6 AQUATIC ECOLOGY

6.1 INTRODUCTION

This chapter assesses the impacts of the Development (**Figure 1.2**) on Aquatic Biodiversity. The Development refers to all elements of the application for the construction of Gortyrahilly Wind Farm (**Chapter 2: Project Description**) including the Grid Connection Route. In accordance with Article 3(1) of 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 Development:

- Construction of the Development
- Operation of the Development
- Decommissioning of the Development

Common acronyms used throughout this EIAR can be found in **Appendix 1.2**. 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 17.1**. 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 that are conditioned and will be submitted to the planning authority for written approval as required.

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.). Karen Banks assisted during the Freshwater Pearl Mussel survey as bankside recorder. Karen is a professional ecologist with 15 years' experience in the field of ecological assessment and holds a BSc in Environment and Development from Durham University, and is a full member of the Chartered Institute of Ecology and Environmental Management.

Electro-fishing surveys were undertaken by Ross Macklin (Triturus Environmental Ltd.) and John Brown (Stillwater's Consultancy). Ross holds is an environmental scientist who specialises in freshwater and fisheries ecology, in addition to informing engineering solutions for construction works on rivers, including site improvement and rehabilitation. He has fifteen years professional experience and holds a PhD and BSc. 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.

The assessments in this chapter, together with the desktop study outlined in Section 6.2.1.2 and the field investigations outlined in Section 6.2.1.4 are considered adequate to allow the Board to carry out an assessment of the development.

6.1.2 Assessment Structure

In line with the revised EIA Directive and current (draft) EPA guidelines (2017) 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 Development during the construction, operational and decommissioning phases of the Development
- Identification of cumulative impacts if and where applicable
- Mitigation measures to avoid or reduce the impacts identified
- Identification and assessment of residual impact of the Development considering mitigation measures.

6.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

6.2.1 Assessment Methodology Aquatic Biodiversity

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).

6.2.1.1 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 development on the National Biodiversity Data Centre (NBDC) and National Parks and Wildlife Service (NPWS) websites.

6.2.1.2 Consultations

A sensitive species data request was made to the NPWS for aquatic flora and fauna within 10km grid squares IW17 and IW27 on 21st May 2020. 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 development. Licence applications were submitted to NPWS in relation to Stage 1 survey for Freshwater Pearl Mussel and to Inland Fisheries Ireland (IFI) in relation to Electro-fishing surveys.

6.2.1.3 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, 2022) has been prepared for the proposed development 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 development and for 500m downstream were undertaken on 3rd June 2020 and on the 14th and 15th July 2020.

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 to avoid the potential for transfer of invasive alien species 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

Electro-fishing was undertaken at eight locations on watercourses downstream of the Development under appropriate licence, Authorisations under Section 14 of the Fisheries (Consolidation) Act 1959, (licence authorisation dated 9th July 2020) from the Department of Communications, Climate Action and Environment. The electro-fishing survey was undertaken by Ross Macklin (Triturus Environmental Ltd.) and John Brown (Stillwater's Consultancy). A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish a total of eight sites on the Rivers Douglas, Toon and Abha Bhun Silinn (Bunsheelin) catchments.

The electro-fishing survey is considered adequate for the Board to carry out its assessment for the following reasons. 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). Stations were selected on the basis of representative and accessible locations along each of the watercourses within or draining the

Site. Each station was fished over a length of 30m of channel with 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.

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. The presence and abundance of aquatic vegetation in the river was recorded and a species list compiled. A photographic record was made with locations noted on the field maps.

Freshwater Pearl Mussel Stage 1 Survey

On the basis of the known distribution of Freshwater Pearl Mussel (FPM) within the catchment of the development derived from consultation with NPWS, a review of Ordinance Survey Ireland (OSI) mapping and aerial imagery was undertaken to identify potentially suitable locations for survey. Locations were selected on the basis of the criteria specified in the NPWS Stage 1 and Stage 2 survey guidelines (Anon, 2004) and aimed to determine the presence / absence of FPM in the watercourses on or downstream of the Site outside of their known range.

A licence application to carry out a Stage 1 Survey was submitted to NPWS and this was subsequently received (Licence No. C171/2020). Field maps and data sheets were prepared and the NPWS Divisional Manager was notified in advance of the proposed survey. The surveys were undertaken on 14th, 15th and 16th July 2020 using the NPWS Stage 1 methodology (presence/absence survey) detailed in the Irish Wildlife Manual No. 12 (2004) aimed specifically to establish presence or absence at 12 locations. The FPM Stage 1 survey is considered adequate for the purposes of this chapter . At each survey location a total length of 200m was intensively searched using a bathyscope wading in an upstream direction covering areas of fast flowing water, glides and pools. Specific attention was given to areas under overhanging vegetation where mussels frequently are found in rivers subject to periodic algal growth. Bankside shingle banks were also surveyed for dead shells where they occurred. The operation was undertaken by two people with one operator instream (Paul Murphy) and one bank-side recorder (Karen Banks). The surveys were carried out in conditions of moderate flow though with high water clarity. The weather during the survey period was generally bright and sunny with occasional cloudier periods.

Biotic Index (Q Value) Macro-invertebrate Assessment

Water quality was assessed using the Q Value biotic index system at the eight locations sampled for electro-fishing on each of the watercourses draining the Development. This 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
Q1-2	Seriously Polluted	Bad-to-Poor	Bad

6.2.1.4 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).

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, 2017). 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).

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, such as 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. the 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 associated 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
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

The Site area is approximately 667 ha in size, of which a significant area is commercial forest owned by Coillte. Most of the Coillte lands comprises different stages of coniferous plantation forestry. Forestry activities at the Site include planting, thinning and harvesting using standard techniques which includes open drainage and ground preparation, fertiliser application, access track development, and clear-felling by heavy machinery. These activities cumulatively give rise to significant risks to water quality within the Site and in the downstream catchment that are managed through current best practices for forestry.

The remaining land within the Site Boundary is third party property and the principle land use in the general area is comprised of open upland heath with agricultural grazing of varying intensity in enclosed farmlands at lower altitudes, with some residential properties on the periphery. Agricultural activities, in particular intensification including land clearance, drainage and fertilisation, can result in significant impacts directly on aquatic habitats in the vicinity and on water quality in the downstream catchment.

6.3.1 Aquatic Environment

6.3.1.1 Aquatic Habitats

The Proposed Windfarm Site

The Development lies within three sub-catchments, all tributaries of the Lee (see **Figure 6.1**). In the northern and main part of the Site, there are three tributaries of the Douglas River which flows in to the Sullane River downstream of Ballyvourney. The

Sullane flows into the River Lee within the Inishcarra Reservoir downstream of Macroom. There are records of Freshwater Pearl Mussel from the River Douglas at Rahoonagh West. In the southeast, the Site drains to the headwaters of the Toon River which flows directly into the Lee, while in the south-west the Abha Bhun Silinn also flows directly into the Lee. The watercourses within the Site are small 1st order tributaries which have high gradients and do not provide suitable habitat for fish or larger aquatic organisms.

The Sullane River supports good populations of brown trout (*Salmo trutta*) with resident populations as well as larger fish running up from the reservoir downstream (O'Reilly, 2004).

Grid Connection Route

The Grid Connection Route extends into the catchment of the Clydagh River, which becomes the River Flesk in its lower reaches downstream of its confluence with the Loo River. The Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC extends to include the Clydagh River upstream to its upper reaches on the county boundary. The Grid Connection Route will cross a number of minor tributaries of the Clydagh as it follows the existing forestry trail network between the N22 and the county boundary northeast of Mullaghanish, where it leaves the catchment. The tributaries rise on the northern flanks of the Derrynasaggart Mountains and are mostly minor streams with steep gradients upstream of the forestry track. The majority of the streams are already culverted by the existing forestry track and there is sufficient depth of material to enable the Grid Connection to be laid on top of the culverts avoiding any instream works.

Turbine Delivery Route

The Turbine Delivery Route will follow the existing road network to the N22 immediately west of Ballyvourney before linking to the L-3400-79. At this point, the alignment on the L-3400-79 road at the existing bridge crossing of the Sullane River from Ballyvourney is inadequate to accommodate the turbine blade delivery trucks, and a temporary Bailey bridge crossing is proposed at a location a short distance upstream. This location was used as a temporary crossing of the Sullane River during the construction of the Grousemount Windfarm in 2018.

The proposed crossing point and bridge design is shown on Drawing No.'s 6225-PL-810 and 6225-PL-811 in Appendix A and photos of such a bridge in Appendix B of the Method

Statement for the works included in **Appendix 2.6**. The Sullane River at this location is a meandering channel with a base width of approx. 10m over cobble and boulder with localised outcropping bedrock. The flow regime is a pool which then flows over a low cascade formed from a rock outcrop, with cobble bars along the southern bank. The woody vegetation along the banks in the vicinity of the crossing point was removed during the earlier bridge construction leaving boulder and cobble with coarse grasses and ruderals. The adjacent lands on either side linking between the N22 and the minor road are improved agricultural grassland.

6.3.1.2 Electro-fishing Survey and Fisheries Habitat

The locations of watercourses surveyed by electro-fishing are shown in **Figure 6.2**. 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.

Site 1 - River Douglas Catchment

Site 1 was a small stream of 0.5m water width with very shallow water <0.1m deep. The bank heights were 0.7m and were more open with scrubby vegetation. This included gorse, rushes, bramble and spear thistle. Further upstream of the survey area the riparian zone had mature downy birch and grey willow which increased shading. The stream had a bed of exposed bedrock, small boulder and cobble but was dominated by medium gravels. These were however bedded and had a soft silt layer underneath indicating moderate to heavy siltation. The small stream supported the macrophyte species bog pondweed (*Potamogeton natans*), lesser spearwort (*Ranunculus flammula*), starwort (*Callitriche* sp.) and water forget-me-not (*Myosotis scorpioides*) that were recorded as occasional. The stream was bordered by improved grassland (GA1).

From a fisheries perspective the small stream was not considered of any fisheries value given very shallow depth <0.5m, very limited flow and small width. The stream has suffered from siltation and historical drainage maintenance works. No fish were recorded present during electro-fishing.

Site 2 - River Douglas Catchment

Site 2 was a lowland depositing river (FW2) that had a water width of 3m, an average water depth of 0.15m and bank heights of 2m. The channel has been historically straightened and deepened. It has good recovery exhibiting semi-natural characteristics with riffle, pool and glide sequences in equal proportions. The bed consisted of abundant boulder, with smaller amounts of cobble. It was however, dominated by coarse gravels with smaller amounts of

medium gravel, sand and silt. The substrata were bedded and siltation was considered moderate. The small river channel had frequent beds of water crowfoot (*Ranunculus* spp.) vegetation. The boulders supported the liverwort *Chiloscyphus polyanthos* which was abundant with smaller quantities of the generalist moss *Fontinalis antipyretica*. The riparian areas supported mature ash, grey willow and hawthorn with a bramble and ivy understory, with adjacent improved (GA1) and dry-humid acid grassland (GS3).

The small river channel at site 2 was considered a good brown trout nursery given the presence of good nursery habitat, i.e. shallow riffle and glide habitat. It also supported crowfoot, boulder and coarse gravel refugia for juvenile trout with crowfoot vegetation also providing important feeding areas (given this species is important for attracting mayflies and black fly larvae). The spawning value of the stream was considered moderate due to coarse bedding of the substrata. Holding habitat (areas of deeper water used by older fish as lie-ups) was also considered moderate due to the absence of deeper pools that would support larger 2+ and 3+ trout.

Site 3 - River Douglas Catchment

Site 3 was an upland eroding small river channel (FW1) that had a 4m water width. The stream was predominantly very shallow (<0.1m deep) apart from isolated pools. The bank heights were typically low between 0.5m to 2.5m high. The channel was of very high energy with boulder cascade reaches. The profile comprised 20% pool, 70% riffle and 10% glide. The bed was boulder and cobble dominated with locally frequent pockets of coarse, medium and fine gravels. The stream gradient was high and cascaded over steep waterfalls 30m upstream of the bridge as shown on **Figure 6.2**. The bed comprised loose (unconsolidated) bed material and siltation levels were low. The riparian zone of the river comprised of mature willow, ash, holly and bramble. The river was bordered by improved grassland (GA1).

From a fisheries perspective the very high gradient of this small river and very shallow depth indicated the watercourse has a low value as a salmonid river as the depth would be lower in dry summers confining fish habitat to localised pools. The nursery value of the stream and spawning value (despite having some moderate potential) were low as a consequence. Holding habitat was considered good downstream of the bridge in an area of deep pool habitat where a single adult trout was captured. However, overall the holding habitat was considered poor.

Site 4 - River Douglas Catchment

Site 4 was an upland eroding stream (FW1) site that had been deepened and straightened historically. The stream was shallow at 0.1m deep and narrow being 0.5m wide (water width). The bank heights were between 2.0m and 2.5m. The bed was dominated by coarse and medium gravels with localised boulder and cobble. The bed however suffered from moderate siltation and heavy sewage fungus cover indicating nutrient loading. It is likely the recent clear-fell has resulted in the deterioration of the stream bed given clear-fell was carried out within 2m of the stream margin. The stream was dominated by riffle and glide habitat with very localised pool. The riparian zone had both recent clear-fell and a Sitka spruce plantation that was in the thicket stage (>15 years old). The wider upland catchment consisted of extensive conifer plantation.

From a fisheries perspective the small upland stream had no fisheries value. The stream was in a higher gradient area and had been deepened and realigned as part of historical forestry works. The stream had poor nursery, spawning and holding value that would have been higher if not impacted by recent clear-fell. No fish were recorded during electro-fishing.

Site 5 - River Toon Catchment

Site 5 was a lowland depositing river (FW2) that was 3m wide and on average 0.1m deep. The bank heights were 2m and the river exhibited historical deepening and straightening. The bed was dominated by medium gravels with occasional cobble and gravel. These were partially bedded and suffered from moderate to heavy siltation. Filamentous algae cover was high, covering over 60% of the river bed. This however improved upstream where gravels become cleaner with increased flow rates. Macrophytes included frequent bog pondweed and occasional *Myriophyllum alterniflorum*. The river profile was dominated by shallow glide (70% by area), with 20% riffle and 10% pool habitat by area of the reach surveyed. The riparian zone comprised of mature oak, birch and grey willow with open banks of adjoining wet improved pasture (*Juncus* frequent).

The channel was considered a moderate quality nursery but improved upstream where more riffle was present and cleaner gravels. Spawning habitat was moderate but improved upstream where pockets of clean gravels were present in deeper glide and localised pool habitat. Holding habitat was poor overall given the very limited pool habitat.

Site 6 - River Toon Catchment

Site 6 was a lowland depositing river (FW2) that was 4m wide and on average 0.15m deep. The bank heights were 2m and the river exhibited historical deepening and straightening.

The bed was dominated by boulder and cobble with frequent patches of coarse and medium gravels. These were partially bedded and suffered from moderate siltation. There was high moss cover with frequent *Chiloscyphus polyanthos*, *Fontinalis antipyretica* and *Racomitrium aciculare* on boulder and cobble. Macrophytes included frequent *Ranunculus* sp. and *Myriophyllum alterniflorum*. The river profile was dominated by shallow glide (50% by area), with 40% riffle and 10% pool habitat by area of the reach surveyed. The riparian zone comprised mature ash, grey willow with bramble and bracken in the understories. Adjoining land use was heavily improved pasture.

The channel was considered a good brown trout nursery given shallow riffle and glide habitat with boulder, cobble and macrophyte refugia. The spawning value was also good with patches of gravels between cobble and boulder pockets. Holding habitat was considered moderate only given limited deeper pool.

Site 7 - Abha Bhun Silinn River Catchment

Site 7 was an upland eroding stream site with water depths between 0.2m and 0.3m. The water width was 1m and bank heights were also 1m. The profile comprised of 40% glide, 40% riffle and 20% pool habitat. The stream was very natural with no historical alterations and had a very good physical profile. The bed comprised exposed bedrock and boulder locally with frequent cobble. It was however, dominated by coarse and medium gravels. The bed had light siltation and all substrata were loose (un-bedded). The riparian zone consisted of bracken, bramble and gorse scrub with pockets of fuchsia. Scattered grey willow were also present. The adjoining land use was improved grazing land (GA1).

Site 7 was considered a very good nursery and spawning area for brown trout for a small stream. The stream had ample riffle and glide habitat with clean gravels in deeper glide and pool tailings that supported the nursery and spawning habitat. Holding habitat was good locally for a stream of this size and was enough to support a mixed cohort trout population.

Site 8 - Abha Bhun Silinn River Catchment

Site 8 was an upland eroding river site with water depths between 0.2m and 0.7m. The water width was 3m and bank heights were variable between 1m and 2m grading into a shallow V shaped valley. The river profile was very natural comprising of boulder cascade areas with 40% glide, 20% riffle and 40% pool habitat. The bed consisted exposed bedrock and boulder with frequent cobble. The bed was dominated by coarse and medium gravels that were abundant in pool and deeper glide areas between bedrock and boulder outcrops. The bed had light siltation and all substrata were loose (un-bedded). The riparian zone was

dominated by a band of oak-birch-holly woodland (WN1) with scattered mature ash, willow with ivy, bramble scrub and montbretia in the understories.

Site 8 was considered an excellent nursery and spawning area for brown trout. The stream had ample riffle and glide habitat with clean gravels in deeper glide and pool tailings that supported the excellent nursery and spawning habitat. Holding habitat was excellent with abundant deep pools below boulder cascades. These excellent spawning, nursery and holding characteristics supported the high density mixed cohort trout population recorded during electro-fishing.

6.3.1.3 Freshwater Pearl Mussel Stage 1 Survey

The known distribution of Freshwater Pearl Mussel (*Margaritifera margaritifera*) (FPM) in the catchment of the Development is shown in **Figure 6.3** based on records provided by the NPWS (2020). The nearest records of FPM to the Development is on the River Douglas at Rahoonagh West (c 5km downstream), and on the Toon River at Coolcaum (c10km downstream). A population also occurs on the Sullane River approximately 5 km from the Siteand is in the catchment of the haul route to the Site. There are records of FPM from the immediate vicinity of the proposed bailey bridge crossing of the river at Gortnatubbrid in Ballyvourney.

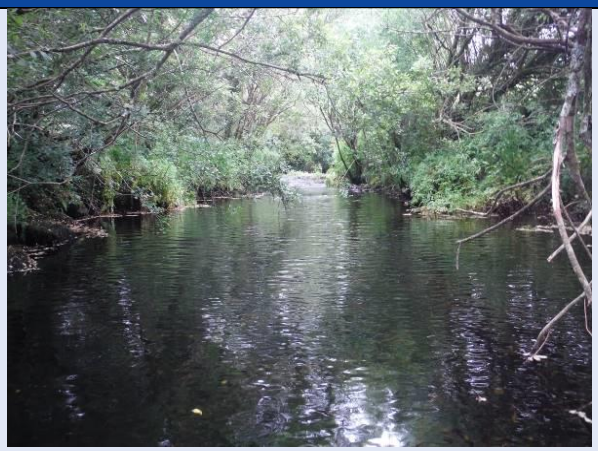
A total of 12 locations as shown in **Figure 6.4**, were surveyed for FPM using a bathyscope wading in an upstream direction over a length of 200m of river bed. Each location was subject to an intensive search which included examination of shingle banks where they occurred for evidence of dead shells. The results of the survey are detailed in **Table 6.3** which presents an overview of each survey location including a description of the aquatic and riparian habitats, and a photograph showing a typical view of the survey area. No evidence of freshwater pearl mussels was recorded from any of the transect locations surveyed for the Development.

Table 6.3: Summary results of Stage 1 Freshwater Pearl Mussel survey on watercourses draining the Site.

Site number	Grid ref.	Description and Results	Overview Photograph
1	515906 574325	Douglas River – upper reaches W=1-2m. Limited flow with cobble and gravelly sand. Heavily tunnelled with scrub. No FPM recorded and conditions considered unsuitable.	
2	517316 574318	Douglas River – upper reaches W=1.5-2m. Gravels and sand with limited flow. Pool and occasional riffle. Ranunculus and Fontinalis occasional. Banks with line of trees and adjacent unimproved pasture. No FPM recorded and conditions considered marginally suitable.	
3	517983 574138	Douglas River W=3m. Cobbles, gravel and occasional boulder. Uniform glide flow with dense Ranunculus beds upstream of bridge with open banks, and rich bryophyte downstream under shade of adjacent woodland. Channel modified in the past with dredge spoil heaps along banks. No FPM recorded and conditions considered marginally suitable.	

Site number	Grid ref.	Description and Results	Overview Photograph
4	518211 574049	Douglas River tributary W=4-5m. Cobbles and gravel with some exposed bedrock and occasional boulders. 1m cascade upstream of bridge and 0.5m step downstream. Elsewhere pool and glide. Banks with woodland cover and heavily shaded. No FPM recorded and conditions considered marginally suitable.	
5	519197 574362	Douglas River W=6-7m. Cobbles, gravel substrate, Glide and riffle flow. Banks wooded. No FPM recorded but conditions considered suitable.	
6	520680 574847	Douglas River W=4-5m. Cobble with gravel and occasional bedrock exposure. Riffle, glide and pool habitat. Ranunculus occasional with plentiful bryophytes. Banks tree-lined. No FPM recorded but conditions considered suitable.	

Site number	Grid ref.	Description and Results	Overview Photograph
7	518065 571588	Toon River upper W=2-3m. Upstream bridge cobble and gravel with pool and glide, and open banks. Small amounts of Myriophyllum and Callitriche. Downstream bridge bedrock and boulder with pool and small cascades and heavily vegetated banks. No FPM recorded and conditions considered marginally suitable.	
8	519539 571108	Toon River upper W=2-4m. Cobble with gravels and abundant silt on substrate. Riffle-glide habitat with occasional Ranunculus, Oenanthe and bryophytes. Banks with briar and gorse scrub and scattered willow, and adjacent improved grasslands. Cattle access. No FPM recorded and conditions considered marginally suitable.	
9	520717 571061	Toon River W=6-7m. Boulder, cobble and gravel. Riffle, glide and pool sequence. Ranunculus and Oenanthe occasional and abundant Fontinalis. Banks with over-hanging woodland cover. No FPM recorded but conditions considered suitable.	

Site number	Grid ref.	Description and Results	Overview Photograph
10	522410 570488	Toon River W=6-8m. Gravels and with exposed bars, and locally exposed bedrock. Riffle and pool sequence. Ranunculus abundant, Oenanthe frequent. Banks tree-lined. No FPM recorded but conditions considered suitable.	
11	514616 568720	Abha Bhun Silinn tributary W=4-5m. Large boulders, cobbles, and gravel pockets. Pools and cascades. Banks with woodland fringe. Some silt and algae present. No FPM recorded and conditions considered marginally suitable.	
12	515348 570569	Abha Bhun Silinn tributary (No photo) W=1-1.5m. Bedrock, boulder and cobble with some gravels. Small cascades and pools. Heavily tunnelled with willow scrub vegetation with adjacent semi-improved grasslands. No FPM recorded and conditions considered unsuitable.	

Freshwater Pearl Mussels (FPM) are also recorded from the River Flesk, which is the lower reaches of the Clydagh River. FPM are a qualifying interest for the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC which extends to include the Clydagh River. The distribution of FPM on this system has not been assessed as part of the surveys undertaken to inform this EIAR, but the NPWS provided known records from the River Flesk which are shown in **Figure 6.5**.

6.3.1.4 Biotic Index (Q Value) Macro-invertebrate Assessment

Water quality was assessed using the Q Value biotic index system at the eight locations sampled for electro-fishing (see **Figure 6.2**) on each of the watercourses draining the 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 Douglas River at Gortnascarty Bridge (Site 2) is from 2005 when the river was given a Q4 equating to good quality. Data from 2017 for the bridge upstream of the Sullane confluence was Q4-5 (high quality). The River Toon at the bridge south of Lack (Site 6) and at the bridge at Coolcaum further downstream were both assigned a Q4-5 (high quality) in 2017. These data are in keeping with the results obtained during the current assessment and suggest no significant change in water quality within these watercourses within recent years.

All watercourses are in Good or High status with the exception of Site 4 which was rated as Q3-4 (WFD status poor) on account of the limited macroinvertebrate diversity and the high algal cover within the stream. This small stream is located within the Site and the reduced water quality probably reflects the release of nutrients from the surrounding area during forestry clear-fell activities. The effect on water quality at this site appears to be localised in its extent, as water quality at Site 3 further downstream on the watercourse, was assessed as being Q4-5 (high quality).

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	0.5m water width, <0.1m deep, bank heights 0.7m. Substrate exposed bedrock, small boulder, cobble and gravels with embedded silts. Macrophytes occasional. Macroinvertebrate diversity good with abundant flattened mayfly, occasional stonefly and low numbers of water louse.
2	4	Good	3m width, 0.15m deep, bank heights of 2m. The channel has been straightened but has good riffle, glide and pool sequence. Substrate boulder, cobble and gravels with some sand and silt. Macrophytes frequent. Macroinvertebrate diversity good with abundant flattened mayfly, occasional stonefly, frequent cased cadis and water louse.
3	4-5	High	4.0m width, <0.1m deep (occasional pools), bank heights 0.5m to 2.5m. The channel is high energy with frequent boulder cascades. Flow regime 20% pool, 70% riffle and 10% glide and small waterfalls 30m upstream of the bridge. Substrate boulder and cobble dominated with pockets of gravels and very little silt. Macroinvertebrate diversity high with abundant flattened mayfly and frequent stonefly and cased cadis. Abundant beetle and blackfly.
4	3-4	Poor	0.5m wide, 0.1m deep, bank heights 2m. Modified and straightened channel with riffle and glide flow and occasional pool. Substrate dominated by gravels with localised boulder and cobble, and embedded silts. Heavy sewage fungus cover. Macroinvertebrate

Site No.	Q Value	WFD Ecological Status	Comments
			diversity moderate with small numbers of flattened mayfly, abundant Baetis and Gammarus.
5	4	Good	3m wide, 0.1m deep, bank heights 2m. Modified and straightened channel with mainly shallow glide flow and occasional riffle and pool. Substrate dominated by gravels with occasional cobble and moderate to heavy siltation. Filamentous algae cover high and frequent Macrophytes. Macroinvertebrate diversity reasonable with frequent flattened mayfly, Baetis and Gammarus.
6	4-5	High	4m wide, 0.15m deep, bank heights 2m. Modified and straightened channel with shallow glide and riffle flow with occasional pool. Substrate dominated by boulder and cobble with frequent gravels and moderate siltation. Macrophytes and moss abundant. Macroinvertebrate diversity high with abundant flattened mayfly, frequent stonefly, cased cadis, beetle and molluscs.
7	4-5	High	1m wide, 0.2m - 0.3m deep, bank heights 1m. Natural streambed with riffle glide, and pool sequence. Substrate exposed bedrock, boulder and cobble occasional, dominated by gravels with small amounts silt. Macroinvertebrate diversity high with abundant flattened mayfly, occasional stonefly, cased cadis, and small numbers of Gammarus.
8	4-5	High	3m wide, 0.2m - 0.7m deep, bank heights 1m - 2m. Natural stream bed with frequent boulder cascade areas and good riffle, glide and pool sequence. Substrate exposed bedrock and boulder with frequent cobble, dominated by gravels with very little silt. Macroinvertebrate diversity high with abundant flattened mayfly, stonefly, cased cadis, molluscs and blackfly.

6.4 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS

A more in-depth discussion of water quality is provided in **Chapter 9: Hydrology and Hydrogeology**. The focus in this section is on the effects on aquatic species and ecology. Groundwater pathways are not considered an issue at the Site on account of the underlying geology and the area is mapped as low vulnerability by the EPA (EPA Maps).

6.4.1 The 'Do-Nothing' Impact

If the development does not proceed, lands at and in the vicinity of the Site will continue to be used for forestry and agricultural purposes. This 'do-nothing' scenario would result in no significant change to aquatic ecology and habitats within or downstream of the Site subject to the continuation of current activities and practices. It should be noted however, that current forestry and agricultural activities are having some effects on water quality within the catchment as evidenced by the results of the surveys undertaken.

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 include:

- Clearance of vegetation, soil and rock for widening and construction of access roads, hardstand and turbine bases with associated impacts on the drainage network and site run-off on water quality within the watercourses onsite and downstream;
- Clear-fell of approximately 35.4 ha coniferous forestry mostly consisting of Sitka Spruce or Lodgepole Pine;
- Crossing of watercourses on the Turbine Delivery Route, Grid Connection Route and the Site Access Roads;
- Effects of felling on water quality as a result of sediment and nutrient release;
- 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;
- 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;
- Potential of peat slippage or failure, and,
- Removal and restoration of existing infrastructure at decommissioning stage.

The principal potential construction phase effects of the 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, drainage network, sub-station building, borrow pits or repository areas, and the Grid Connection Route. There is a minor risk of nutrient release as a result of the clear-fell of conifers required for the proposed development though this of a minor scale in comparison to the normal forestry activities taking place at the Site. The most pertinent sources of impact on the aquatic environment are considered to be:

- The loss of natural watercourses due to watercourse crossings and the placement of bridges and culverts.
- Water quality degradation in surface and groundwater from siltation or other forms of pollutants.

All turbine locations are located a minimum of 65m from the nearest watercourse, while the borrow pit location is over 500m from the nearest watercourse. No works will take place

within a 65m buffer zone of watercourses except for the clear span and culverts on the seven watercourse crossings on the access track network.

The connection of the wind farm to the national electricity grid, will be via 110 kV underground cable connection to the existing Ballyvouskill 220 kV Substation approximately 27.8km from the Site (**Figure 1.2**). Approximately 20km of the route is located along the route of an existing forestry road which runs parallel to the Clydagh River and entails the crossing of numerous tributaries of the river. The Clydagh River is within the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC.

For most of the crossings along the Grid Connection Route, there is sufficient depth over existing culverts to accommodate trenching of the cable. However, there are five water crossings along the Grid Connection Route which do not have sufficient depth of material and these will be constructed by means of directional drilling technology. Details of the directional drilling procedure are outlined in **Chapter 2: Project Description** (Section 2.9.5.2). This methodology sets out the potential risks of siltation or other pollutants entering the watercourses during the construction phase.

There are in addition, a number of minor ditches that are either dry or have minimal flows, that will be crossed by damming the ditch upstream and over-pumping (if necessary) during the trenching operation. Without mitigation, these crossings present a temporary minor risk of sediment release and of other pollutants entering the Clydagh River downstream. The trenching and laying of the Grid Connection pipe at these open crossings will be undertaken as a single operation which will be completed in a number of days. These works will be confined to dry periods during the summer months.

The Turbine Delivery Route extends from Ringaskiddy Port to the Site (via the N28, N40, N22, L-3400-79, L-3405-0, L-7405-0 and an upgraded private road) is shown on **Figure 2.5**. The route will require the placement of a temporary bailey bridge over the Sullane River at a location just upstream of Ballyvourney. The location has been used previously for this purpose and the woody vegetation along the river bank has not yet regenerated. In view of the sensitivities of the Sullane River at this location (supporting populations of Freshwater Pearl Mussel, Atlantic salmon and Brown trout) the bridge structure has been designed to avoid any instream works or requirement for any modification to the river banks. A detailed method statement has been developed for the construction and removal of the structure which forms part of the project design (**Appendix 2.6: Temporary Bridge Crossing Over Sullane River- Method Statement**). The bridge abutments will be set

back 5m from the top of the river bank with a post and rail fence defining the working zone set back 3m from the top of the bank. On the landward side of this there will be triple silt curtains installed. All site drainage will be directed to attenuation sumps which will be discharged to silt busters, with the resulting wastewater then tankered off the Site by a licensed waste collector to the nearest wastewater treatment plant, Ballyvourney/ Ballymakeera. There will be no on-site treatment of wastewater.

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. The potential for increased silt loads could negatively impact on water quality, salmonid spawning habitat and Freshwater Pearl Mussel (FPM) populations in the downstream reaches, with the scale of impact being proportionate to the scale and duration of siltation.

The nearest record of FPM to the Development is c5km downstream on the River Douglas at Rahoonagh West, while a population also occurs on the Toon River at Coolcaum (c10km downstream). A population also occurs on the Sullane River which is outside of the catchment for the Development, but will be crossed by a temporary Bailey bridge for the haul route. While none of the populations are 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.

FPM also occur on the River Flesk (the lower reaches of the Clydagh River) and are a qualifying interest for the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC which extends to include the Clydagh River. The construction of the Grid Connection Route parallels the Clydagh River where it runs along an existing forestry track. There are numerous feeder tributaries crossed by existing culverts along the track, the majority of which have sufficient depth of over-lying material to accommodate the burying of the Grid Connection across the culvert. There are five watercourses which do not have culverts and these will be directionally drilled thereby minimising risks of silt or other pollutants entering the watercourse. A small number of un-culverted drains will be crossed by open-cut.

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 international scale. In view of the existing threats to water quality in the lower reaches of the River Douglas and Toon River, effects on the FPM populations from siltation or other pollutants, may last longer than the impact-causing activity.

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 Development are limited to the crossing points of the road access network which will entail seven separate watercourse crossings as shown in **Figure 6.4**. All seven watercourse crossings are on minor headwater streams at locations that are of limited fishery value on account of their small size and variable flow rates. Some also have potential barriers to fish movement in their lower reaches. The seven new watercourse crossings have been designed on a bespoke basis in consultation with Inland Fisheries Ireland (IFI) (design calculations are presented in **Appendix 2.1** of the EIAR). The following approach and guidance were used in the sizing of watercourse crossings:

- Detailed mapping of drainage paths across the Site has been undertaken; utilising topographical surveys, contour mapping and aerial photography.
- Hydrological assessments made using a number of methods including Flood Estimation Handbook (Statistical Analysis) and Flood Studies Report (FSR) where appropriate to determine the design flow.
- CIRIA Culvert Design and Operation Guide (C689).

- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*.
- Where planning consent is received a Section 50 Application will be submitted to Office of Public Works (OPW) for approval prior to works commencing on site (required to ensure unimpeded conveyance and storage capacities of channels and floodplains).

Without appropriate design and construction methodologies, the crossings could result in a loss of aquatic habitat or interfere with the connectivity of the watercourses. In addition, the construction works for the crossings would have the potential to give rise to water quality effects that would extend downstream to stretches of the watercourses with higher fisheries value and freshwater pearl mussel 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, fine concrete particles and the spillage of hydrocarbons is primarily associated with the construction of watercourse crossings as other infrastructure is set back from watercourses. The potential impact of sediment release in the absence of mitigation is therefore considered short term but significant negative at the local scale.

All of the water crossings will be clear span structures (as shown on Planning Drawing No. 6225-PL-WC-01 to 6225-PL-WC-07 and **Appendix 2.1**) with the following design criteria:

- The clear span design is a nominally segmented precast arch or similar and will avoid disruption to the stream bed and banks, protecting fishery habitats.
- The crossing direction will be perpendicular to the stream direction, therefore minimising the length of stream affected.
- The crossing detailed design allows for the passage of out-of-bank flood flows within the clear span.
- The crossing locations have been informed by the hydrological analysis and identification of constraints to:
  - Ensure location in an area where bank slopes are shallow, thus reducing the potential for runoff to carry sediment into the watercourse.
  - Avoid locations with any incoming tributary streams.
- The structure shall include ledges or areas of undisturbed riverbank to allow for the free passage of otters.

The clear span design of the crossings will not affect instream aquatic habitat or interfere with the passage of fish or aquatic fauna. While the construction phase has associated risks

of negative impacts on water quality with appropriate mitigation, the design of the clear span crossings is expected to result in no negative residual impact on any aquatic species.

A number of existing minor drains on the road network within the Site will require upgrading to accommodate the increased width of the road. These are minor surface drains that are mainly dry and receive flows only following heavy rainfall events. However, due to their connectivity to the more important lower reaches in the catchment, appropriate measures will be required during the upgrade works to avoid siltation or other pollutants entering the drainage network.

Machinery required for construction activities also poses a risk as a vector for the introduction and spread of invasive non-native species, such as Himalayan balsam (*Impatiens glandulifera*), Japanese knotweed (*Follopia japonica*), to watercourses that could have negative effects on aquatic ecology and riparian habitats. There are no records or evidence of any invasive plant species recorded from the Site or its surrounds however so any risk will be limited to introduction via plant.

The risk of peat failure or slippage occurring on the Site during the construction phase has been analysed by Minerex Environmental as part of the hydrogeological assessment. Site investigations at 378 locations around the Site found very shallow peat (0.01 to 0.5m) at the vast majority of locations, with moderately deep peat (2.0 to 3.5m) at only 12 locations. The depth of peat has informed the layout of the Site and all areas of deep 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.

In the absence of mitigation, potential impacts on the aquatic environment are classified as being medium term significant negative at the international scale on account of the sensitive freshwater pearl mussel populations in the downstream catchments and the value of the lower reaches of the watercourses for salmonids.

6.4.3 Operational Phase Potential Effects

There is potential for effects on watercourses within the Site during the operational phase due to operational activities and maintenance of 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 development in **Section 6.4.2**. Impacts on water quality

and aquatic habitats occurring during the operational phase is not considered likely in view of the distance between the turbines and substation and watercourses (>65m) 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 is considered to be short term Significant at the Local (Higher) scale.

6.4.4 Decommissioning Phase Potential Effects

The decommissioning phase 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 65m for turbines and associated infrastructure from watercourses and utilising existing forestry access tracks where feasible.

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 development. Key to minimising this risk has been the siting of all turbine locations and other key infrastructure at a minimum set-back from watercourses (65m). In designing the layout of the access roads careful consideration has been given to minimise the numbers of watercourse crossings and in choosing locations where crossing design can readily achieve the objective of maintaining the potential for unimpeded fish pass and ecological connectivity. The layout has also avoided any interference with existing hydrology on the Site and maintains surface water flow networks through the use of cross drains on access roads.

6.5.2.2 Mitigation by Design

A comprehensive suite of drainage measures have been developed to protect all receiving waters from potential impacts during the construction of the development in the catchment of the Site and along the proposed Grid Connection, and are outlined in full in **Chapter 9: Hydrology and Hydrogeology**. These measures are aimed at 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 ecology.

The mitigation measures have been incorporated into a Construction and Environmental Management Plant (CEMP) for the development which includes Construction Method Statements for key works. The CEMP includes a Surface Water Management Plan (SWMP), a Water Quality Management 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 Development (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 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*

Surface water management measures, including the installation of silt fencing and delineation of buffers will be put in place in advance of the development of the internal road network. All other measures including 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.

Dewatering flow rate or pumping rate will be controlled by an inline gate valve or similar infrastructure. This will facilitate reduction of loading on the receiving drainage and attenuation network, thus enhancing the attenuation and settlement of suspended solids. All pumped water will be discharged to constructed drainage and in line treatment train or to a vegetated surface through a silt bag outside of surface water buffer zones. Dewatering is a dynamic process and will require continuous monitoring and modification depending on conditions encountered.

The seven separate watercourse crossings along the network of access roads are all designed as clear span structures with abutments set back from the river banks to avoid any modification to the stream channel in accordance with the requirements of Inland Fisheries Ireland. The

outline method statements prepared for the construction of the bridges and associated works in Section 4 of the Water Quality Management Plan detail the sequencing of works required to avoid the risk of silt or other pollutants entering the watercourses. The construction of the watercourse crossing will be undertaken during the period 1st July to 30th September as set out in Inland Fisheries Ireland Guidance (2016) to avoid accidental damage or siltation of spawning beds, unless otherwise specified by Inland Fisheries Ireland during consultations in advance of works.

There will be no instream works undertaken and no tracking of machinery across any watercourse. Crossings will be undertaken by Bailey bridge or similar if required. All machinery will stay within designated routes (working corridor) within the Site Boundary. To protect any known ecological features that occur close to the planned infrastructure, a delineated working corridor will be employed throughout the construction. Posts and tape will be used to establish these areas and thus prevent the entry of Contractors' plant outside the working corridor during construction works. Locations of ecological significance or where invasive species are identified will also be fenced off.

This will also include preparatory work in the vicinity of all watercourses and all river bank works. Method statements for watercourse crossings will be prepared at the construction stage and submitted to Inland Fisheries Ireland for prior approval. All bank-sides in the vicinity of the new crossings will be fully reinstated with vegetation cover as quickly as possible using only native species appropriate to the existing environment.

There are 183 No. water crossings along the grid connection route. Five of these crossings will be constructed by means of directional drilling technology in accordance with the outline method statements provided in the CEMP. These methods detail the potential risks of pollutants or contaminants arising during the works and provide specific measures to neutralise the risks.

The method statement for the construction and subsequent removal of the proposed temporary bridge crossing of the Sullane River is provided in **Appendix 2.6**. The temporary bridge will have a clear span of 32.0m. The chosen bridge location provides for the shortest required span (of 9m at riverbed level) with 20m from top of bank to top of bank. A similar bridge was installed at this location for turbine component deliveries to Grousemount Wind Farm, and the vegetation on the riverbanks at this location is comprised of low herbaceous species that will not require any removal or cutting back.

The bridge will comprise a single span simply supported steel structure that entails no instream works (see Drawing No.'s 6225-PL-810 and 6225-PL-811 in Appendix A and photos of such a bridge in Appendix B). From the river's edge (top of the bank), a no-go zone of 5m will be fenced off across the whole width of the working corridor. A double layer of silt fencing will be erected on the field side of each fence. All surface water run-off from the Site will be collected in sumps and directed through silt-busters with discharge via silt-socks to adjacent grassland. A suction type tanker will be on call so as to empty the silt busters in the unlikely event of a malfunction and to empty the concrete wash-down skips and to transport the contents to a licenced waste water treatment plant. Once all turbine components have been delivered to the Site and turbines have been commissioned, the stone fill will be removed locally from either end of the bridge and the crane will remobilise to the crane hardstand area. Fixing to the abutments will be removed and the bridge deck will be lifted out of position and components disassembled. The main wall faces will be exposed by removing soil within the original excavation. The concrete abutments will be broken down with a rock breaker attached to an excavator and the reinforcing steel cut with an angle grinder until each abutment is fully removed. The top layer of crushed stone of the track each side of the river as well as crane hardstand area and bridge assembly area will be removed, and the material taken from site either for re-use elsewhere or for disposal at a licenced landfill. The previously excavated topsoil will then be spread over the works area and reseeded with grass.

In accordance with the requirements of Inland Fisheries Ireland, the CEMP contains a contingency plan to deal with the scenario of a peat movement occurring on the Site 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. Specific measures are detailed in **Chapter 9: Hydrogeology and Hydrology** (Section 9.5.2.10 Emergency Response) 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.

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 Site but equally with regards to the protection of the downstream population of Freshwater pearl mussel and salmonids. These measures are a summary of the principle 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 65m buffer zone of watercourses except for the watercourse crossings, road development and drainage measures as detailed on the **Appendix 2.1** CEMP and Water Quality Management Plan.
- The site compound and any temporary soil storage areas will be located at a minimum distance of 65m from any watercourse. All drainage from these facilities will be directed through a settlement pond with appropriate capacity and measures to provide spill containment. A Peat and Spoil Management Plan, Surface Water Management Plan and a Water Quality Management Plan can be found in **Appendix 2.1**.
- All site drainage, as described in the surface water management plan and shown on associated drawings, 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 will not exceed 25mg/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.
- The storage of oils, hydraulic fluids, etc., will be undertaken in accordance with current best practice for oil storage (Enterprise Ireland, BPGCS005).
- All machinery operating at the Site will be fully maintained 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.
- Any extensions to existing drainage culverts on the Site Access Roads will be undertaken in dry conditions and in low flow.
- 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 (see **Chapter 9** for further details). There will be no batching or storage of cement allowed in the vicinity of any watercourse crossing construction area.
- Procedures (as detailed in **Chapter 9: Hydrology and Hydrogeology**) 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.
- 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 operational phase to prevent silt-laden run-off. Seed mixes will contain only suitable native species of plant that occur in the local area.
- 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 and not in natural streams or drainage lines.
- 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.

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 Site and in downstream reaches:

- The Site compound / office will house all potential pollutants within a secure bunded COSSH store for the operational phase of the project.
- All onsite wastewater treatment facilities will function in full compliance with current water quality requirements (Building Regulations 2010 as amended S.R. 66:2015) to prevent nutrient loading entering aquatic environments.

6.5.4 Decommissioning Phase Mitigation

Decommissioning of the Development will be scheduled to take place after the proposed 35year 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 Development, the areas within the Site 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 Site which will have developed over the intervening 35 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 DEVELOPMENT

While culverting 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 two affected watercourses are minor and of low fisheries values. The five clear span watercourse crossings will result in no loss of instream habitat. The design of the culverts and the clear span crossings will ensure no impediment to movement of fish or other 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 development do not suffer any deterioration in water quality, either during construction, operation, or decommissioning. The populations of Freshwater Pearl Mussel in the lower catchments of the windfarm and along the Grid Connection Route will not be negatively affected by the 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 proposed wind farm development.

6.7 MONITORING

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 a qualified and experienced Environmental Manager or Ecological Clerk of Works.

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 Site 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 Site, including discharge rates. The construction and post construction monitoring programme for the Gortyrahilly site 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 Site 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 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 Water Quality Management Plan. During the operational phase of the project the stilling ponds and buffered outfalls will be periodically inspected during maintenance visits to the Site.

6.8 SUMMARY OF SIGNIFICANT EFFECTS

The proposed Gortyrahilly Wind Farm Development will entail the crossing of seven small watercourses along the access track network. The watercourses are all minor headwater tributaries with limited fisheries value, though the downstream catchments are of significant value for salmonids as well as supporting populations of the Annex II listed Freshwater Pearl Mussel. All watercourses will be crossed by clear-span structures with the abutments set back from the riverbanks. These and other construction works present a risk of impacting on water quality within the streams with potential for impacts extending downstream to affect salmonid and Freshwater Pearl Mussel populations.

In addition, the haul route will entail the construction of a temporary Bailey bridge crossing of the Sullane River just upstream of Ballyvourney. This location is within the known range of a population of Freshwater pearl mussel as well as within reaches that are important habitat for Atlantic salmon and Brown trout. The bridge construction will be clear-span with abutments set-back from the riverbanks to avoid any instream works or modification to the river banks. Appropriate measures will be required to avoid effects of siltation or other pollutants entering the water. The construction of the Grid Connection Route parallels the Clydagh River, which also supports a population of Freshwater pearl mussel as well as being an important salmonid river, where it runs along an existing forestry track. There are numerous feeder tributaries crossed by existing culverts along the track, the majority of which have sufficient depth of over-lying material to accommodate the burying of the Grid Connection across the culvert. There are five watercourses which do not have culverts and these will be directionally drilled thereby minimising risks of silt or other pollutants entering the watercourse. A small number of un-culverted drains will be crossed by open-cut.

The mitigation measures as described in this chapter and within the CEMP and WQMP (**Appendix 2.1**) 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.

The operational phase of the proposed development is considered not to present any significant risk of affecting water quality within the catchment. Decommissioning of the Development will be scheduled to take place after its proposed 35 year lifespan. Decommissioning phase impacts are likely to be broadly similar to construction phase impacts and 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.

6.9 STATEMENT OF SIGNIFICANCE

It is considered that with the proposed mitigation successfully implemented, the proposed wind farm development at Gortyrahilly will result in an overall negligible to low significance residual impact upon the aquatic ecological features that lie within the Zone of Influence.