endangered in the Republic of Ireland (Moorkens 2006), they are considered of international importance.

6.3.1.8 Evaluation of Watercourses

The three watercourses that rise within the Wind Farm Site are all small streams with minor flows. Resultantly they have limited fisheries or aquatic ecological habitat value and are rated of local importance higher value within the Wind Farm Site. However, in their lower reaches they all become of national importance on account of their Salmonid, Lamprey and in the case of the Easkey, its Freshwater Pearl Mussel populations. The Wind Farm Site is hydrologically linked to the Killala Bay / Moy Estuary SAC/SPA via the Gowlan River.

The Dooyeaghny or Cloonloughan River flows to the south of the Hydrogen Plant Site. The stream rises a short distance upstream of the Hydrogen Plant Site and has limited fisheries value in the vicinity of the Hydrogen Plant Site, being rated of local importance higher value. However, in its lower reaches it has some salmonid spawning habitat and it flows into the Killala Bay / Moy Estuary Moy SAC/SPA approx. 4 km downstream of the Hydrogen Plant Site.

All surface waters associated with the Project are considered sensitive and in view of their connectivity to the European designated areas of Very High Importance.

6.4 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS

A detailed description of the Project is given in **Chapter 2: Project Description**. In summary the Proposed Development will comprise the construction of 13 No. wind turbines (to be known as Firlough Wind Farm), an on-site 110 kV loop-in substation and all ancillary works and the construction of an underground Grid Connection via a looped connection between the Wind Farm Substation and the existing 110 kV overhead powerline north of Bunnyconnellan village, Co. Mayo. The Proposed Development will also include a Hydrogen Plant comprising 80 MW of modular alkaline electrolyser and all associated infrastructure including; compressors, cooling equipment, refuelling points, water abstraction, storage and processing, and the Hydrogen Plant Substation which will be connected to the Wind Farm via an underground electrical interconnector.

An in-depth discussion of water quality is provided in **Chapter 9: Hydrology & Hydrogeology.** The focus in this section is on the effects on aquatic species and ecology. Groundwater pathways are assessed within **Chapter 9: Hydrology and Hydrogeology**.

A Construction Environmental Management Plan (CEMP) has been prepared for the Proposed Development which will be further developed and expanded following the

appointment of the Contractors for the main construction works, subject to planning approval. The CEMP is accompanied by a suite of targeted management plans as follows:

Management Plan 1 -	Emergency Response Plan
Management Plan 2 -	Water Quality Management Plan
Management Plan 3 -	Surface Water Management Plan
Management Plan 4 -	Peat and Spoil Management Plan
Management Plan 5 -	Waste Management Plan
Management Plan 6 -	Decommissioning Plan
Management Plan 7 -	Traffic Management Plan

The CEMP has been prepared on a preliminary basis, and will be further developed and expanded following the appointment of the Contractors for the main construction works.

6.4.1 The 'Do-Nothing' Impact

If the Proposed Development does not proceed, lands at and in the vicinity of the Sites will continue to be used for turbary activities. This 'do-nothing' scenario would result in no significant change to aquatic ecology and habitats within or downstream of the Sites subject to the continuation of current activities and practices. It should be noted however, that current peat harvesting activities may be giving rise to some effects on water quality within the catchment through sediment release.

6.4.2 Construction Phase Potential Effects

A full description of the project is given in **Chapter 2: Project Description.** A summary of potential sources of direct impacts during the construction and decommissioning stage of the project include:

- Clearance of vegetation, soil and rock for widening and construction of access roads, hardstand and turbine bases;
- Construction of or extension of existing culverts on watercourses within the Sites;
- Run-off from site works areas into watercourses giving rise to sediment loads and other pollutants including concrete laitance and hydrocarbons;
- Clear-felling of c. 2.92 ha coniferous forestry affecting water quality as a result of sediment and nutrient release;
- The demolition of a house and four agricultural sheds;
- Creation of temporary infrastructure such as blade set-down areas, associated storage and assembly areas and crane pads;
- Placement and storage of material arising from infrastructure works including spoil and peat storage areas;

- Access by construction equipment, including access away from the proposed infrastructure location (compaction and other damage);
- Potential for accidental spillage of hydrocarbons and other pollutants including concrete laitance;
- Horizontal Directional Drilling on the Grid Connection Route and Interconnector Route;
- Potential of peat slippage or failure, and,
- Removal and restoration of existing infrastructure at decommissioning stage.

The principal potential construction phase effects of the Proposed Development relate to the release of sediments into the drainage network arising from all construction related site works including the access road network, turbine bases and associated hardstands, sub-station building, and spoil repository areas. The most pertinent source of impact on the aquatic environment is water quality degradation in surface waters during the construction phase.

Within the Wind Farm Site all turbine locations and associated infrastructure have a buffer zone of at least 50 m from natural streams, with a 20 m buffer to significant drains. No works will take place within these buffer zones except for the three watercourse crossings on the access track network. Within the Hydrogen Plant Site, the Site is located c70 m from the Dooyeaghny River at its closest point with the exception of the drainage outfall on the river.

Construction Effects on Aquatic Biota

All construction activities have the potential to cause negative effects to receiving watercourses and aquatic species and habitats as a result of the release of suspended solids, concrete and hydrocarbons in run-off. Increased silt loads have the potential to negatively impact on water quality, salmonid spawning habitat and within the Wind Farm Site, on Freshwater Pearl Mussel (FPM) populations in the downstream reaches, with the scale of impact being proportionate to the scale and duration of siltation. In view of the hydrological connectivity with designated European Sites downstream, in the absence of mitigation, impacts on watercourses could be moderately to profoundly adverse and of temporary to long-term duration.

The nearest records of FPM to the Wind Farm is on the Gowlan River approx. 3.5 km downstream of the Redline Boundary, with records existing further downstream within the Easkey River. Fine sediment can affect adult FPM, as it interferes with filter feeding. It can also dramatically change the nature of a river bed where juveniles require water movement through gravel beds to obtain oxygen. Even short-term sedimentation is likely to kill all

juveniles present (DAFM, 2018). In addition, nutrient-rich sediment may enter watercourses following harvesting, while the decomposition of harvest residue onsite can lead to the release of P for several years after harvesting. Any impact on FPM as a result of construction phase activities would be considered a medium term significant negative effect at the national scale.

Salmonid species require very high levels of water quality in order to complete their life cycles. High levels of suspended solid concentrations in waterbodies can affect the feeding and health of individual species through increased turbidity (inhibiting respiration through gills) and increased siltation affecting composition of riverbed substrate (reducing fry survival) as well as affecting spawning beds. Suspended solids often hold nutrients such as phosphorus that can result in eutrophication and reduced oxygen levels, which can affect all life stages of Atlantic salmon. Aquatic invertebrate communities and aquatic macrophytes can also be affected by sediment loading which reduces both the biotic diversity and the food resource for fish populations through direct toxicity to fish and invertebrates, and also indirectly effecting top predators such as otter and kingfisher in downstream reaches through a reduction in prey availability.

Direct effects on watercourses within the Wind Farm Site are limited to the crossing points of the road access network which will entail three separate crossings as shown in **Figure 6.6.** All watercourse crossings are on minor headwater streams of the Owencam River. This is a tributary of the River Brusna, which rises to the north of Carrowleagh and flows for c.18 km to the Moy River in its tidal section downstream of Ballina. The River Moy is designated as the River Moy SAC upstream of Ballina, and as the Killala Bay / Moy Estuary SAC downstream of the town, and is recognised as an internationally important salmon fishery. The crossing locations within the Wind Farm Site are of limited fishery value on account of their small size and variable flow rates, though may support small numbers of juvenile Brown Trout.

The existing culverts at these crossing points will require extension or upgrading to accommodate the wider track width which will result in the loss of a limited area of aquatic and riparian habitat, and without proper design, could potentially interfere with the connectivity of the watercourses and movement of fish. The culvert design for these crossings is for pre-cast box culverts installed to conform to the natural slope and alignment (avoiding the need for channel realignment), with inverts buried to 300 mm below the existing streambed with the original bed material placed in the bottom of the culvert. In view of the small size and limited fisheries value of the affected watercourses this would constitute at most a minor negative impact at a local level.

Without appropriate construction methodologies however, the construction works for the culverts has the potential to give rise to water quality effects which would extend downstream in to stretches of the Owencam River and River Brusna with higher fisheries value and supporting resident salmonid populations. Pollutants entering the watercourses could result in direct mortality of aquatic biota with the scale and extent dependant on the volumes and toxicity of the pollutant. The potential for release of sediment, concrete laitance and the spillage of hydrocarbons is primarily associated with the construction of watercourse crossings due to the set-backs of other infrastructure from watercourses. The potential impact in the absence of mitigation is therefore considered short term but significant negative at the county scale.

The Hydrogen Plant Site is located c.70 m from the Dooyeaghny River at its closest point. Drainage from the Site will be directed via a vegetated swale to an outfall on the river. Without appropriate mitigation, there is a risk of sediment and other pollutants entering the Dooyeaghny River and impacting on local aquatic biota, as well as impacting on the Killala Bay / Moy Estuary SAC/SPA c. 4 km downstream. The installation of the drainage outfall to the Dooyeaghny River also poses a risk of concrete laitance and sediment release to the stream, which could impact on fish populations locally and downstream, including salmonid ova if undertaken within the fisheries closed season.

The connection of the Wind Farm to the national electricity grid, will be via 110 kV underground cable connection along the existing road network. There are six watercourse crossings along the proposed route, four of which will require Horizonal Directional Drilling (HDD) due to there being insufficient cover within the bridge deck. These are as follows:

- Srafaungal River
- Fiddaun Stream
- Glenree Stream
- Loughnagore Stream

An additional four watercourse crossings will be required along the Interconnector Route between the Wind Farm Site and Hydrogen Plant Site, with only one, the Brusna River, requiring HDD.

The HDD operations, while avoiding any direct impacts on the watercourses, will present a risk of indirect effects on water quality and thus aquatic biota. HDD requires drilling fluid (consisting of polymers and bentonite) to assist with lubricating and mobilising drill arisings during the drilling process and to promote sealing and stabilising the borehole.

The HDD process also present a risk to water quality as a result of silt run-off and / or accidental spillage of hydrocarbons. As these crossings of watercourses are in stretches with salmonid spawning and nursery habitat, pollution could result in short term but significant negative impacts at the county scale, with potential downstream impacts on the Killala Bay / Moy Estuary SAC/SPA.

The turbine delivery route will not require any modification to any watercourses (including existing bridges or culverts) and is therefore not considered to present any risk to aquatic ecology.

Machinery required for construction activities at all locations poses a risk as a vector for the introduction and spread of invasive non-native species (e.g. Himalayan balsam, Japanese knotweed) to watercourses, which would have negative effects on aquatic ecology and riparian habitats. There are no records or evidence of any invasive plant species recorded from the Sites or the surrounds and this risk is considered unlikely.

The risk of peat failure or slippage occurring at the Sites during the construction phase has been assessed as part of the hydrogeological assessment (see **Chapter 9**). The depth of peat has informed the layout of the Proposed Development and all areas of deep and wet peat have been avoided. The risk of peat failure is therefore considered to be extremely unlikely due to the overall shallow nature of the peat deposits in the works zone and level topography. No borrow pits are proposed for the Proposed Development.

In the absence of mitigation, potential impacts on the aquatic environment are classified as being medium term significant negative at the national scale on account of the sensitive freshwater pearl mussel populations in the downstream Easkey catchment and the value of the lower reaches of the Owencam River, River Brusna watercourses for salmonids, and connectivity to the Killala Bay / Moy Estuary SAC/SPA.

6.4.3 Operational Phase Potential Effects

Wind Farm Site

There is very limited potential for effects on watercourses within the Wind farm Site during the operational phase due to operational activities and permanent site drainage. The risk to watercourses during the operational phase of the Wind Farm is considered slight, and would primarily arise from the use of oils and lubricants for infrastructure maintenance either through accidental spillage or inappropriate disposal. These effects are already described for the construction phase of the Proposed Development in **Section 6.4.2** above. The

likelihood of impacts on water quality and aquatic habitats occurring is considered very unlikely in view of the distance from the turbines and associated infrastructure to watercourses (>50 m) and the standard operating procedures employed to avoid such risks. Site maintenance activities such as road repair and drainage network maintenance may give rise to a localised risk of sediment release, but again, this risk is considered to be very unlikely in view of the infrequency and limited scale of such operations.

Taking this into account, the potential for secondary effects on watercourses resulting from the unmitigated operational phase of the Wind Farm Site is considered to be short term Significant at the Local (Higher) scale.

Hydrogen Plant Site

During the operational phase, waste water from the Hydrogen Plant Site will be discharged to the Dooyeaghny River which flows directly into the Killala Bay / Moy Estuary SAC/SPA approx. 5 km downstream of the Hydrogen Plant Site. Therefore, without appropriate mitigation, there is a risk of a significant deterioration in water quality within the receiving watercourses and the European Sites. The scale of impact could be moderately to profoundly adverse and of temporary to long-term duration.

Apart from the discharge of the trade effluent from the Hydrogen Plant and effluent from welfare facilities on site, there are additional risks to aquatic environment from the accidental spillage or release of chemicals or other pollutants. A range of chemicals will be used within the Hydrogen Plant which include:

- Potassium Hydroxide (KOH) for the electrolysis process (lye).
- Sodium bisulphite for de-chlorination of mains water, should it be used for process.
- Antiscalant used to prevent/reduce scaling of water treatment equipment (i.e. from build-up of salts and calcite).
- Glycol for coolant.
- Oils used by hydraulic systems, compressors and transformers and diesel,
- Facility cleaning chemicals.

As all chemicals used in the Hydrogen Plant Site will be stored in bunded facilities in accordance with specified legislation (Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001 to 2021), the risk of accidental spillage or release is considered to be unlikely.

Potassium hydroxide and glycol are used only in the closed-loop electrolysis process and will not enter the waste water stream. As the source water for the Hydrogen Plant will be groundwater or rainwater, this should be free of chemicals or dangerous substances. Sodium bisulphite will only be used if mains water is used in the process which would require de-chlorination. In large quantities sodium bisulphite can depress pH and dissolved oxygen, causing mortality of fish (Ryon et al, 2002). However, expected levels of treatment that would be required are at most 5 mg/l (5ppm), typically 2-3 mg/l. Sodium bisulphite is regularly used in the treatment of drinking water supplies and is a non-hazardous solution commonly used as a waste water dechlorination agent. While high concentrations will contribute to elevated chemical oxygen demand in aquatic environments, but it is subject to rapid biological decomposition (Product Data Sheet).

Antiscalants will be used in small quantities to prevent/reduce scaling of water treatment equipment and therefore is likely to occur in the waste water stream. While the specific Antiscalant to be used has not been identified, most antiscalants are proprietary organic man-made polymers. These products are considered non-hazardous as defined by the US Occupational Safety and Health Act regulations.

The wastewater arising from the Hydrogen Plant will be treated through constructed wetlands and regulated discharge rates before being discharged to the Dooyeaghny River to the south of the Hydrogen Plant.

With appropriate wastewater treatment and controls to avoid risks of accidental spillage or release of chemicals, potential adverse impacts on the aquatic environment can be mitigated. In the absence of such measures however, there is a risk of medium term significant adverse impacts at the international scale on account of the connectivity of the Dooyeaghny River to the Killala Bay / Moy Estuary SAC/SPA.

6.4.4 Decommissioning Phase Potential Effects

The decommissioning phase of the Project poses a similar suite of risks of potential effects on the aquatic environment as the construction phase, though in view of the presence of the road network and associated infrastructure, the resultant scale of impact is considered to be much lower. In the absence of mitigation, the potential impact on the aquatic environment is considered to be a significant short-term negative impact at the local scale.

6.5 MITIGATION MEASURES

6.5.1 Embedded Mitigation

The Proposed Development incorporates embedded mitigation aimed at minimising the potential impacts during the design phase. This includes the design principle of maintaining set-backs of 50 m for turbines and associated infrastructure from watercourses and utilising existing access tracks within the Wind Farm Site, and a 70 m setback from the Dooyeaghny River at the Hydrogen Plant Site, with the exception of the discharge point.

6.5.2 Construction Phase Mitigation

6.5.2.1 Mitigation by Avoidance

The greatest risk of negative impacts on the aquatic environment will occur during the construction phase of the Project. Within the Wind Farm Site, key to minimising this risk has been the siting of all turbine locations and other key infrastructure at a minimum set-back from watercourses (50 m). In designing the layout of the site careful consideration has also been given to utilising the existing access track network and minimising the numbers of watercourse crossings required. The layout has also avoided any interference with existing hydrology on the Sites and maintains surface water flow networks through the use of cross drains on access roads.

The Hydrogen Plant Site was selected for its proximity to the national road network in order to reduce traffic impacts on local roads as well as its limited visual impact from public vantage points, distance from houses and access to underground water resource. The proposed layout has maintained a distance of at least 70 m (excluding water treatment) to the Dooyeaghny River to the south of the south of the site, with the exception of the proposed outfall to the river.

The Grid Connection Route and Interconnector Route avoids the need for any open cut crossings of watercourses along its length, though will require horizontal directional drilling under five watercourses due to there being insufficient cover and depth in the existing bridges to cross within the bridge decks.

6.5.2.2 Mitigation by Design

A comprehensive suite of drainage measures has been developed to protect all receiving waters from potential impacts during the construction of the Proposed Development in the catchment of the proposed Wind Farm Site, the Hydrogen Plant Site and along the proposed Grid Connection Route and Interconnector Route. These measures are outlined in **Chapter 2: Project Description** and detailed in full in **Chapter 9: Hydrology and Hydrogeology**, and

have been transposed into the CEMP for the proposed project. The measures are aimed at avoiding or mitigating any negative effect on aquatic ecology during the construction and operation of the Proposed Development, including preventing sediments or other pollutants from entering watercourses through the containment and treatment of all surface water run-off from areas of works.

An Ecological Clerk of Works (ECoW) will be appointed to ensure compliance during the construction stage with all mitigation measures, planning conditions and legislative requirements related to aquatic ecology. The ECoW will be consulted with regard to all watercourse crossing works. Surveys by the ECoW will be carried out along with review of all construction methodologies prior to construction to ensure compliance with all specified mitigation in terms of design and avoidance of impacts on downstream ecology.

The mitigation measures have been incorporated into a Construction and Environmental Management Plant (CEMP) for the Proposed Development which includes Construction Method Statements for key works. The CEMP includes a Surface Water Management Plan (SWMP), a Water Quality Monitoring Plan and Watercourse Crossing Plan (WQMP) and a Waste Management Plan (WMP). The CEMP, SWMP, WQMP and WMP will require mandatory adherence by all parties involved in the construction of the Wind Farm Site (including any sub-contractors) in order to protect aquatic conservation interests within the study area. The development of the mitigation measures and all method statements for watercourse crossings follows all relevant guidance and current best practice as detailed in:

- CIRIA (2001). *Control of water pollution from construction sites – Guidance for consultants and contractors (C532)*. Construction Industry Research and Information Association, London.
- CIRIA (2019). *Culvert, screen and outfall manual (C786).* Construction Industry Research and Information Association, London.
- DHPLG (2019). *Draft Revised Wind Energy Development Guidelines*. Department of Housing, Planning and Local Government. December 2019
- Enterprise Ireland (unknown). *Best Practice Guide (BPGCS005) Oil storage guidelines*.
- IFI (2016). *Guidelines on Protection of Fisheries during Construction Works in and adjacent to waters.* Inland Fisheries Ireland, Dublin.
- IWEA (2012). *Best Practice Guidelines for the Irish Wind Energy Industry*. Guidance prepared by Fehily Timoney & Company for the Irish Wind Energy Association.
- Kilfeather, P.K. (2007). *Maintenance and protection of the Inland Fisheries resource during road construction and improvement works*. Southern Regional Fisheries Board.

- Murphy, D.F. (2004). *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites.* Eastern Regional Fisheries Board.
- NRA (2008). *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*. National Roads Authority.
- SNH (2019). *Good Practice during Wind Farm Construction (4th edition).* Scottish Natural Heritage.

The Surface Water Management Plan (SWMP) details the existing baseline environment of the Sites, describes how the surface water management will operate during construction to minimise modification and disruption to the existing site hydrology, outlines the proposed maintenance regime and the proposed drainage management post-construction. The SWMP is a live document and where there is a requirement for variation to the proposed management of surface water during construction, the SWMP will be updated to reflect any such changes. The SWMP will be updated by the Environmental Manager (EM) and, where it is relevant to ecology, with input from the Ecological Clerk of Works (ECoW) before any changes are made to the proposed management of surface water during construction of the Firlough Wind Farm and Hydrogen Plant.

The use of Sustainable Drainage Systems (SuDS) on site will eliminate risk to watercourses from sedimentation during the construction and operational phases of the Proposed Development. SuDS adopts the following design principles to drainage:

Minimise → *Intercept* → *Treat* → *Disperse* → *Dilute*

All surface water management measures will be put in place concurrently during the development of the road network. The measures entail the following key elements which are described in detail within the Surface Water Management Plan:

- Open Constructed drains for development run-off collection and treatment;
- Collection Drains for upslope "clean" water collection and dispersion;
- Filtration Check Dams to reduce velocities along sections of road which run perpendicular to contours;
- Settlement Ponds, Settlement Lagoons and Buffered Outfalls to control and store development runoff to encourage settlement prior to discharge at Greenfield runoff rates.

There will be no direct site run-off to watercourses during the construction phase with all outflows from drainage via settlement ponds from which treated surface water is released by diffuse overland flow at appropriate locations. To reduce the amount of silt laden water to be

treated, clean water drains will be created upstream of the works area to divert water away from construction areas, thereby lessening the volume of water to be treated onsite.

De-watering of excavations where required, will be through filtered 'silt socks' / dewatering bags or a '*Siltbuster'* or similar system, prior to discharge. Excavations will be kept to the absolute minimum for the specific task and undertaken on a 'just in time' basis to minimise the extent of silty water generated and requiring treatment prior to discharge.

The three watercourse crossings within the Wind Farm Site requiring culvert extensions or upgrades along the access track network will have culvert dimensions matched to existing channel bed width. The installation of these culverts will be carried out in a single operation during dry conditions between July and September (as required by IFI for in-stream works). The outline method statements prepared for the extension of the culverts and associated works is detailed in Section 4 of the WQMP. An additional 10 no. drainage ditch crossings within the Wind Farm Site will require culvert extensions or upgrades.

All roadside drains within the temporary works area will be culverted and check dams made from stone or sandbags covered with terram will be inserted upstream and downstream of these culverts to intercept any solids generated during the insertion or which wash out during the works.

Where the ground slopes from the working area toward a watercourse, or if there is evidence of solids washing off the works area toward nearby watercourses or drains, a silt fence with straw bales, will be interposed between the works area and the watercourse.

Hydrogen Plant Discharge

The waste water from the Hydrogen Plant entails an appropriate level of treatment to remove or neutralise the potential pollutants within the waste water prior to discharge of the water to the receiving watercourse. The final trade effluent entering the Dooyeaghny River will be subject to a discharge licence from the EPA and all parameters will be within the defined limits set by the licence.

There are two wastewater streams from the Hydrogen Plant:

- Hydrogen process wastewater
- Welfare (toilets, canteen etc).

The two wastewater streams will initially be dealt with separately. Welfare wastewater will be run through a septic tank, and then through a welfare constructed wetland (WCW). The WCW will be positioned in the northeast corner of the Hydrogen Plant Site and will be approximately 80 m^2 to facilitate the required retention time of c. 12 days to adequately treat the welfare effluent loading prior to discharge. The outfall of the WCW will then be combined with hydrogen process wastewater in storage. The hydrogen process wastewater, which will include water treatment reject, non-chemical rinse/ drains and the oil/water separator discharge, will be collected in a sump prior to discharge to the process constructed wetlands (PCW). The PCW will achieve a minimum of 6 days retention time prior to discharge to the Dooyeaghny River.

Subject to the above, the nature and quality of the proposed discharge of trade effluent will meet all surface water Environmental Quality Standards (EQS) and is therefore considered not to pose a risk to water quality within the receiving watercourse.

The drainage outfall from the Hydrogen Plant Site to the Dooyeaghny River will be via a 300 mm pipe in a concrete headwall. The structure will be pre-cast to avoid a risk of concrete laitance during installation. The risk of sediment release to the stream will be mitigated for by confining the construction to a single operation during dry conditions between July and September (as required by IFI for in-stream works). Bare ground around the installed outfall will be covered with hessian pinned to the ground to prevent silt-laden run-off until the re-establishment of vegetation.

Horizontal Directional Drilling

On the Grid Connection Route and Interconnector Route, the directional drilling under watercourses where there is insufficient cover and depth in the existing bridges to cross within the bridge deck will be undertaken by Horizontal Directional Drilling using the following methodology:

1. A works area of circa .40 m^2 will be fenced on both sides of the stream crossing,
2. The drilling rig and fluid handling units will be located on one side of the bridge and will be stored on double bunded 0.5 mm PVC bunds which will contain any fluid spills and storm water run-off.
3. Entry and exit pits (1 m x 1 m x 2 m) will be excavated using an excavator, the excavated material will be temporarily stored within the works area and used for reinstatement or disposed of to a licensed facility.
4. A 1 m x 1 m x 2 m steel box will be placed in each pit. This box will contain any drilling fluid returns from the borehole.

5. The drill bit will be set up by a surveyor, and the driller will push the drill string into the ground and will steer the bore path under the watercourse.
6. A surveyor will monitor drilling works to ensure that the modelled stresses and collapse pressures are not exceeded.
7. The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit.
8. Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit pit and will pull a drill pipe back through the bore to the entry side.
9. Once all bore holes have been completed, a towing assembly will be set up on the drill and this will pull the ducting into the bore.
10. The steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.
11. The duct will be cleaned and proven, and their installed location surveyed.
12. The entry and exit pits will be reinstated to the specification of ESB Networks and Mayo County Council.
13. A transition chamber will be installed on either side of the bridge following the horizontal directional drilling asper ESB requirements.

Emergency Response

Specific measures are detailed in **Chapter 9: Hydrogeology and Hydrology** to be implemented in the unlikely eventuality a peat failure or some other form of failure or over-loading of the drainage and attenuation design. Despite the low potential risk, the CEMP contains a contingency plan to deal with the scenario of a peat movement occurring on the Sites which will include measures to control silt in such a scenario, and measures to be put in place at the initial stages of construction to off-set this risk.

6.5.2.3 Mitigation by Reduction

The specified measures detailed below are aimed at protection of instream aquatic biota within the vicinity of any proposed works at watercourses on the Sites but equally with regards to the protection of the downstream populations of Freshwater pearl mussel and salmonids in the various catchments. These measures are a summary of the principal requirements with full detail being presented in **Chapter 9: Hydrogeology and Hydrology**, which are transposed into the Construction Environmental Management Plan:

- During the construction phase the appointed Contractor(s) will ensure that the following mitigation is adhered to in line with IFI (2016) *Guidelines on Protection of Fisheries during* Construction Works in and Adjacent to Waters:
- No works will take place within the 50 m buffer zone of watercourses except for the culvert extensions and road upgrade works.

- Site compounds and all storage areas will be located at a minimum distance of 65 m from any watercourse. All drainage from these facilities will be directed through a settlement pond with appropriate capacity and measures to provide spill containment.
- All site drainage will be directed through either sediment traps, settlement ponds and / or buffered drainage outfalls to ensure that total suspended solid levels in all waters discharging to any watercourse shall not exceed 25 mg/l (IFI, 2016). All construction site run-off will be channelled through a stilling process to allow suspended solids to settle out and through a spill-containment facility prior to discharge.
- Daily monitoring of all sediment traps and settlement ponds will be undertaken by the Environmental Manager or Ecological Clerk of Works to ensure satisfactory operation and/or maintenance requirements. A full specification for the water quality monitoring is presented in the WQMP and will include at a minimum:
    - Groundwater samples taken from 4 no. locations at the Wind Farm Site.
    - Daily visual observation in areas of high construction activity or during high rainfall periods to identify any evidence of siltation, oil or other pollutants. Visual inspections will include details of the colour of the water at the time of inspection.
    - Weekly visual inspections and monthly field hydrochemistry monitoring.
    - One round of post construction monitoring, to be agreed with Mayo and Sligo County Councils. Post construction will be defined as when the reinstatement phase is completed.
    - Monthly analysis of water parameters will be carried out. Construction-stage analytical determinants (including limits of detection and frequency of analysis) will be specified and agreed with the Local Authority and third parties for each sample location. The agreed suite of sample determinants will include the following:
        - pH
        - Temperature
        - Total Suspended Solids
        - Dissolved Organic Carbon
        - Conductivity
        - Dissolved Oxygen
        - Total Oxidized Nitrogen
        - Ammoniacal Nitrogen
        - Ammonia
        - Potassium
        - Phosphate
        - Biological Oxygen Demand

        - Chemical Oxygen Demand
        - Total Petroleum Hydrocarbons
    - In the event that a pollution incident arises which threatens to enter or has entered a watercourse from the construction works, additional sampling and analysis of surface water samples will be undertaken to determine the level of impact to the surface water receptor and remedial requirements, where necessary.
- The storage of oils, hydraulic fluids, etc., will be undertaken in accordance with current best practice for oil storage (Enterprise Ireland, BPGCS005).
- The pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents, etc., will be completed in the dry to avoid pollution of the freshwater environment.
- All machinery operating on water course crossings will be steam-cleaned at the site compound in advance of works and routinely checked to ensure no leakage of oils or lubricants occurs. All fuelling of machinery will be undertaken at a discrete "fuel station" designated for the purpose of safe fuel storage and fuel transfer to vehicles.
- Instream works will be undertaken during the period 1st July to 30th September as required by IFI Guidance (2016) to avoid accidental damage or siltation of spawning beds in downstream reaches.
- Method statements for the watercourse crossing culverts will be prepared and submitted to inland Fisheries Ireland for prior approval.
- Culvert extension or upgrade works will be undertaken in dry conditions and in low flow conditions.
- In the event that stream dewatering is required for the construction of culvert extensions, electrofishing will be undertaken during the instream working window from July to September by suitably qualified and licenced personnel with any fish translocated downstream.
- During the culvert installation and associated construction work, double silt fences will be emplaced immediately down-gradient and downstream of the construction area for the duration of the construction phase.
- Any extensions to existing culverts or new culverts will be set at an embedded depth of 0.5 m.
- Where bank strengthening or scour protection is required, this will utilise sensitively placed rock armour with appropriate landscaping to tie the feature into the existing river bank profile. Gabion baskets and Reno mattresses will not be used.

- All bank sides and streambeds will be fully reinstated to avoid ongoing erosion. This will entail appropriately sloped banks to provide stability, and establishing vegetative cover as quickly as possible using only native species appropriate to the existing environment.
- There will be no batching or storage of cement allowed in the vicinity of the crossing construction area.
- Procedures (as detailed in **Chapter 9**) will be put in place to ensure the full control of raw or uncured waste concrete to ensure that watercourses will not be impacted.
- Should there be any incidents of pollution to watercourses, immediate steps as specified in the Emergency Response Plan (CEMP-Management Plan 1) will be undertaken to resolve the cause of the pollution and where feasible, mitigate against the impact of pollution.

6.5.3 Operational Phase Mitigation

The following measures will be implemented during the operational phase to ensure the ongoing protection of watercourses and water quality at the Wind Farm and Hydrogen Plant Sites and in downstream reaches:

- Re-seeding / re-vegetation of all areas of bare ground or the placement of Geo-jute (or similar) matting will take place prior to the start of the operational phase to prevent silt-laden run-off. The seed mix will contain only suitable native species of plant.
- Silt traps erected during the construction phase within roadside and artificial drainage will be replaced with stone check dams for the lifetime of the project. These stone check dams will only be placed within artificial drainage systems such as roadside drains.
- A full review of construction stage temporary drainage will be undertaken by the Developer (in conjunction with the Project Hydrologist/ Site Engineer and the Project Ecologist) following the completion of construction, and drainage removed or appropriately blocked where this will not interfere with infrastructure.
- The Site compound / office will house all chemicals within a secure bunded COSSH store for the operational phase of the project.
- All onsite wastewater treatment facilities will be in full compliance with current regulations to prevent nutrient loading entering aquatic environments.

6.5.4 Decommissioning Phase Mitigation

Decommissioning of the Proposed Development will be scheduled to take place after the proposed 40 year lifespan of the project. Decommissioning phase impacts for the Proposed Development are likely to be broadly similar to construction phase impacts, in terms of potential surface water quality impacts from ground disturbance, refuelling and the storage of potentially hazardous materials onsite. The implementation of all mitigation measures detailed for the

construction phase will be adopted in full during the decommissioning phase to ensure all such impacts are avoided.

When the final Decommissioning Plan is prepared prior to decommissioning and presented as a standalone document, all drainage management measures, which will include maintenance of the operational drainage measures, will be included in that document, as required. However, it should be noted that by the time decommissioning is undertaken after the planned 30-year lifespan of the Project, the areas within the Sites will have revegetated resulting in a resumption of the natural drainage management that will have existed prior to any construction. It is not anticipated that the decommissioning phase will interrupt this restored drainage regime in any way with the works proposed. As a minimum measure, areas where freshly placed soil material as part of turbine foundation reinstatement work will be surrounded by silt fencing if deemed necessary until the area has naturally revegetated.

Restoration of the Site following decommissioning of infrastructure will require the prior establishment of the new baseline conditions at the Sites which will have developed over the intervening 40 years life of the project. These studies will inform any modification or additional sensitivities that may need to be factored in restoration and site-specific measures.

6.6 RESIDUAL EFFECTS OF THE PROPOSED DEVELOPMENT

While culverting of the three watercourses within the Wind Farm Site will result in the loss of a limited area of aquatic habitat this will constitute at most a minor negative impact at a local level as the affected watercourses are minor stream of low fisheries values. The design of the culverts crossings will ensure no impediment to movement of aquatic biota.

The approach to the development design, the use of SuDS drainage and the suite of comprehensive measures to avoid, reduce or remedy all potential impacts on water quality will ensure that the receiving water bodies in the catchment of the Proposed Development do not suffer any deterioration in water quality, either during construction, operation, or decommissioning. The populations of Freshwater Pearl Mussel in the lower catchment of the Gowlan River and Easkey River will not be negatively affected by the Proposed Development.

There is expected to be no negative residual impact on any aquatic species, habitat or on water quality at a local or catchment level as a result of the Wind Farm.

The operational Hydrogen Plant Site will require ongoing monitoring and active management to ensure source water and wastewater treatment systems perform adequately, and discharge

rates and quality are in line with discharge licence conditions. Subject to this, there will be no negative residual impact on any aquatic species, habitat or on water quality at a local or catchment level as a result of the Hydrogen Plant.

6.7 MONITORING

Monitoring of the Proposed Development during the construction and operational phase will potentially indicate weaknesses of the drainage and attenuation design, and/or the potential for excessive loading at particular locations etc. In such instances corrective actions will be taken to mitigate against any potential adverse impacts as detailed in **Section 9.5.2.18 of Chapter 9**. In order to verify the efficacy of pollution prevention and mitigation works during construction, Water Quality Monitoring will be undertaken prior to, during and post completion of construction works in accordance with the parameters and schedules as set out in the Water Quality Management Plan. Monitoring will be undertaken in all watercourses within the catchment of the construction area. Monitoring will be overseen by an independent Environmental Consultant and undertaken by the Environmental Manager or by the Ecological Clerk of Works (appropriately qualified and experienced on the required monitoring methods and the use, calibration and maintenance of all monitoring equipment used).

The specific monitoring requirements including frequency and parameters, are detailed in the **Chapter 9: Hydrogeology and Hydrology** and in the Water Quality Management Plan.

Baseline monitoring undertaken at the Proposed Development as part of this study will be repeated periodically i.e. before, during and after construction phase, to measure any deviations from baseline hydrochemistry that occur at the Sites, including discharge rates. The construction and post construction monitoring programme for the Sites will include the following:

- During the construction phase daily inspection of silt traps, settlement ponds, buffered outfalls and drainage channels will be undertaken. Routine measurement of total suspended solids, electrical conductivity, pH and water temperature at selected water monitoring locations at the Sites will be carried out. Monitoring of locations where excavations are being dewatered (likely high in solids) will be done in real time.
- During the construction phase of the Project, the Proposed Development areas will be monitored daily for evidence of groundwater seepage, water ponding and wetting of previously dry spots, and visual monitoring of the effectiveness of the constructed drainage and attenuation system so that it does not become blocked, eroded or damaged during the construction process.

6.7.1 Post-construction phase monitoring

On completion of the construction phase one round of post construction monitoring will be undertaken using the suite of parameters as detailed in the WQMP. During the operational phase of the project the stilling ponds and buffered outfalls will be periodically inspected during maintenance visits to the Sites.

6.8 SUMMARY OF SIGNIFICANT EFFECTS

The implementation of mitigation through avoidance principles, choice of best alternatives for location of works, pollution control measures, surface water drainage measures and other preventative measures incorporated into the project design in order to minimise potential significant adverse effects on water quality at the Wind Farm Site, Hydrogen Plant Site and along the Interconnector Route, Grid Connection Route and Killybegs Turbine Delivery Route and Galway Turbine Delivery Route.

The Project will entail the extension of existing culvert crossings along the access track network within the Wind Farm Site. The watercourses are all minor headwater tributaries of the Owencam River with low fisheries value, though the downstream reaches are of significant value for salmonids. The Owencam is a tributary of the Brusna which feeds into the tidal reaches of the River Moy, which is a Special Area of Conservation. In addition, the north-eastern part of the Wind Farm Site lies within the Easkey Catchment which supports a population of the Annex II listed Freshwater Pearl Mussel. The construction works present a risk of impacting on water quality within the streams draining the site, with potential for impacts extending downstream to affect salmonid and Freshwater Pearl Mussel populations. As all infrastructure within the Wind Farm Site (with the exception of the access track network) is setback a minimum of 50 m from the streams, the potential for negative effects is greatly reduced and the mitigation measures prescribed will ensure no deterioration in water quality within the watercourses.

The operational phase of the Proposed Development is considered not to present any significant risk of affecting water quality within the catchment. The mitigation measures as described in this chapter and within the EMP and WQMP are aimed at avoiding any deterioration in water quality during the construction phase. Subject to their successful implementation, there is considered to be no significant risk of a deterioration in water quality associated with the Proposed Development.

While the extension to the culverts on the three stream crossings will result in the loss of a limited area of aquatic habitat, this is rated as a minor negative impact at a local level as the affected watercourses are minor streams with low fisheries values. The design of the culverts

will ensure no impediment to movement of fish or other aquatic biota and there is expected to be no negative residual impact on any aquatic species as a result of the Wind Farm.

The operational Hydrogen Plant Site will require ongoing monitoring and active management to ensure source water and wastewater treatment systems perform adequately, and discharge rates and quality are in line with discharge licence conditions. Subject to this, there will be no negative residual impact on any aquatic species, habitat or on water quality at a local or catchment level as a result of the Hydrogen Plant.

6.9 STATEMENT OF SIGNIFICANCE

It is considered that with the proposed mitigation successfully implemented, the proposed project will result in an overall negligible residual impact upon the aquatic ecological features that lie within the Zone of Influence.

6.10 REFERENCES

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