MEENBOG WIND FARM
Fisheries Assessment

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Table of Contents

1 STATEMENT OF AUTHORITY 2

2 INTRODUCTION 2

3 LOCATION & FISHERIES ADMINISTRATION 2
3.1 Location 2
3.2 Loughs Agency 2
3.3 Fisheries Status 3

4 CONSERVATION STATUS 3
4.1 WFD Ecological Status 3
4.2 EC Habitats Directive 4

5 EXISTING DATA 5
5.1 River Derg 5
5.2 Fish species 5
5.3 Adult Salmon Runs 6
5.4 Salmon Spawning 6
5.5 Juvenile Salmonids 7
5.6 Lamprey 9
5.7 Freshwater pearl mussel 9
5.8 Angling 9
5.9 Aquaculture 9

6 FIELD ASSESSMENT 10
6.1 Outline 10
6.2 Site Drainage and Local Hydrology 10
6.3 Methodology 10
6.4 Fish Distribution 12
6.5 Eels 12
6.6 Stream Details 12

7 IMPACTS ON FISH/FISH HABITATS AND ASSOCIATED MITIGATION MEASURES 15
7.1 Description of Impacts 15
7.2 “Do Nothing” Impact 16
7.3 Hydrological Connection to SACs 17
7.4 Trans-frontier Impacts 17
7.5 Impacts during Preparation and Construction Phases 17
7.6 Impacts during Operational Phase 19
7.7 Impacts during De-commissioning Phase 21

8 CUMULATIVE IMPACTS 22
8.1 Additional Developments 22
8.2 Assessment 23

9 CONCLUSION 24

REFERENCES 24

1 STATEMENT OF AUTHORITY

Paul Johnston Associates is an independent fisheries consultancy specialising in freshwater fisheries in Ireland, and providing a range of specialist services related to fish stock assessment, impact assessment and fisheries management.

The practice has completed a wide range of assignments in the areas of environmental impact assessment, fisheries development and catchment management, including fisheries assessments in connection to a series of land-based wind farm developments in Northern Ireland.

2 INTRODUCTION

The proposed Meenbog Wind Farm is located within the catchment of the River Derg which has been designated as a Special Area of Conservation with Atlantic salmon noted as the primary reason for selection of the site.

This chapter assesses the effects of the proposed wind farm on fish stocks and habitats in the river network both within the site boundary and in other areas of the catchment directly connected to the site.

Impacts on fisheries may be caused by:

- Loss of fish through pollution from the site during the construction phase;
- Loss of fish or damage to fish habitats through run-off of suspended solids due to site construction works;
- Reduced productivity due to obstruction of fish passage or loss of habitat in watercourses.

3 LOCATION & FISHERIES ADMINISTRATION

3.1 Location

The proposed wind farm is located adjacent to the border in Co Donegal, at its nearest point 8 km to the south-west of Ballybofey, 14 km north-east of Donegal town and 16 km west of Castlederg in Co Tyrone. The core wind farm development site lies entirely within the catchment of the River Derg (Fig 1), which is a cross border catchment between the Republic of Ireland and Northern Ireland.

3.2 Loughs Agency

The Derg forms part of the wider Foyle river system which is administered by the cross-border Loughs Agency.

Under Section 11 (6) of the Foyle Fisheries Act (Northern Ireland) 1952 and the Foyle Fisheries Act 1952 (Republic of Ireland), the Foyle Fisheries Commission was given the responsibility for "the conservation, protection and improvement of the Fisheries of the Foyle Area generally". The North/South Co-operation (Implementation Bodies) (Northern Ireland) Order 1999 and the British Irish Agreement Act 1999 extended these functions to include the Carlingford Area, and the Foyle Fisheries Commission transferred its functions to the Loughs Agency.

The Loughs Agency is an agency of the Foyle, Carlingford and Irish Lights Commission (FCILC), established under the 1998 Agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of Ireland.

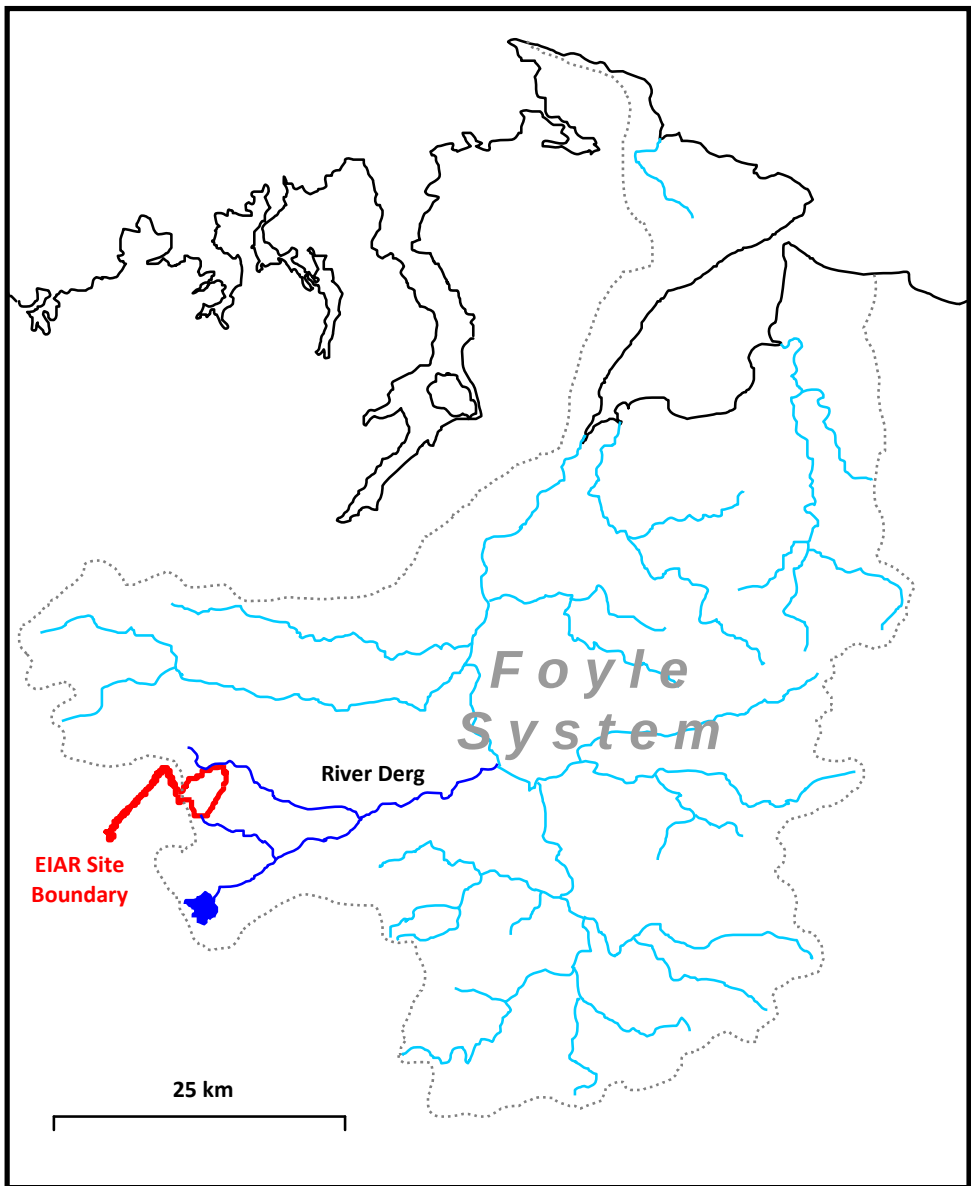

Figure 1: Location of proposed Meenbog wind farm (EIAR Site Boundary) in relation to the River Derg, and the wider Foyle catchment.

3.3 Fisheries Status

The Foyle in general is one of the most productive salmon and trout river systems in the world and has some of the best angling water in Ireland. The Derg is one of the most popular recreational fisheries for salmon and sea trout in the Foyle system, with peak runs of fish during the summer months.

4 CONSERVATION STATUS

4.1 WFD Ecological Status

Within the Derg catchment the development site traverses a total of 5 separate waterbodies as delineated under the Water Framework Directive (WFD). The Ecological Status of these waterbodies during the 2010-15 cycle is shown in Table 1.

Waterbody	ID code	Ecological Status
Glendergan	IE_XB_01_5	Moderate
Bunadaowen	IE_NW_01_1373	Poor
Mourne Beg	IE_NW_01_691	Poor
Mourne Beg	IE_NW_01_623	Poor
River Beg	IE_XB_01_4	Poor

Table 1: Ecological status of Derg catchment waterbodies partially included within proposed wind farm development boundary (Source: EPA).

These waterbodies connect to the the main channel River Derg within Northern Ireland - the middle section (River Derg (Killeter) UKGBNI1NW010102094) and lower section (River Derg (Millbrook) UKGBNI1NW010102095) of which have been assessed as of Good and Moderate Ecological Status respectively in 2015.

All of these waterbodies are located within the North Western International River Basin District, an area which incorporates the Foyle, Erne and Melvin catchments along with Co Donegal.

To achieve the ecological objectives of the Water Framework Directive, River Basin Management Plans will be implemented through Water Management Units (WMUs) during the 2010 to 2015 cycle. This area is covered by the Finn/Derg/Foyle WMU which assesses the status of constituent water bodies together with pressures/risks and proposes an action programme to ensure that each of these waters achieves its objectives in terms of WFD ecological status.

4.2 EC Habitats Directive

4.2.1 Atlantic Salmon

The Atlantic salmon is listed in Annex II of the EU Habitats Directive as a species of European importance. The species is featured in Ireland's National Biodiversity Plan (2011) which includes a series of actions aimed at restoration of stocks. In the UK, it was added to the UK Biodiversity Action Plan (BAP) list in 2007 as a priority species for conservation action.

4.2.2 River Foyle & Tributaries SAC

In Northern Ireland, the River Derg is included in the River Foyle and Tributaries Special Area of Conservation (SAC). The designation includes the Mourne Beg and Glendergan tributaries which drain the proposed wind farm site area.

The site was recommended as a candidate SAC in 2007, with salmon noted as the species providing the primary reason for selection of the site which subsequently received full designation as an SAC (UK0030320). The river has the largest population of Atlantic salmon (*Salmo salar*) in Northern Ireland, with around 15% of the estimated spawning numbers. The majority of the salmon returning are grilse (single wintering salmon), with a smaller but important number of spring salmon (multi-wintering salmon) also occurring. Research has indicated that individual sub-catchments within the system support genetically distinct salmon populations (JNCC, 2007). The Freshwater pearl mussel (*Margaritifera margaritifera*) is also noted as qualifying features of the site.

4.2.3 River Finn SAC

The River Finn (IE002301) was recommended as a candidate SAC in 2006, with salmon listed as one of the Annex II species providing the primary reason for selection of the site, and received full designation in 2014. The SAC comprises almost the entire freshwater element of the River Finn and its main tributaries but also the headwaters of the River Derg in Co Donegal, including the Mourne Beg tributary where its course follows the border over a reach of 9-10 km immediately downstream of the proposed wind farm site.

Lough Derg and the tidal stretch of the Foyle north of Lifford to the border are also part of the site.

4.2.4 Lough Eske and Ardnamona Wood SAC

Lough Eske and Ardnamona Wood (IE000163) was recommended as a candidate SAC in 1998 and was designated in 2015. The site was selected for two freshwater Annex II species, Freshwater pearl mussel and Atlantic salmon. The EIAR Site Boundary follows the course of the N15 and the Lowerymore River in a south-westerly direction to Keadew Bridge. Although the cable route does not encroach on the SAC it is hydrologically connected to the site via the river channel and terminates just before the upstream limit of the SAC at Keadew Bride.

5 EXISTING DATA

5.1 River Derg

The River Derg issues from Lough Derg in Co. Donegal and drains a catchment area of 438 km^2 through a river length of approximately 66 km including tributaries. A significant area of the wind farm site is drained by the Mourne Beg, the largest tributary of the Derg, which joins the main channel approximately 3.5 km upstream of Castlederg.

The location of the proposed wind farm site in the Derg catchment and the Foyle basin is shown in Figure 1.

5.2 Fish species

The following fish species are recorded by the Loughs Agency as being present in the River Derg system (Loughs Agency, 2011a):

- Atlantic salmon (*Salmo salar*);
- Brown trout and sea trout (*Salmon trutta*);
- Eel (*Anguilla anguilla*);
- Minnow (*Phoxinus phoxinus*);
- River/Brook lamprey (*Lampetra* sp);
- Sea lamprey (*Petromyzon marinus*).

Loughs Agency survey data also indicates the presence of:

- Minnow (*Phoxinus phoxinus*);
- Three-spined stickleback (*Gasterosteus aculeatus*);
- Stone loach (*Noemacheilus barbatula*)
- Pike (*Esox lucius*)
- Perch (*Perca fluviatilis*)
- Roach (*Rutilis rutilis*)
- Gudgeon (*Gobio gobio*)

5.3 Adult Salmon Runs

Adult salmon runs are now measured by electronic fish counters at six counting stations in the Foyle system, but there is no individual counter for the Derg. However, all fish running the river must pass through the River Mourne counter at Sion Mills – the data from this site may therefore be used to provide some indication of trends in annual runs although many of the fish counted at this point will be destined for other tributaries in the Mourne system. Annual counts for the Mourne over the last 16 years are shown in Figure 2.

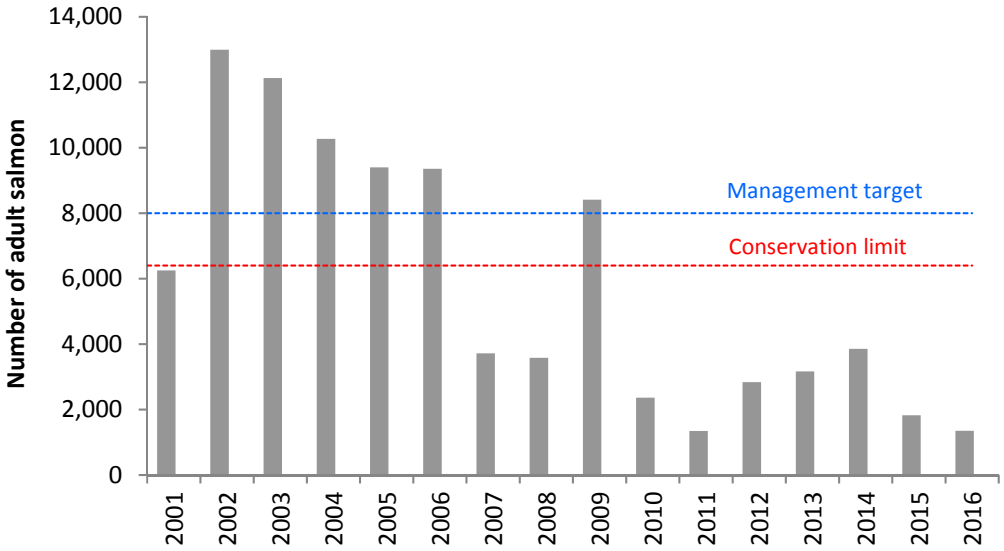

Figure 2: Numbers of salmon ascending River Mourne at Sion Mills fish counter, 2001-16 (Source: Loughs Agency).

This data indicates that the salmon runs exceeded the management target of 8,000 fish for the Mourne during 2002-2006 but, apart from 2009, have declined to significantly less than both the management target and the conservation limit of 6,400 fish. It should be noted that the figures for 2007 and 2010 are considered to be minimum counts due to specific technical difficulties in those years (Loughs Agency, 2011).

5.4 Salmon Spawning

Annual spawning redd counts for the last five years in the Derg and the Foyle system as a whole are shown in Table 2. Redd counts are highly dependent on river levels and therefore subject to considerable variability. However the data does indicate that the Derg is a key salmon spawning catchment with an average of 20% of the total spawning in the Foyle catchment as a whole.

Area/catchment	2009/10	2010/11	2011/12	2012/13	2013/14	Average
Total Foyle	4000	3382	1313	2152	3189	**2,807**
Derg catchment	637	442	269	698	866	**582**
Derg as % of Foyle	16%	13%	20%	32%	27%	**22%**

Table 2: Annual spawning redd counts for the Foyle and Derg, 2009/10 to 2013/14 (Source: Loughs Agency).

5.5 Juvenile Salmonids

Trends in abundance of juvenile salmon and trout are monitored by the Loughs Agency through annual semi-quantitative electrofishing surveys according to a methodology developed by Crozier & Kennedy (1994). Over 450 sites are sampled each year throughout the Foyle area including 35-40 in the Derg catchment.

Figure 3 shows the average catch of trout and salmon fry at 35 - 41 survey sites on the Derg over a recent seven year period. It would appear from this data that salmon spawning is more widespread and intense than trout spawning.

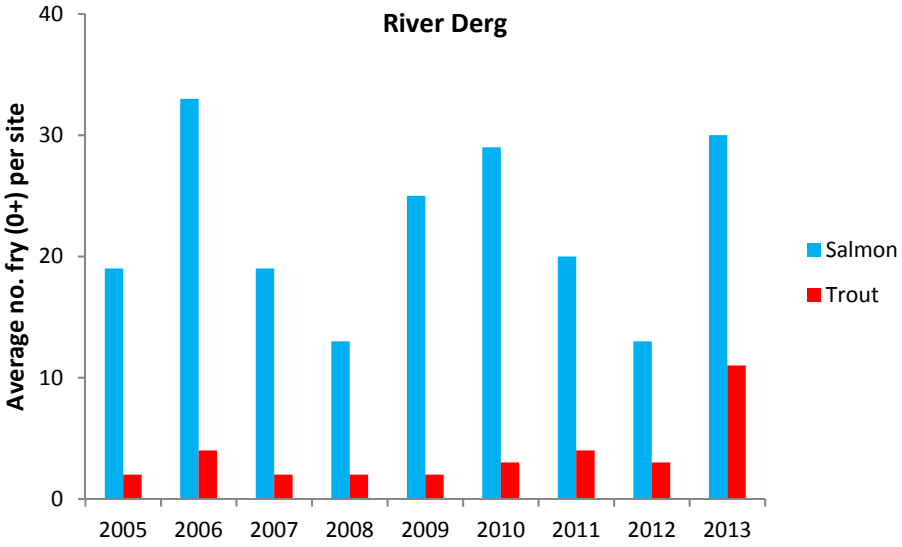

Figure 3: Salmon and trout fry index based on mean fry numbers at electrofishing sites on the Derg, 2005-13 (Source: Loughs Agency).

Fry abundance may be classified according to systems defined for trout (Kennedy, *unpublished*) and salmon (Crozier & Kennedy, 1994), each based on a calibration of the semi-quantitative electrofishing method in river reaches of known juvenile salmonid density (Table 3). On this basis salmon fry abundance has been *Excellent/Good* in 7 out of the last 9 years; trout abundance during this period has been mostly *Poor*.

Species	Abundance category	Semi-quantitative (Fry/5 min)	Quantitative (Fry/100m^2)
Trout	**Excellent**	18+	60+
	Good	9-17	32-59.9
	Moderate	4-8	17-31
	Poor/Fair	2-3	7.1-16.5
	Poor	0-1	0.1-7.0
	Absent	0	0
Salmon	**Excellent**	25+	114.6+
	Good	15-24	69.1-114.6
	Fair	5-14	41.1-69.0
	Poor	1-4	0.1-41.0
	Absent	0	0

Table 3: Semi-quantitative abundance categories for age 0 trout (Kennedy, *unpublished*) and salmon (Crozier & Kennedy, 1994).

Fry densities in the Derg for 2011 are compared with those from other leading catchments in the Foyle system in Figures 4 and 5. This illustrates that, in comparison to other rivers in the region, the Derg is in the mid-range of productivity for salmon and the lower range of productivity for trout.

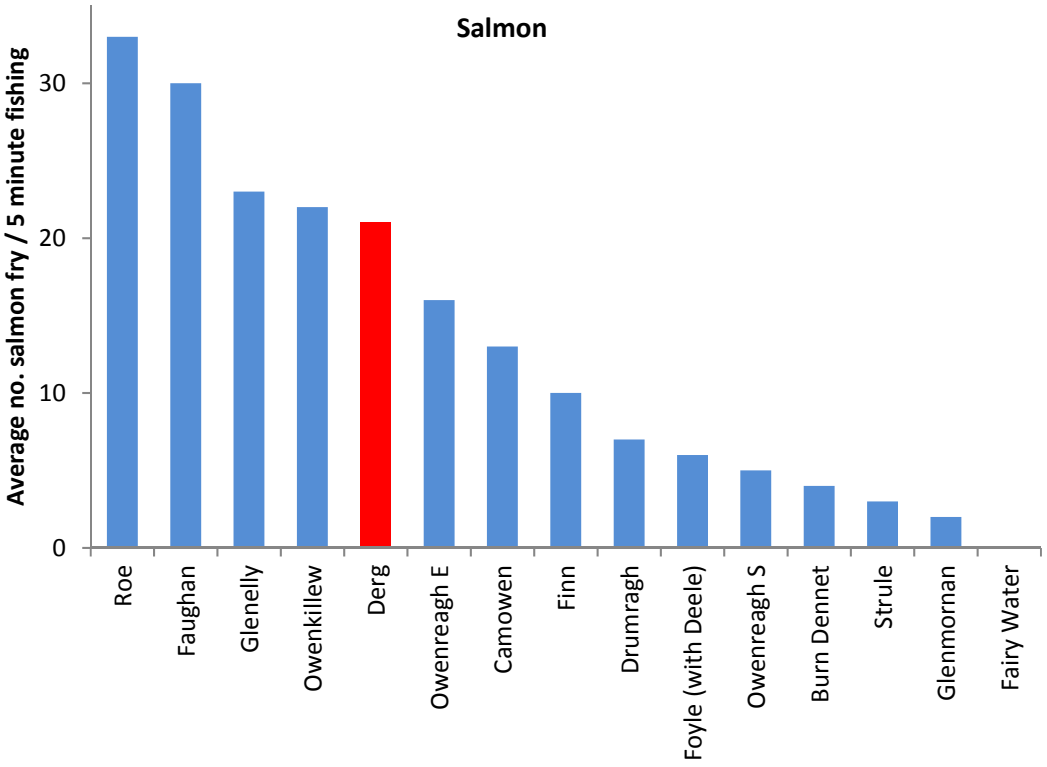

Figure 4: Salmon fry abundance index based on mean fry numbers in 15 principal catchments of the Foyle, 2016. (Source : Loughs Agency).

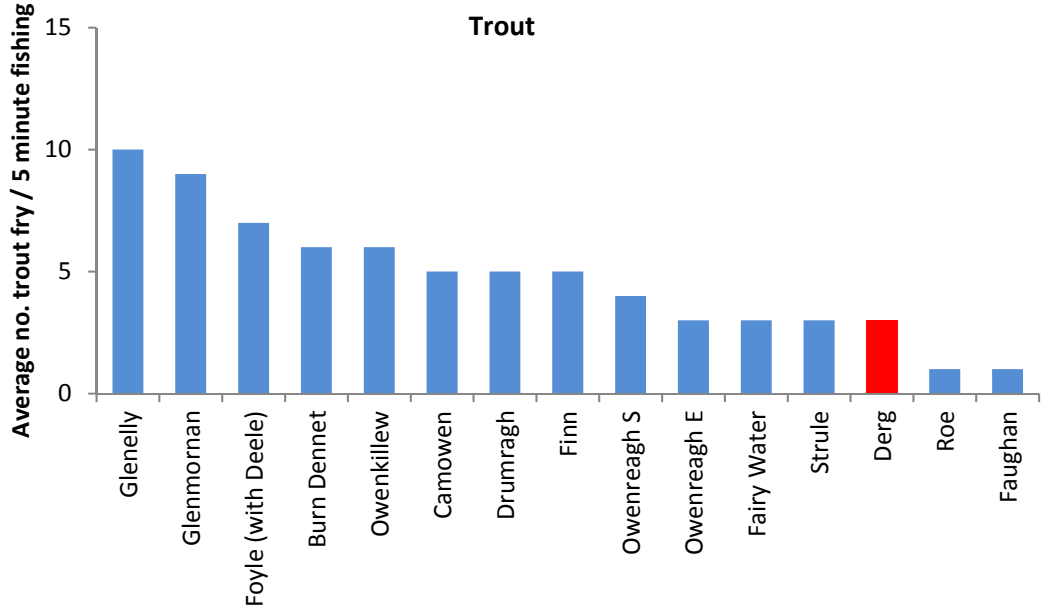

Figure 5: Trout fry abundance index based on mean fry numbers in 15 principal catchments of the Foyle, 2016. (Source : Loughs Agency).

5.6 Lamprey

The Loughs Agency has conducted a baseline survey of the River Foyle and Tributaries SAC to examine the distribution and abundance of juvenile lamprey (Niven & McCauley, 2013). A low density of River/Brook lamprey juveniles was recorded at downstream sites in the Mourne Beg with higher densities in the River Derg, notably from Castlederg downstream. Sea lamprey larvae were not detected at any sites in the Derg catchment.

5.7 Freshwater pearl mussel

Freshwater pearl mussel is noted as a qualifying feature of the SAC and a small population was still present in the Mourne River (also part of the River Foyle & Tributaries SAC) during the mid 1990s. There are no definitive records of pearl mussel in the Derg, but a recent population has been noted in a tributary of Lough Derg and is still under investigation (J McCartney, *pers comm*). The tributaries of Lough Derg are not hydrologically connected down-river of the proposed wind farm site and therefore cannot be impacted by any potential run-off from development of the wind farm.

5.8 Angling

The River Derg is one of the most productive rivers in the Foyle system and is a popular rod fishery for the local population and visitors to the area. Most of the angling downstream of Aghyaran Bridge is controlled and administered by the Castlederg Angling Club – upstream of this point the fishing rights are controlled by private estates. The season opens on 1 April and closes on 20 October but most angling takes place from June onwards.

Details of reported salmon catches from licence returns varying between 10% and 79% are shown in Table 4. These figures are adjusted by the Loughs Agency according to a methodology developed by Small (1991). This adjustment would suggest an annual catch of 200 to 850 salmon during this period with an average of 437 fish. By any standards this is a very productive angling river.

Catch statistics	2007	2008	2009	2010	2011	2012	2013	Average
% licence returns	22.1%	54.9%	43.9%	55.8%	46.0%	79.0%	10.0%	**44.5%**
Raising factor	2.06	1.25	1.38	1.24	1.35	1.08	3.7	**1.72**
Reported salmon catch	310	260	144	186	209	494	230	**262**
Adjusted salmon catch	638	324	199	230	283	533	851	**437**

Table 4: Adjustment of salmon angling catches on the Derg according to overall rate of licence/logbook return (Source: Loughs Agency).

5.9 Aquaculture

There is a commercial trout farm located on the Mourne Beg River approximately 10 km downstream of the proposed wind farm site – the unit is licensed by DAERA for the production of Rainbow trout. The farm operates by abstracting water directly from the Mourne Beg and is therefore heavily dependent on a constant supply of uncontaminated river water.

6 FIELD ASSESSMENT

6.1 Outline

Electrofishing by the Loughs Agency tends not to include sampling sites in the upper reaches of smaller tributaries in most river systems. This part of the fisheries assessment therefore sets out to obtain details on salmonid distribution in the headwater streams draining the Meenbog wind farm site.

6.2 Site Drainage and Local Hydrology

The proposed development site is drained through a series of streams connecting to the Mourne Beg and Glendergan tributaries of the River Derg (Figure 6). Further site drainage details are described in detail in Ch 8 Hydrology & Hydrogeology.

6.3 Methodology

A survey of the three main streams draining the wind farm site was carried out in September 2014 at six selected sites. All sites were examined for fisheries potential followed by juvenile fish stock surveys by electrofishing.

Electrofishing was carried out according to a semi-quantitative methodology described by Crozier & Kennedy (1994). The procedure involves two operators fishing continuously in an upstream direction for five minutes at each sampling location, using a single anode backpack electrofishing set (24V DC input; 250V, 100W 50 Hz DC output). All fish were caught using a dip net and retained for inspection and then returned to the water live. Any additional Age 0 salmonids seen but not captured were also recorded. This method is consistent with the annual Loughs Agency monitoring procedure.

Localised areas identified as potential lamprey larval habitat (stable fine sediment or sand > 15 cm deep, low water velocity and the presence of organic detritus) were sampled by adapting the electrofishing methodology as described by Harvey & Cowx, 2003).

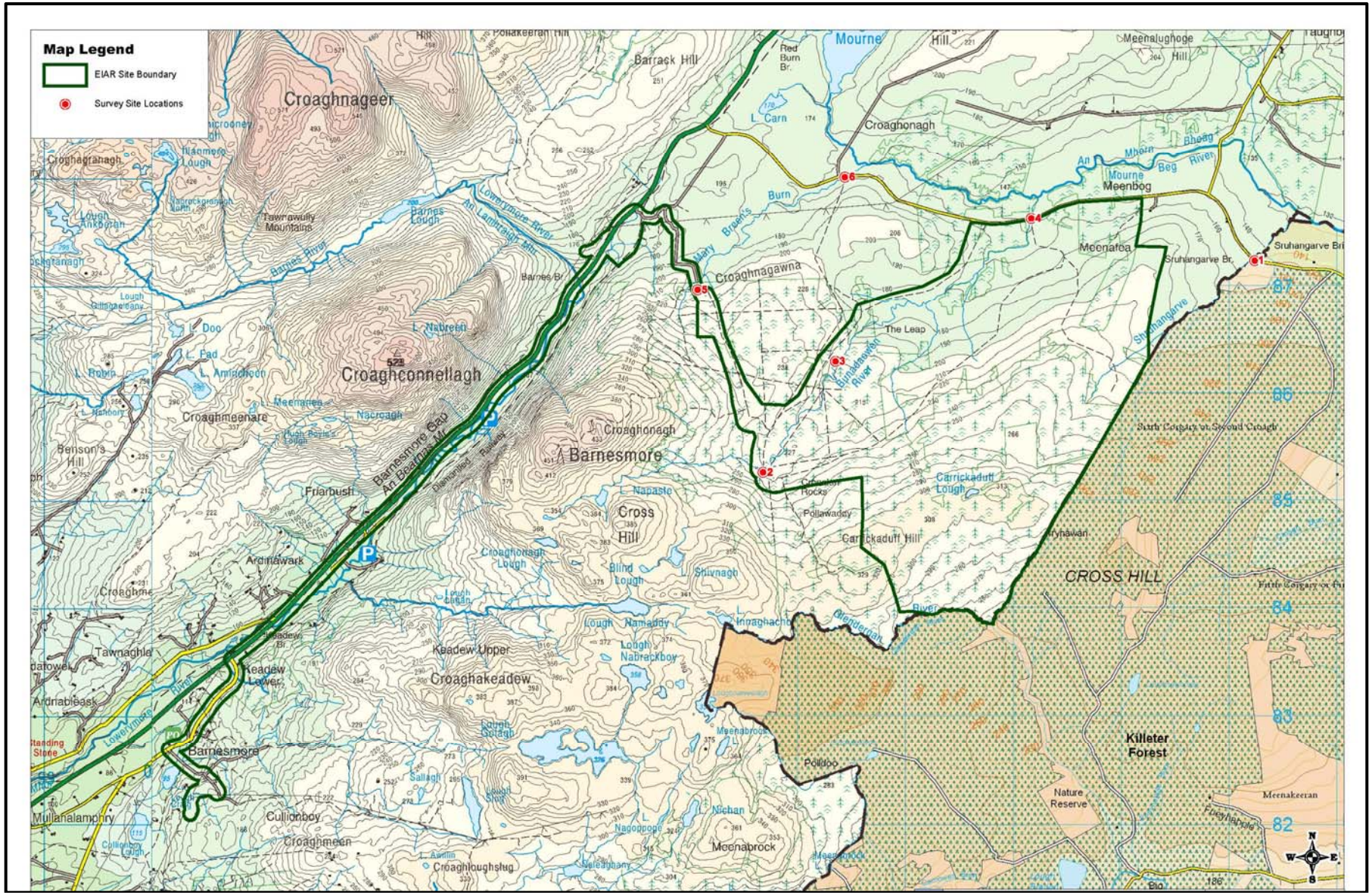

Figure 6: Location of survey sites on streams draining the proposed Meenbog wind farm site.

6.4 Fish Distribution

The survey results are presented in Table 5; as anticipated, the main fish species encountered was brown trout. A single site was assessed as being insufficient to support fish life due to poor habitat quality and was not electrofished.

Site	Stream	Grid reference	Trout		Salmon		Other species	Trout abundance
			Age 0+	Age 1++	Age 0+	Age 1++		
1	Sruhangarve	210238/387249	0	0	0	0	1 Eel	Absent
2	Bunadaowen	205681/385273	8	5	0	0	-	Moderate
3	Bunadaowen	206352/386306	5	7	0	0	-	Moderate
4	Bunadaowen	208167/387637	18	0	0	0	2 Eel	Excellent
5	Mary Breen's	205074/386978	(0)	(0)	(0)	(0)	(0)	(Absent)
6	Mary Breen's	206439/388021	15	4	0	0	-	Good

Table 5: Summary results of electrofishing survey of Mourne Beg tributaries, indicating numbers of Age 0+/1+ trout and salmon, and other species recorded at each site. Figures in brackets indicate sites not sampled but where fish were assumed to be absent.

Trout were detected in two of the tributaries and were observed to be widely distributed throughout the Bunadaowen River; salmon absent from all sites and none of the sites were adjudged suitable for lamprey larvae. Eels were the only other species noted during the survey.

Trout fry abundance index was assigned according to the classification system defined for trout (Kennedy, *unpublished*) outlined in Table 3 (See 5.5). Where present, trout were observed at *Moderate*, *Good* or *Excellent* indices of abundance.

As already noted, salmon were absent from the streams surveyed – this is believed to be a function of fish distribution rather any limiting habitat factors.

6.5 Eels

Eels were regularly observed at two sites and this is a significant finding in view of the current poor status of eel stocks in general.

Over a wider range the European eel stock has been in rapid decline since around 1980, and the species has recently been added to the IUCN Red List of Threatened Species in the category of *Critically Endangered*. The European Eel Regulation (EC) 1100/2007 aims to establish measures for the recovery of the stock through action by Member States to implement Eel Management Plans in each eel river basin, in this case the North Western International River Basin District.

6.6 Stream Details

Habitat details in the three streams are summarized in the following paragraphs:

6.6.1 Sruhangarve Burn

Outline Description: Moderate quality stream; low conductivity.

Fisheries Interest:

- *Within site boundary:* Minor
- *Downstream of site:* N/a – located within site and along site boundary.

Fish stocks: Eel.

Annex II species*:* None.

Site 16 Lower section.

6.6.2 Bunadaowen River

Outline Description: Good quality stream trout throughout.

Fisheries Interest:

- *Within site boundary:* Significant
- *Downstream of site:* N/a – located within site and along site boundary.

Fish stocks: Brown trout, eel

Annex II species*:* None.

Site 17 Good nursery stretch.

Site 18 Near waterfall and abstraction point.

Site 19 Up to 8m wide; good trout habitat.

6.6.3 Mary Breen's Burn

Outline Description: Poor quality stream but significant fish stock; ferric run-off evident.

Fisheries Interest:

- *Within site boundary:* N/a
- *Downstream of site:* Significant

Fish stocks: Brown trout

Annex II species*:* None

Site 17 Cobble bed but very low flow.

Site 18 Riffle/glide habitat.

7 IMPACTS ON FISH/FISH HABITATS AND ASSOCIATED MITIGATION MEASURES

7.1 Description of Impacts

Impacts are described in accordance with the definitions provided in the Glossary of Impacts contained in the guidance documents produced by the Environmental Protection Agency (EPA):

- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003)
- Guidelines on the Information to be contained in Environmental Impact Assessment Reports – Draft August 2017 (EPA 2017)

The glossary of impacts as published in the EPA guidance documents is summarised in Table 6.

Impact Characteristic	Qualification	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error
	Negative	A change which reduces the quality of the environment
Significance	Imperceptible	An effect capable of measurement but without significant consequences
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate	An impact that alters the character of the environment in a manner consistent with existing and emerging trends
	Significant	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends
	Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
	Profound	An impact which obliterates sensitive characteristics
Duration & Frequency	Momentary	Effects lasting from seconds to minutes
	Brief	Effects lasting less than a day
	Temporary	Effects lasting less than a year
	Short-term	Effects lasting one to seven years
	Medium-term	Effects lasting seven to fifteen years
	Long-term	Effects lasting fifteen to sixty years
	Permanent	Effect lasting over sixty years
	Reversible	Effects that can be undone, for example through remediation or restoration
	Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
Type	Indirect	Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway
	Cumulative	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	'Do Nothing'	The environment as it would be in the future should the subject project not be carried out

Worst Case'	The effects arising from a project in the case where mitigation measures substantially fail
Indeterminable	When the full consequences of a change in the environment cannot be described
Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost
Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
Synergistic	Where the resultant effect is of greater significance than the sum of its constituents

Table 6: Impact Classification Terminology (EPA, 2017)

7.2 "Do Nothing" Impact

A significant area of the land that forms the site of the proposed development is currently under forestry plantation.

If the proposed wind energy development does not proceed, it is assumed that the character of the landscape and its uses will remain much as they are today i.e. that forestry will dominate the site and that mature trees will be harvested and felled areas replanted to maintain forestry rotation in the area. Since the area of forestry that will be felled to make way for the development footprint is relatively small, the main land use of the area will effectively remain as forestry, with land use for wind energy being superimposed over forestry during the lifetime of the proposed development.

The proposed development will provide green energy that can partly replace power generation methods that produce carbon dioxide emissions. The development will be responsible for virtually no carbon emissions in the operational phase, and will contribute to the slowing or reversal of climate change.

An EPA study has considered the potential Impacts of Climate Change on Biodiversity in Ireland (Sweeney et al, 2003); among fish species the salmon was highlighted along with Arctic char as being particularly susceptible to climate change by 2055 with a negative response to changes in temperature and rainfall, and a vulnerability rank of Medium-High.

Clearly these are major concerns for the future and will have the potential to impact not only on water quality through reduced dilution, but will also have implications for salmon in other ways. Increasing water temperatures will lead to alterations in the aquatic community in general. With regard to salmon higher temperatures may reduce egg survival, retard fish growth, and increase stress and susceptibility to disease. There is also evidence that salmon smolts are leaving rivers earlier and it has been suggested that this may be a factor in reduced marine survival rates. Moreover, changing rainfall patterns are leading to more concentrated periods of rain leading to flash floods which has resulted in the wash-out of spawning gravels and salmon redds in some Scottish rivers. At the other end of the scale, longer periods without rain could limit the distribution of spawning fish throughout river catchments.

It is possible that part of the cumulative 'Do Nothing' impact for this and other renewable energy developments will accelerate the loss of salmon and other aquatic species from their range of distribution in Ireland as a whole.

7.3 Hydrological Connection to SACs

The proposed wind farm site drains into two key tributaries of the River Derg, the Mourne Beg and the Glendergan, both of which are included the River Foyle and Tributaries SAC in Northern Ireland. Similarly, a 9 km reach of the Mourne Beg along the border is included in the River Finn SAC in the Republic to mirror the designation in the north.

the proposed wind farm site has direct hydrological connection to the above SAC channels via a series of principal drainage streams, and therefore a number of potential routes for run-off of suspended solids or other adverse materials to either designated site.

7.4 Trans-frontier Impacts

The location of the proposed site adjacent to the international boundary between the Republic of Ireland and Northern Ireland, combined with the hydrological connection with the River Foyle system in Northern Ireland, implies that any significant impacts resulting from the development could have trans-frontier implications.

The following discussion of potential impacts, mitigation measures and residual impacts does not distinguish between trans-frontier impacts and internal impacts, but does highlight potential impacts on the two designated SACs hydrologically connected to the proposed site and located within the two national jurisdictions.

7.5 Impacts during Preparation and Construction Phases

7.5.1 Run-off of Suspended solids

Salmonid fish are particularly sensitive to reductions in water quality and habitats can be damaged by siltation from settlement of Suspended Solids (SS) (Alabaster & Lloyd, 1980). This is recognised through the EC Freshwater Fish Directive which specifies a normal maximum SS concentration of 25 mg/l for salmonids, although a precautionary target of less than 10 mg/l (annual mean) is recommended for most river reaches by JNCC (2005).

The impacts of SS on fish have been reviewed by Bilotta & Brazier (2008) who confirm that there are a range of potential impacts notably with regard to the deposition of sediments in salmonid spawning areas of rivers and its impact on development on eggs and fry. There can also be a direct effect on fish gills either through physical damage to the gill tissue or through clogging of the gills with waterborne particulate matter.

The settlement of sediments on the substrate can smother invertebrates and fish eggs, while the infiltration of coarse sediments (gravel and cobble) with fines can have longer term implications for the productivity of both groups. The characteristics of the riverbed are critical for fish spawning (Fluskey 1989), and the tolerance of salmon eggs to sedimentation has been examined on the River Bush by O'Connor & Andrew (1998) who found that alevin survival was closely related to the level of fines with impacts detectable at a level of 10% fines.

The discharge of suspended solids could result from:

- Clear felling of coniferous plantation
- Earthworks – removal of vegetation cover, excavations and stock-piling
- Erosion around new structures at watercourse crossings
- Road run-off

Much of the natural drainage at each site will be by soakage rather than direct run-off. However, whenever the ground is saturated a high percentage of the rainfall will run off quickly to receiving

watercourses. The main risk to these streams will therefore be during and following periods of heavy and sustained rainfall; such events are more likely during the autumn/winter period.

There is a direct hydrological connection with two SACs incorporating the Mourne Beg river (River Foyle & Tributaries (NI); River Finn (RoI)), and therefore a potential route for suspended solids run-off from proposed site. Corgary Trout Farm is also located on the Mourne Beg River approximately 10 km downstream of the site, and would therefore be subject to any elevation in suspended sediments during the construction phase. This would have the potential to affect fish feeding and growth rates or, in an extreme case, to cause gill damage possibly leading to fish mortalities.

Similarly, the proposed grid connection route follows the course of the Lowerymore River and will require a series of watercourse crossings of both the main river and small adjoining streams, with the potential for run-off of sediment. The river channel and terminates just before the upstream limit of the SAC at Keadew Bride

Impact Assessment
Impacts from run-off of suspended solids have the potential to be:

- Negative
- Significant
- Short to Medium-term
- Cumulative

Mitigation (by Avoidance)
It is important that sensitive aquatic areas of the site should be avoided during the construction phase. To this end a 50m wide watercourse buffer zone has been applied with regard to significant watercourses as detailed in Chapter 9: Hydrology & Hydrogeology.

Mitigation (by Design)
Chapter 9 (Hydrology & Hydrogeology) describes a series of construction phase runoff control measures with source controls, in-line controls and treatment systems to ensure that there will be a negligible impact on the suspended sediment load in surface waters draining from the site. A water treatment train will also be put in place to filter and treat all surface discharge water collected in the dirty water drainage system, and silt fences will be deployed down-gradient of construction areas that drain towards on-site natural streams. In addition, a pre-emptive site drainage management will be applied to take account of predicted rainfall so that large excavations and internal transportation of peat/subsoil or vegetation stripping can be suspended or scaled back when heavy rain is forecast.

With regard to new stream crossings bottomless culverts will be used where possible, to avoid instream works and disturbance of banks. Where near stream construction work is required, double row silt fences will be erected immediately down-gradient of the construction area and maintained during the construction phase. Watercourse crossings on the grid connection route will employ construction methodologies which have been designed to eliminate the requirement for in-stream works. In most cases a trench will be excavated above existing culverts to install the duct which will contain the cable. Crossings of the main channel Lowerymore River will be beneath the riverbed by means of either Directional or Horizontal Drilling.

These measures will prevent the run-off of excess sediments via the streams directly draining the site to key adjoining watercourses, in particular the three designated SACs.

Mitigation (by Timing of Works)
The Loughs Agency's Guidelines for Fisheries Protection during Development Works (2011b) recommends that instream river works should be avoided during the salmonid spawning season and egg incubation phases, 1 October – 30 April. As there are no significant instream works required in

this development, restrictions on timing of construction need not apply. However, it is recommended that to minimise the risk of suspended sediment entrainment in surface water run-off, the site drainage system should only be constructed during periods of low rainfall and therefore minimum run-off rates.

Residual Impacts
With the recommended mitigation measures in place the residual impacts from run-off of suspended solids will be Neutral.

7.5.2 Release of other pollutants

As the development site drains directly to a series of tributaries and thence to the Mourne Beg and the Derg, there is some potential for spillage or release of diesel, oil or other polluting substances to reach any of these channels with consequences for resident fish together with invertebrate organisms.

During site development with high usage of plant fuel and oil there is clearly an increased risk of accidental spillage and discharge to the river. Similarly, the application of concrete slurries in construction processes carries some risk of inadvertent discharge with the potential to impact on wild fish stocks and also on Corgary Trout Farm.

Impact Assessment
Impacts from the release of pollutants have the potential to be:

- Negative
- Significant
- Short to Medium-term

Mitigation (by Design)
Chapter 9 (Hydrology & Hydrogeology) outlines a series of measures to mitigate the probability of runoff of hydrocarbons including:

- Storage of fuels on-site to be minimised
- On site re-fuelling of machinery using mobile double-skinned fuel bowser according to clearly defined refuelling protocol.
- On-site storage of fuels will be minimised

The proposed drainage system for the site including detention basins will also facilitate the interception of diesel, oil or other polluting substances during the construction phase.

Mitigation (by Management)
All precautions will be taken to avoid spillages of diesel, oil or other polluting substances during the construction phase. This may be achieved through good site practices and in line with EPA Integrated Pollution Prevention Control procedures.

In addition, the Environmental Management Plan will contain an emergency plan to deal with accidental spillages during the construction phase of the project.

Residual Impacts
With the recommended mitigation measures in place the residual impacts from the release of pollutants will be Neutral.

7.6 Impacts during Operational Phase

7.6.1 Habitat loss at culvert sites and main watercourse crossings

A watercourse crossing may result in significant loss of habitat if an extensive length of channel is enclosed in a culvert structure, particularly where the original channel bed is lost and cannot be restored. Unnecessary removal of bed materials at stream crossing points can also result in long term loss of habitat, loss of channel diversity and damage to invertebrate food organisms.

As noted above bottomless culverts will be used where possible new stream crossings, to preserve the streambed and existing aquatic habitats. There will therefore be no perceptible loss of habitat or reduced productivity at stream crossings on the proposed development site.

Impact Assessment
Impacts due to habitat loss have the potential to be:

- Neutral
- Imperceptible

Mitigation
No specific measures required.

Residual Impacts
None.

7.6.2 Fish Passage – permanent obstruction/inhibition

There is likely to be a degree of localised fish migration within the proposed site boundary in some of the site drainage streams. Poorly designed or improperly installed culverts at crossing points on these streams could result in obstruction of the stream channel preventing fish migration during critical periods e.g. spawning.

Impact Assessment
Impacts due to the obstruction of fish passage have the potential to be:

- Negative
- Significant
- Permanent

Mitigation (by Design)
A series of reports have been produced on the issues relating to river crossings and migratory fish, with recommended procedures to avoid impacts (Loughs Agency, 2011; Anon, 1998; ERFB 2004).

The design principles outlined by the Loughs Agency should be followed at significant on-site stream crossings:

- Culverts should be as short as possible
- Where the topography allows, they should be laid so as to remain backwatered in drought flow to a depth of not less than 500mm at the upstream invert, thereby providing a fishway over their full length.
- In all cases, provisions must be made to ensure that the velocity of flow will be less than the swimming speed which can be comfortably maintained by the weakest upstream migrants.
- Transition pools should be formed at each end to allow upstream migrants to enter and exit without stress or delay.

New crossings of significant watercourses will utilise bottomless culverts where possible to comply with the above conditions. Minor watercourse crossings required within the site will not interfere directly with fish movements as it is unlikely that fish will be present at these locations. Standard culverts will be adequate at these locations but should be installed in a way that will minimise the release of suspended solids into the watercourse to avoid impacts further downstream.

Residual Impacts
With the recommended mitigation measures in place the residual impacts in terms of the obstruction of fish passage will be Neutral.

7.6.3 Surface Water Run-off

Surface water run-off from hard surfaced areas (i.e. access tracks, hardstands, control building area) have the potential to lead to excess discharge of suspended solids to the receiving watercourses with impacts on fish and other forms of aquatic life as outlined above.

Wash-out of storage areas of excavated peat/subsoil during or following periods of heavy rainfall have the potential to result in run-off of suspended solids to the receiving watercourses with potential increases in sediment load impacting on fish stocks, habitats and the nearby trout farm.

Impact Assessment
Depending of the sensitivity of individual watercourse, impacts due to the run-off of suspended solids have the potential to be:

- Negative
- Significant
- Long-term

Mitigation (by Design)
Chapter 9 (Hydrology & Hydrogeology) outlines a series of measures to be implemented with regard to the control and attenuation of surface water run-off including:

- Stilling ponds to buffer runoff from the drainage system during periods of high rainfall
- Reduction in flow velocity of discharge water by stilling ponds
- Check dams along the drainage route to reduce the velocity of flow thereby preventing channel erosion
- Vegetation filters to receive drainage water from overland flow, will remove suspended sediment
- No direct discharge of development storm water into the existing natural watercourses within the site.

These measures will prevent the run-off of excess sediments to the River Foyle & Tributaries SAC via the streams directly draining the site.

Residual Impacts
With the recommended mitigation measures in place the residual impacts from run-off of suspended solids will be Neutral.

7.7 Impacts during De-commissioning Phase

The decommissioning process will involve the removal of all above ground structures, and reinstatement of disturbed areas. Access tracks will remain for farm and forestry use.

Impact Assessment
The impacts of decommissioning are likely to be similar to those of construction although probably of lower magnitude, as it is unlikely that any of the structures at or near to primary watercourses will be removed or modified in any way.

Impacts will therefore have the potential to be:

- Neutral
- Imperceptible

Mitigation
No specific measures required.

Residual Impacts
None.

8 CUMULATIVE IMPACTS

8.1 Additional Developments

This section considers other wind farm developments within a 20 km radius which have either been constructed or are at different stages of the planning process in RoI or NI. Along with the proposed wind farm at Meenbog, these developments/proposals could give rise to the potential cumulative impacts on local rivers, in particular the River Derg in the context of its SAC status on both sides of the border.

With regard to fisheries and the aquatic environment, the potential for cumulative effects is only relevant when proposed or existing developments are either hydrologically connected or which drain to the same receiving environment. It is therefore more important to consider additional developments in the context of river catchments, both locally and on a wider river basin scale.

Within a 20 km radius of the Development a total of 16 additional wind farm developments have been identified which are located within River Derg catchment and might therefore be considered to have the potential for cumulative impacts on the river (Table 7). Currently there are 28 turbines operational within the catchment with a potential for 91 additional turbines and associated infrastructure including the Meenbog development.

Windfarm Name	RoI/NI	No. of turbines	Status Nov 2017
Crighshane	NI	14	Operational
Lough Hill	NI	6	Operational
Church Hill	NI	8	Operational
Meenagrauv	RoI	1	Permitted
Tievenamenta	NI	15	Permitted
Bin Mountain	NI	6	Permitted
Seegronan	NI	6	Permitted
Altgolan	NI	7	Under Appeal
Meenablagh	NI	11	Under Appeal
Church Hill Ext	NI	1	Proposed
Crighshane Ext	NI	4	Proposed
Crilly Tullylinn	RoI	4	Proposed
Gronan	NI	4	Proposed
Meenakeeran	NI	4	Proposed
Meenamullen	NI	4	Proposed
Seegronan Ext	NI	3	Proposed
	TOTAL	**100**	

Table 7: Additional wind farm developments within 20 km radius of Meenbog and located within the River Derg catchment.

All of the projects listed above have had or will involve civil engineering works including land excavation to a greater or lesser extent and possibly including in-river works, each with the potential for similar effects on the aquatic environment including fisheries. As such there is the potential for the run-off of sediments to local watercourses with resultant damage to aquatic fauna and habitats.

There are a further 15 operational and 7 permitted developments within a 20 km radius of Meenbog, but not within the Derg catchment (Table 8), and therefore with no potential for cumulative impact on the aquatic environment.

Windfarm Name	RoI/NI	No. of turbines	Status Nov 2017
Cark	RoI	25	Operational
Lough Golagh	RoI	25	Operational
Culliagh	RoI	18	Operational
Culliagh Extn	RoI	3	Operational
Cark/Largymore	RoI	9	Operational
Meentycat 1	RoI	9	Operational
Meehahorna	RoI	7	Operational
Meenlaban	RoI	7	Operational
Anarget	RoI	6	Operational
Ballystrang	RoI	6	Operational
Cark Extension	RoI	6	Operational
Meenadreen	RoI	4	Operational
Meenagrauv	RoI	4	Operational
Ballystrang	RoI	6	Operational
Meenanilta	RoI	6	Operational
Meenagrauv II	RoI	1	Permitted
Dromnahough	RoI	15	Permitted
Lenalea	RoI	9	Permitted
Lough Cuill	RoI	8	Permitted
Croaghnameal	RoI	7	Permitted
Meenadreen Ext	RoI	5	Permitted
Altilow	RoI	1	Permitted
	TOTAL	**191**	

Table 8: Additional wind farm developments within 20 km radius of Meenbog but not located within the River Derg catchment.

8.2 Assessment

The greatest risk to fisheries and the aquatic environment is during the construction phase of these projects when the civil engineering works are carried out. It follows that it is vital for the highest standards to be maintained with regard to site preparation, temporary works and site drainage issues, and that full mitigation measures must be applied to remove any potential for this type of incident.

There is no evidence that existing wind farm developments in the area have had any adverse impact on the River Derg catchment which in turn could have affected the integrity of either of the two designated SAC sites.

The likelihood of significant cumulative impacts on the aquatic environment is increased if two or more wind farms are to be constructed or decommissioned simultaneously. The likelihood of simultaneous construction cannot be determined at this stage but, provided high standards of construction and site management are maintained in subsequent developments, the development of the proposed wind farm at Meenbog with specific mitigation measures as outlined, should not contribute to any cumulative impact with other similar developments in the Derg catchment.

Implementation of the mitigation measures as described will ensure that the proposed Meenbog development will not contribute to any cumulative impact on either of the designated SAC sites, in particular on Atlantic salmon as a leading selection feature of each site.

9 CONCLUSION

The proposed Meenbog wind farm development is located in the headwaters of the River Derg which is subject to SAC designations in RoI and NI due to its stocks of Atlantic salmon. The principal risk to fish and the aquatic environment will be during the construction phase of the proposed development.

A series of specific mitigation measures have been designed to prevent negative impacts on fisheries with regard to construction and operational phases of the project. Implementation of these measures will mitigate any effects relating to run-off of suspended sediments, release of pollutants, loss of habitat and obstruction of fish passage, thus ensuring that the overall significance of effects will be neutral with regard to fish stocks and aquatic biology of the River Derg system as the sensitive receptor.

In relation to the SAC designation of the Derg on both sides of the border, construction and operation of the proposed wind farm will have no effect on the conservation objectives or status of the site in either jurisdiction. Similarly, the works required to deliver the grid connection will have a neutral effect on the Lough Eske and Ardnamona Wood SAC.

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