N4 Collooney to Castlebaldwin, *Proposed Road Development*

APPENDIX NO. 12.6

AQUATIC ECOLOGY AND FISH ASSESSMENT

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1 Introduction

In order to provide a baseline assessment of the fish populations present in watercourses affected by the proposed N4 Collooney to Castlebaldwin Realignment, a five site quantitative electrical fishing survey was undertaken during June 2006. In July of 2013, electrical fishing was repeated at selected sites and two additional sites were examined taking account of the extension to the northern end of the study area. These surveys were carried out under a Section 14 licence issued by the Department of Communications, Marine and Natural Resources.

An on-site meeting with Inland Fisheries Ireland (IFI) staff, formerly the North Western Regional Fisheries Board (NWRFB), took place on 15th June 2006. Consultation was also undertaken prior to the 2013 assessments.

This Aquatic Ecology and Fish Assessment has been informed by survey work undertaken within the study area between 2006 and 2013. Taking account of the elapsed time between the original baseline survey and the preparation of the current report, it was considered necessary and appropriate to undertake an updated assessment of the watercourses within the study area during 2012 and 2013. This updated assessment built on the existing baseline data and provided verification that the watercourse character and biological conditions had not been significantly altered in the interim. The updated field survey included sampling of aquatic macroinvertebrates and aquatic habitat evaluations of all affected watercourses during July 2013.

2 METHODOLOGY

The electrical fishing surveys (Bohlin *et al*, 1982) were undertaken using a Smith-Root LR-24 portable electrical fishing unit. These studies were undertaken during June 2006 and July 2013. The machine was set up using the automatic set up routine, which automatically sets the machine according to site conductivity and water depth. The anode handle of this machine consists of fibreglass and is equipped with a safety switch and a steel ring shaped electrode (diameter 300 mm). The steel ring electrode was fitted with a fine mesh net (1 mm) to facilitate fish collection during the survey. The cathode – a single 'rat tail' wire - was allowed to trail behind the operator. Two operators (both wearing insulated chest waders) undertook the surveys. The machine was secured on the back of one operator who also held the anode. The assistant held an insulated dip net (mesh size 1 mm; 40 cm x 40 cm frame, handle length 182 cm) for collecting fish that fail to be captured by the operator.

Sites were closed off using heavy duty fine mesh stop nets (mesh size 3 mm; 1.21 m x 9.14 m net) with bottom weights and floats. During the 2013 survey, quantitative fishing's were undertaken on the Drumfin River at Behy Bridge on the existing N4 corridor and at Kilmorgan Bridge upstream of the proposed road, on the Turnalaydan Stream (i.e. the Lough Corran outflow) at the existing N4 crossing and on the tributary of the Drumderry Stream. Semi-quantitative surveys were undertaken at the other sites. Electrical fishing followed the Central Fisheries Board (now IFI) manual '*Electric Fishing in Wadeable reaches*' (CFB, 2008).

A minimum of three passes were made in each enclosure on the quantitative sites, with a twenty-minute rest period after each sampling effort. Only one pass was made at the semi-quantitative sites. Sampling areas at each site were fished in a zigzag manner. A fishing operation was started with the gear constantly 'on' followed by a regular on/off sequence. While the gear was 'on' the anode was slowly pulled backwards in the water. This encourages fish caught in the field to swim towards the electrode by the process of 'electrotaxis'. The stunning of fish ('electronarcosis') was avoided by reducing the voltage appropriately when this behaviour was observed. Captured fish were removed quickly using the anode net or dip net and placed into a container of river water.

Surveys were completed after a minimum of 20 minutes continuous fishing. After each survey was completed, all captured fish were anaesthetised using a 0.05% solution of tricaine methanesulphonate (MS-222). Fish were measured to the nearest millimetre on a measuring board. Fish from each pass were retained separately for identification, enumeration and measurement of length and weight. Minimum densities were calculated using the Leslie-Davies Method. Ages of fish were estimated using the Peterson length frequency distribution method. Results of the electrical fishing investigations were presented as a minimum density estimate (number m^{-2}). All fish were released alive and spread evenly over the sampling area at the end of the investigation.

It is noted that a watercourse marked on OSI mapping in the townland of Mullaghnabreena was examined as part of the current survey. This 'channel' was found to be unsuitable for fish, as there was no surface water. At the time of the survey, the course of this channel was comparable to a marsh, though it is likely to carry surface water in winter.

At each survey location, searches were carried out for fluvial deposits of fine sand/silt. Where present, electrical fishing was carried out for juvenile lampreys following methodology outlined in O'Connor (2004).

Qualitative sampling of benthic (or bottom dwelling) macroinvertebrates was undertaken at selected (index) sites using kick-sampling (Toner *et al*., 2005) during June 2008, October 2012 and July 2013. Only the results of the 2013 investigations are presented in detail here. This procedure involved the use of a 'D' shaped hand net (mesh size 0.5 mm; 350 mm diameter) which was submerged on the river bed with its mouth directed upstream. The substrate upstream of the net was then kicked for one minute in order to dislodge invertebrates, which were subsequently caught in the net. This procedure was undertaken at three points along/across the watercourse. Stone washings and vegetation sweeps were also undertaken to ensure a representative sample of the fauna present at each site was collected.

The EPA Quality Rating (Q) System (Toner *et al*., 2005) was used to obtain a water quality rating for each site. Macroinvertebrate taxa are grouped according to their sensitivity to organic pollution; with the most sensitive taxa classified as Group A to those taxa identified as being most tolerant classified as Group E. The general characteristics of the biological Quality Classes and the Quality Rating System are set out in Table 1 below.

Any white-clawed crayfish seen during electrical fishing and biological sampling were recorded. Other methods used for the capture of White-clawed Crayfish were hand searching and sweep netting where methodology followed O'Connor *et al*. (2009). One hundred potential White-clawed Crayfish refuges (ten patches each with ten potential refuges) were examined by hand searching at Toberscanavan Lough. Ten traps evenly spaced along a rope were set on the evening of 10th July on Lough Corran. Sweep netting was also carried out at both of these locations.

Table 1 General characteristics of the various biological Quality Classes of the Quality Rating System (note: intermediate scores, e.g. Q4-5 are also possible).

Quality classes	Class A		Class B	Class C	Class D	
Q ratings	Q5	Q4	Q3-4	Q3	Q2	Q1
Pollution status	Pristine, unpolluted	Unpolluted	Slight pollution	Moderate pollution	Heavy pollution	Gross pollution
Fishery potential	Game fisheries	Good game fisheries	Game fish at risk	Coarse fisheries	Fish usually absent	Fish absent

2.1 Location of sites

Site locations are provided in Table 2. The physical characteristics of these electrical fishing sites are given in Table 3. 2006 survey work was completed during the period 13th to 15th June 2006 under the supervision of Inspector Peter Collins of IFI. The most recent (2013) surveying was carried out between 9th and 12th July.

Table 2 Locations of the electrical fishing and macroinvertebrate sampling sites during the 2006, 2012 and 2013 surveys.

Site	Waterbody and location	Electrical fishing and macroinvertebrate sampling (2006)	Macroinvertebrate sampling (2012)	Electrical fishing (2013)	Macroinvertebrate sampling and/or White-clawed crayfish surveying (2013)
1	Markree Demesne Stream / Toberscanavan Lough Outflow stream	-		✓	✓
2	Toberscanavan Lough, north- eastern side	-		-	✓
3	Turnalaydan Stream / Lough Corran outflow downstream of existing N4	✓	✓	✓	✓
4	Lough Corran, north-eastern side	-		-	✓
5	Turnalaydan Stream / Lough Corran inflow, upstream of proposed new road			✓	
6	Drumfin River at Behy Bridge	✓	✓	✓	✓
7	Drumfin River at Kilmorgan Bridge	✓		✓	✓
8	Springfield Stream /	-	✓	✓	

Site	Waterbody and location	Electrical fishing and macroinvertebrate sampling (2006)	Macroinvertebrate sampling (2012)	Electrical fishing (2013)	Macroinvertebrate sampling and/or White-clawed crayfish surveying (2013)
	Loughmeenaghan outflow south of Swallow Hole				
9	Lissycoyne Stream ca. 1km east of Loughmeenaghan	-	✓	✓	
10	Drumderry Stream / Lough Arrow inflow ca. 0.5km south east of Castlebaldwin		✓	-	
11	Drumderry Stream tributary ca. 0.5km south of Castlebaldwin at existing N4	✓		✓	✓

Note: Electrical fishing at Site 5 was solely for juvenile lampreys given restricted accessibility.

3 RESULTS

3.1 Fish

3.1.1 Species recorded

The fish species recorded at each site investigated during the June 2006 and July 2013 electrical fishing survey of watercourses affected by the proposed N4 Collooney to Castlebaldwin Realignment are listed by site in Table 4. Overall a total of seven species of fish were recorded; Atlantic salmon *Salmo salar*, Brook lamprey *Lampetra planeri*, Eel *Anguilla anguilla*, Brown trout *salmo trutta*, Three-spined stickleback *Gasterosteus aculeatus*, Rudd *Scardinius erythropthalmus* and Perch *Perca fluviatilis*. The Annex II White-clawed crayfish *Austropotamobius pallipes* was recorded at Site 1 on the Toberscanavan Lough outflow Stream. Both Atlantic salmon and Brook lamprey are also listed under Annex II of the EU Habitats Directive (1992).

Overall a total of 402 fish were intercepted, of which trout (n=198) and Atlantic salmon (n=136) were the most common. Salmon were present at both sites investigated on the Drumfin River and also on the sites surveyed on the Turnalaydan Stream (the Lough Corran outflow) and the Toberscanavan Lough outflow. Trout were present at all sites with the exception of the Springfield Stream (Site 8) and the Lissycoyne Stream (Site 9). The Turnalaydan Stream upstream of Lough Corran is heavily modified, being deepened and channelised. Standard electrical fishing could not be carried out at this location due to the soft substrate and the extent of emergent vegetation. Adult brown trout were seen in the river at this location however.

European eel was recorded in the Turnalaydan Stream (the Lough Corran outflow), the Toberscanavan Lough outflow stream and in the Drumfin River but numbers were considered low. Altogether, only seven eels were recorded during the current assessment. The classification of the European eel as 'Critically Endangered' is a reflection of its significant International decline (King *et al*, 2011).

Three-spined stickleback were recorded in the Drumfin River at both sites, in the Turnalaydan Stream, the Lissycoyne Stream and in the Toberscanavan Lough outflow stream.

During the current assessment, the Toberscanavan Lough outflow Stream was found to support the seven fish species previously mentioned, as well as White-clawed crayfish.

3.1.2 Size characteristics

The length percentage frequency distribution of salmon and brown trout captured on the Turnalaydan Stream, the Drumfin River at Behy Bridge, the Drumfin River at Kilmorgan Bridge, and the tributary of the Drumderry Stream are shown in Figures 1. Evidence of recent recruitment was recorded at all sites where salmonids were present (i.e. trout and salmon spawning takes place in these areas). Based on the age structure of the salmonids present at the surveyed sites, watercourses in the study area are used primarily for the spawning and early life stages of trout and salmon.

3.1.3 Densities (quantitative assessments)

Figure 2 presents depletion lines, Leslie-Davies method, for the numbers of Salmon and Brown trout captured during the quantitative electrical fishing investigations during the July 2013 survey. The minimum density estimations (fish m^{-2}) for salmon and trout at these sites are presented in Table 6. In the current study, estimated juvenile salmon densities were 0.41 fish m^{-2} (Drumfin River at Kilmorgan Bridge), 0.78 fish m^{-2} (Drumfin River at Behy Bridge) and 1.27 fish m^{-2} (Turnalaydan Stream). The estimated densities of trout ranged from 0.32 fish m^{-2} (Drumfin River at Kilmorgan Bridge), 0.41 fish m^{-2} (Drumfin River at Behy Bridge), 0.75 fish m^{-2} (Turnalaydan Stream) to 1.88 fish m^{-2} in the tributary of the Drumderry Stream.

Brook lamprey was recorded in the Turnalaydan Stream and in the Toberscanavan Lough outflow Stream. There was little habitat for juvenile lampreys in the Turnalaydan Stream at Site 3. At this location, only one brook lamprey was recorded in an area of $3m^2$ (0.3 fish m^{-2}). There was more suitable habitat for juvenile lampreys in the Turnalaydan Stream upstream of Lough Corran, but no lampreys were recorded in a area of $4m^2$, an area considered ideal for ammocoetes. Similarly, no lampreys were recorded in the Drumfin River at Kilmorgan following examination of $5m^2$ of silt deposits. In the Toberscanavan Lough outflow Stream, juvenile lampreys (n=2) were recorded in an area of $2m^2$ (1 fish/m^2).

Table 3 Characteristics of the July 2013 electrical fishing sites.

Parameter	Site 1	Site 3	Site 5	Site 6	Site 7	Site 8	Site 9	Site 11
Wetted Width (m)	2	2.5	3.5	2.5	2.5	0.6	0.7	1.1
Section Length (m)	22	36	N/a	27	35	25	20	42
Area fished (m^2)	44	90	4	67.5	87.5	15	14	46.2
Mean Depth (cm)	15	20	30	20	25	5	5	5
Maximum Depth (cm)	40	45	70	60	45	10	10	20
Bank Height (m)	0.5	0.5	1.5	1.2	1	0.3	0.5	40
Bank Slope (º)	70	90	80	80	75	90	85	80
Bank Cover (%)	0	40	70	15	10	85	60	0
Instream Vegetation (%)	0	5	80	5	5	0	0	0
Canopy (%)	0	10	0	10	10	80	90	0
Shading(%)	65	15	10	35	15	80	90	90
Riffle (%)	15	45	5	25	50	20	15	80
Glide (%)	30	40	10	45	25	20	15	10
Pool(%)	55	15	85	30	25	60	70	10
Rock (%)	5	5	0	23	35	0	10	15
Cobble (%)	40	50	5	40	35	20	50	30
Gravel (%)	40	40	35	35	25	70	30	50
Fine (%)	15	5	60	5	5	10	10	5
Water Temp (ºC)	20.8	18.8	18.5	19.3	15.3	17.9	19.0	13.4
Dissolved Oxygen (ppm)	5.8	9.9	10.1	9.13	5.8	8.15	9.2	9.38
Dissolved Oxygen (%)	65.4	107.6	110.1	99.1	68.4	98.5	100.6	90

Area of $4m^2$ examined at Site 8 for lampreys, standard electrical fishing for salmonids not possible due to luxuriant emergent instream vegetation.

Table 4 Fish species recorded at site investigated during the June 2006 and July 2013 electrical fishing surveys of rivers affected by the proposed N4 Collooney to Castlebaldwin Road Development.

Site	Watercourse	Fish species recorded 2006	Fish species recorded 2013	Other observations
1	Toberscanavan Lough outflow		Atlantic salmon *Salmo salar* Brown trout *Salmo trutta* Three spined stickleback *Gasterosteus aculeatus* Eel *Anguilla anguilla* Rudd *Scardinius erythropthalmus* Perch *Perca fluviatilis* Brook lamprey *Lampetra fluviatilis*	White-clawed crayfish *Austropotamobius pallipes* recorded in 2013
2	Toberscanavan Lough, northeastern side		Perch recorded during White-clawed crayfish survey	
3	Turnalaydan Stream, downstream of N4 crossing	Brook lamprey *Lampetra planeri* Atlantic salmon *Salmo salar* Brown trout *salmo trutta* Three spined stickleback *Gasterosteus aculeatus* Eel *Anguilla anguilla*	Brook lamprey *Lampetra planeri* Atlantic salmon *Salmo salar* Brown trout *Salmo trutta* Three spined stickleback *Gasterosteus aculeatus* Eel *Anguilla anguilla*	White-clawed crayfish *Austropotamobius pallipes* recorded in 2006
5	Turnalaydan Stream / Lough Corran inflow		Brown trout *Salmo trutta*	Silt deposits with an area of 4m^2 were examined for juvenile lampreys but none were recorded.
6	Drumfin River at Behy Bridge	Atlantic salmon *Salmo salar* Brown trout *Salmo trutta* Three spined stickleback *Gasterosteus aculeatus*	Atlantic salmon *Salmo salar* Brown trout *Salmo trutta* Three spined stickleback *Gasterosteus aculeatus*	

Site	Watercourse	Fish species recorded 2006	Fish species recorded 2013	Other observations
		Eel *Anguilla anguilla*		
7	Drumfin River downstream of Kilmorgan Bridge.	Atlantic salmon *Salmo salar* Brown trout *Salmo trutta* Three spined stickleback *Gasterosteus aculeatus* Eel *Anguilla anguilla*	Atlantic salmon *Salmo salar* Brown trout *Salmo trutta* Three spined stickleback *Gasterosteus aculeatus* Eel *Anguilla anguilla*	
8	Springfield Stream/Loughmeenaghan outflow south of Swallow Hole	Three spined stickleback *Gasterosteus aculeatus*	No fish recorded	
9	Lissycoyne Stream ca. 1km east of Loughmeenaghan	Brown trout *Salmo trutta* Three spined stickleback *Gasterosteus aculeatus*	Three spined stickleback *Gasterosteus aculeatus*	
10	Drumderry Stream tributary, upstream of the existing N4 crossing	Brown trout *Salmo trutta* Three spined stickleback *Gasterosteus aculeatus*	-	
11	tributary of the Drumderry Stream	Brown trout *Salmo trutta*	Brown trout *Salmo trutta*	

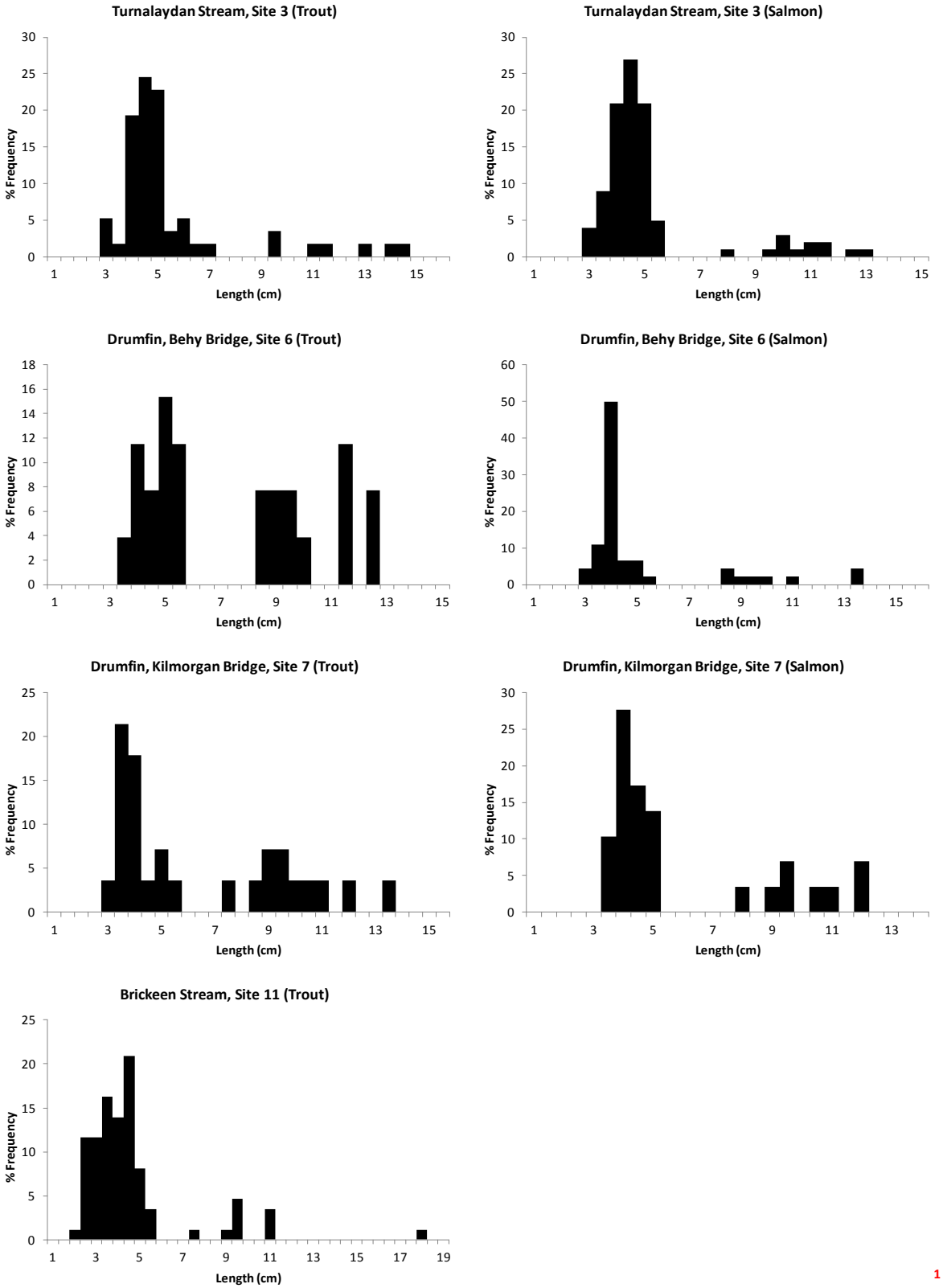

Figure 1 Length percentage frequency distribution of trout and Atlantic salmon captured in the Turnalaydan Stream (Lough Corran outflow), Drumfin River and the tributary of the Drumderry Stream during the 2013 electrical fishing surveys.

[1] Brickeen Stream as quoted above refers to the tributary of the Drumderry Stream as defined in this EIS

Table 5 Results of the depletion electrical fishing surveys on the Drumfin River (Behy Bridge and Kilmorgan Bridge), the Turnalaydan Stream (Lough Corran outflow) and the **tributary of the Drumderry Stream**.

Turnalaydan Stream	Trout	Salmon
Pass 1	31	58
Pass 2	18	32
Pass 3	8	10
Total	57	100
Drumfin R. (Behy Br.)	Trout	Salmon
Pass 1	17	27
Pass 2	7	16
Pass 3	2	3
Total	26	46
Drumfin R. (Kilmorgan Br.)	Trout	Salmon
Pass 1	21	29
Pass 2	4	5
Pass 3	3	2
Total	28	36
tributary of the Drumderry Stream	Trout	Salmon
Pass 1	64	0
Pass 2	14	0
Pass 3	8	0
Total	86	0

Table 6 Minimum density estimations (fish m^{-2}) for salmon and trout at the quantitative sites investigated.

Site	Location	Species	Equation	R^2	Population estimate	Minimum density
3	Turnalaydan Stream	Atlantic Salmon	y = -1.0623x + 121.15	0.94	114	1.27
		Brown trout	y = -0.8571x + 58.143	0.98	68	0.75
6	Drumfin River at Behy Bridge	Atlantic Salmon	y = -1.0719x + 56.78	0.83	53	0.78
		Brown trout	y = -1.6045x + 44.5	0.96	28	0.41
7	Drumfin River at Kilmorgan Bridge	Atlantic Salmon	y = -4.0385x + 145.27	0.97	36	0.41
		Brown trout	y = -2.6622x + 75	0.85	28	0.32
11	tributary of the Drumderry Stream	Brown trout	y = -2.6613x + 230.92	0.92	87	1.88

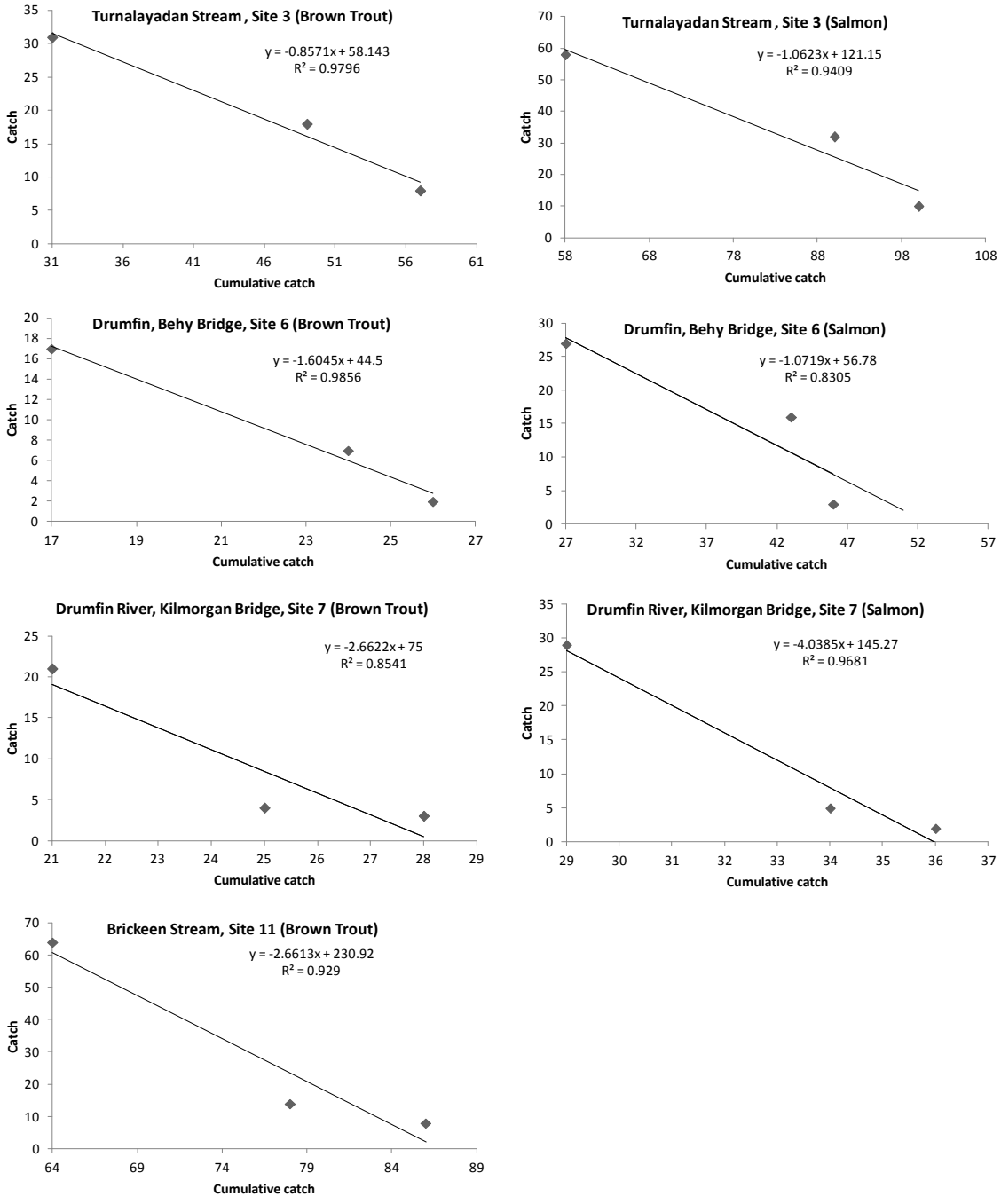

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Figure 2 Depletion lines, Leslie-Davies method, for the numbers of Brown trout and Salmon captured during the electrical fishing investigations at Sites 3, 6, 7 and 11 during the July 2013 survey.

[2] Brickeen Stream as quoted above refers to the tributary of the Drumderry Stream as defined in this EIS

3.2 Aquatic Macroinvertebrates

3.2.1 **Species recorded**

A wide range of macroinvertebrate taxa were recorded during macroinvertebrate sampling. Table 7 gives the list of species recorded at each of the five survey locations. The findings at each site are outlined below where the most recent results are outlined.

3.2.1.1 Site 1

This site was located at Toberscanavan Lough outflow stream, known also as the Markree Demesne Stream. Larvae of Ephemerellidae and Limnephilidae were present in fair numbers at this site. Pollution tolerant *Gammarus deubeni* was dominant at this location. *Platyhelminthes* was present at this location in small numbers while Piscicolidae were scarce.

3.2.1.2 Site 2

This site was located alongside the northeastern shore of Toberscanavan Lough. The focus of this survey was to determine if White-clawed crayfish were using the lake. Stony substrate occurred in the shallows of this part of the lake. White-clawed crayfish were not recorded in this part of the lake following hand searches in 100 potential refuges. Hatchlings and juvenile White-clawed crayfish can be easily found among reeds and vegetative debris at lake verges such as those at Toberscanavan Lough. Vegetated margins along the shore were examined using sweep netting but again, White-clawed crayfish were not recorded.

3.2.1.3 Site 3

This site was located on the Turnalaydan Stream (i.e. the Lough Corran outflow) downstream of the existing N4 crossing. In 2013, a macroinvertebrate family diversity of 17 was recorded at this location. Pollution sensitive mayflies of Heptagenidae and Ephemerellidae were recorded. Pollution tolerant mayfly larvae of *Baetis rhodani* were numerous. *Polycentropus* sp. and green chironomids were present. Freshwater shrimp *Gammarus deubeni* was dominant. White-clawed crayfish were recorded in 2006 but were not recorded in 2013.

3.2.1.4 Site 4

This site was located on Lough Corran along the north eastern shore. The focus of this survey was to determine if White-clawed crayfish were using the lake. White-clawed crayfish were not recorded in Lough Corran however.

3.2.1.5 Site 5

This site was located on the Turnalaydan Stream upstream of Lough Corran. No macroinvertebrate sampling was undertaken at this location during 2013.

3.2.1.6 Site 6

This site was located on the Drumfin River at Behy Bridge. In 2013, pollution sensitive mayflies *Ephemera danica* and *Ecdyonurus dispar* were present in low numbers. Cased caddisfly present included Limnephilidae and *Goera pilosa.* Freshwater shrimp *Gammarus deubeni* was present in small numbers and *Bithynia tentaculata* was present in small numbers.

3.2.1.7 Site 7

This site was located on the Drumfin River at Kilmorgan Bridge. Larvae of Heptagenids and *Baetis rhodani* were numerous at this site. *Limnephilidae, Agapetus fuscipes* and *Goera pilosa* were in fair numbers and common respectively. Simulidae were found in fair numbers with green chironomids scarce. *Gammarus deubeni* was dominant at this location.

3.2.1.8 Site 8

This site was located on the Springfield Stream (Loughmeenaghan outflow), upstream of the Swallow Hole complex. Macroinvertebrate taxa from 12 different families were recorded at this location comprising

Ephemeropterans, Plecopterans, Trichopterans, Dipterans and Crustaceans. Mayfly larvae of *R. semicolorata* were common with *Baetis rhodani* found in fair numbers. Cased caddisfly larvae of *A. fuscipes* were common while *Micropterna* sp. and *Rhyacophila dorsalis* were present. The Dipteran assemblage comprised larvae of blackfly, *Dicronata sp.* and green chironomids. Pollution tolerant *Gammarus deubeni* was dominant at this location.

3.2.1.9 Site 9

This site was located on the Lissycoyne Stream ca. 1km east of Loughmeenaghan. Twenty macroinvertebrate families were recorded at this site. Among the assemblage was two species of pollution sensitive Heptagenid mayfly larvae: *Ecdyonurus* sp. (present) and *Rhithrogena semicolorata* (scarce). Pollution tolerant mayfly larvae of *B. rhodani* were numerous. The best represented group was the caddisflies with larvae of *Micropterna* sp., *Limnephilus flavicornis, S. personatum* and *Silo pallipes* (cased species), as well as *H. siltalai, Wormaldia occipitalis* and *R. dorsalis* generally found in small numbers. Green chironomids were common with larvae of *Dicronata* sp. and Ceratopogonidae present. The beetle *Elmis* sp. and larval Helodid beetles were both present.

3.2.1.10 Site 10

This site was located on the Drumderry Stream ca. 0.5km south east of Castlebaldwin. This watercourse flows into Lough Arrow and a section was found to have been recently maintained. A macroinvertebrate family richness of 13 was recorded at this location. The macroinvertebrate community in this sluggish part of the watercourse was dominated by Crustaceans and Molluscs. *Asellus aquaticus* and *Gammarus deubeni* were dominant and numerous respectively; both taxa are tolerant of impacted water quality conditions. Pollution tolerant leeches *Glossiphonia complanata* and *Piscicola geometra* were present. Small numbers of the snail *Lymnaea peregra* were found and *Planorbis carinatus* was present.

3.2.1.11 Site 11

Heptagenidae were present in the tributary of the Drumderry Stream. Limnephilidae and *Agapetus fuscipes* were both recorded as common at this site. *Asellus aquaticus* was present in small numbers. *Gammarus deubeni* was dominant at this location.

3.2.2 **Biological water quality**

Biological water quality (Q-rating) results and species-richness at each of the macroinvertebrate sampling sites surveyed are presented in Table 8 below. An account of the latest biological water quality is provided below for each site.

3.2.2.1 Site 1

No pollution sensitive taxa were recorded at this site with most of the taxa recorded being pollution tolerant indicators. Biological water quality at this site was rated 'Moderately Polluted, Q3', equivalent to WFD 'Poor Status.

3.2.2.2 Site 3

In 2013, two pollution sensitive species of mayflies were found at this site. The site was rated Slightly Polluted Q3-4 using EPA freshwater biological monitoring criteria (Toner *et al.* 2005), corresponding to WFD 'Moderate Status'.

3.2.2.3 Site 4

Two species of pollution tolerant mayfly were found in the Springfield Stream. Biological water quality was rated Slightly Polluted Q3-4, corresponding to WFD 'Moderate Status'.

3.2.2.4 Site 6

Three species of mayflies were found at this site at Behy Bridge in 2013. Biological water quality was rated Slightly Polluted Q3-4, equivalent to WFD 'Moderate Status'.

3.2.2.5 Site 11

The pollution sensitive mayfly of the family Heptagenidae was recorded as present at this survey site (single record); stonefly larvae were not recorded. The bulk of the macroinvertebrates were pollution tolerant indicators. The Stream was rated 'Slightly Polluted, Q3-4', corresponding to WFD 'Moderate Status'.

Table 7 List of macroinvertebrates recorded at the macroinvertebrate survey sites within the proposed N4 realignment study area during surveys carried out in July 2013.

Taxa	Pollution sensitivity group	Functional feeding group	1	3	6	7	11
Family Heptagenidae							
Autumn dun *Ecdyonurus dispar*	A	Scraper & gathering collector		***	*	****	*
Hexes and big drakes (Ephemeridae)							
The green/grey drake mayfly *Ephemera danica*	A	Filtering collector			*	*	
Spiny crawler mayflies (Ephemerellidae)							
Ephemerella ignita	C	Gathering collector		****	*****		
Baetidae							
Large dark olive *Baetis rhodani*	C	Scraper & gathering collector	****	****		**	**
CASED CADDIS FLIES (Tricoptera)							
Northern caddisflies (Limnephilidae)			****	*****	****	*****	*****
Glossosomatidae							
Little black caddisfly *Agapetus fuscipes*	B	Scraper		***		****	*****
Primitive caddisflies (Sericostomatidae)				*			
Family Goeridae							
Goera pilosa	B	Scraper		**	*****	*****	***
CASELESS CADDIS FLIES (Trichoptera)							
Grey flags (Hydropsychidae)				*	*	*	****
Green sedges (Rhyacophilidae)				*	*	*	
Polycentropus sp.	C	Filtering collector		***	**		

Taxa	Pollution sensitivity group	Functional feeding group	1	3	6	7	11
Tinodes waeneri	C	Filtering collector					
DAMSELFLIES (Odonata, Zygoptera)			*				
TRUE FLIES (Diptera)							
Blackfly (Simulidae)	C	Filtering collector				****	***
Family Chironomidae							
Green chironomid	C	Filtering collector		*****	****	**	**
Clinocera sp.	C	Shredder					
BEETLES (Coleoptera)							
Diving beetles (Dytiscidae)			*				
Sub family Colymbetinae			*				
SNAILS (Mollusca, Gastropoda)							
Family Lymnaeidae							
Wandering snail *Lymnaea peregra*	D	Shredder			*		
Ramshorn *Planorbis planorbis*	C	Scraper		*		*	*
Common Bithynia *Bithynia tentaculata*	C	Shredder		*	**		**
MUSSELS (Mollucsa, Lamellibranchiata)							
Orb/Pea Mussels (Sphaeridae)	D	Filtering collector					
Pisidium sp.	D	Filtering collector	****	**			
AQUATIC MILLIPEDES (Diplopoda)	C	Shredder					
CRUSTACEANS (Crustacea)							
Amphipods (Amphipoda, Gammaridae)							
Freshwater shrimp *Gammarus duebeni*	C	Shredder	*****	*******	***	*******	******
Asellidae							
Asellus aquaticus	D	Shredder		*	*		***
LEECHES (Hirudinae)							
Piscicolidae							
Piscicola geometra	C	Predator	*				

Taxa	Pollution sensitivity group	Functional feeding group	1	3	6	7	11
BUGS (Hemiptera)							
Lesser water boatman (Corixidae)					*		
SEGMENTED WORMS (Annelida, Clitellata)							
Aquatic earthworm (Lumbricidae)	D	Gathering collector	**				
FLATWORMS (Platyhelminthes)	E	Gathering collector	***	**			

**Present, **Scarce/Few, ***Small Numbers, ****Fair Numbers, *****Common, ******Numerous, *******Dominant, ********Excessive.*

Table 8 Species richness and biological water quality (Q-ratings) at the sites surveyed within the proposed N4 realignment study area in 2012 and 2013.

		Site 1	Site 3	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
2012	Family Diversity	17	9	14	12	-	-	-	10
	Q-value	Q3-4	Q3	Q3-4	Q3-4	-	-	-	Q3-4
	Corresponding WFD status	Moderate	Poor	Moderate	Moderate	-	-	-	Moderate
2013	Family Diversity	18	-	21	-	12	20	13	-
	Q-value	4-5	-	4	-	3-4*	3-4	3	-
	Corresponding WFD status	High	-	Good	-	Moderate	Moderate	Poor	-

* Denotes silted conditions

4 CONCLUSIONS

The current report provides updated baseline data on fish stocks in the main watercourses affected by the N4 Collooney to Castlebaldwin Realignment and an updated biological water quality assessment for selected watercourses based on 2013 surveys. This report confirms the fisheries importance of the watercourses; taking account of electrical fishing results; the baseline water quality conditions and corresponding ecological status. The overall evaluation of watercourses from a fisheries perspective is given in Table 9. The Drumfin River and the Turnalaydan Stream are the largest watercourses in the study area. Both of these watercourses support Atlantic salmon, European eel and Brown trout, with Brook lamprey also found in the Turnalaydan Stream. European eel has been listed as 'Critically endangered' and is 'Red Listed' according to the '*Red List No. 5: Amphibians, Reptiles & Freshwater Fish*' (King *et al*., 2011).

As part of the fish sampling programme for the Water Framework Directive (2000/60/EC), the Central and Regional Fisheries Board (now part of Inland Fisheries Ireland) carried out monitoring on the Unshin River, on a stretch approximately 2km southeast of Riverstown in 2009. A total of five fish species were recorded. Salmon was the most abundant species, followed by brown trout, minnow, perch and pike. The ecological status of the Unshin River was rated as 'Good' by IFI following this 2009 WFD fish monitoring. The Drumfin River, the Turnalaydan Stream and the Toberscanavan Lough outflow stream are important tributaries of the Unshin River, providing fluvial spawning and nursery habitats for salmonids.

Salmon densities recorded at the quantitative sites investigated in the 2013 study were 0.41 fish m^{-2} (Drumfin River at Kilmorgan Bridge), 0.78 fish m^{-2} (Drumfin River at Behy Bridge) and 1.27 fish m^{-2} (Turnalaydan Stream). Juvenile salmon abundances are usually presented as numbers of fish per smolt rearing unit (RU, 100 m^2). Cowyx & Fraser (2003) present the UK National Fisheries Classification Scheme which is used to classify juvenile salmon densities using 'absolute' bands ranging from good 'A' to poor 'E'. In the current study density estimations were 41 fish per RU in the Drumfin River at Kilmorgan Bridge, 78 per RU in the Drumfin River at Behy Bridge and 127 fish per RU in the Turnalaydan Stream. Based on this scheme, salmon abundance in the study stretch of the Turnalaydan Stream would be rated as 'Class A'. Based on the densities of juvenile salmon recorded in the Drumfin River at Behy Bridge, this reach would be regarded as a 'Class B' stretch (i.e. 45-86 0+ salmon 100 m^{-2}) while the site at Kilmorgan Bridge further upstream would be rated 'Grade C' (23-44 0+ salmon 100 m^{-2}). The reason for the relatively low rating of the Drumfin River is probably the drainage history of the river.

During the current assessment, the minimum densities of trout ranged from 0.32 fish m^{-2} (Drumfin River at Kilmorgan Bridge), 0.41 fish m^{-2} (Drumfin River at Behy Bridge), 0.75 fish m^{-2} (Turnalaydan Stream) to 1.88 fish m^{-2} in the tributary of the Drumderry Stream. Apart from the tributary of the Drumderry Stream, the values obtained are significantly lower than that density values quoted for other circum-neutral and alkaline rivers in Ireland, where densities may average or exceed 1 fish m^{-2} (Kelly-Quinn & Bracken, 1989).

The Drumfin River has a poor instream physical diversity and suffers from low summer flows. Some gravel has been placed in this river as part of rehabilitation works undertaken by the IFI. However, it is clear that further works may be necessary in this area. Stocks of trout and salmon in downstream areas may be higher than those at Behy Bridge. The Turnalaydan Stream has also subjected to significant drainage works; however, it has a better summer flow than the Drumfin River and has also benefited from gravel placement by the IFI. The hydromorphological character of the Turnalaydan Stream upstream of Lough Corran is not conducive to the spawning and nursery requirements of salmonids, being suboptimal for the early life stages of trout and salmon due to low gradient, lack of gravels and near absence of riffles.

The Drumfin River, Turnalaydan Stream and the Toberscanavan Lough outflow are rated as being of 'Local Importance, higher value' given their ecological function in supporting the early life stages of Salmon and trout, with White-clawed crayfish and brook lampreys also occurring (or having the potential to occur) in these watercourses. The Drumfin River is within the boundary of the Unshin River cSAC downstream of the proposed road crossing and is evaluated as being of international importance within this Natura 2000 site. The evaluation of the tributary of the Drumderry Streamis also 'Local Importance, higher value', as a result of the findings of the survey. This stream was considered by IFI as an important spawning and nursery area for brown trout in Lough Arrow.

The watercourses in the study area are not deemed particularly important for lampreys. Collectively, a total of three Brook lampreys were recorded during the current assessment over an examined area of 14m^2. The areas

examined were deemed optimal for juvenile (ammocoetes). The maximum density of juvenile lampreys recorded during the current survey was 1/m^2 (Toberscanavan Lough outflow stream). The attributes for compliance with favourable status of lampreys are tentatively set by Harvey and Cowx (2003) at population a density >10 river/brook lamprey ammocoetes/m^2 in optimal habitat. The density of juvenile Brook lampreys in the study area are well below 10/m^2, the threshold density set by Harvey and Cowx (2003) for favourable conservation status of lampreys.

Table 9 Description and evaluation of watercourses within the corridor of the proposed N4 Collooney to Castlebaldwin Realignment.

Waterbody	Fisheries value and evaluation		Presence of protected aquatic species		Overall evaluation
Turnalaydan Stream	Spawning / nursery area and tributary of Unshin River cSAC	C	Salmon, otter, brook lamprey, White-clawed crayfish	C	*Local importance, higher value*
Drumfin River	Spawning / nursery area and tributary of Unshin River SAC	C	Salmon, otter, perhaps brook lamprey	C	*Local importance, higher value*
Springfield Stream	No fisheries value	E	None	E	*Local importance, lower value*
Lissycoyne Stream	No fisheries value	E	None	E	*(Local importance, lower value*
Drumderry Stream	High fisheries value. Spawning tributary for trout in Lough Arrow cSAC	C	Otter and perhaps brook lamprey	C	*Local importance, higher value*
Drumderry Stream tributary	High fisheries value. Spawning tributary for trout in Lough Arrow cSAC	C	Otter and perhaps brook lamprey	C	*Local importance, higher value*
Toberscanavan Lough outflow stream / Markree Demesne Stream	Spawning / nursery area and tributary of Unshin River cSAC	C	Salmon, brook lamprey, White-clawed crayfish and perhaps otter	C	*Local importance, higher value*

The aquatic macroinvertebrate assemblages recorded in the study area were typical of stony limestone streams. Macroinvertebrate diversity was greatest in the largest watercourses i.e. the Turnalaydan Stream (17), Drumfin River (14) and the Lissycoyne Stream (20). The macroinvertebrate communities in these watercourses were considered to be suitable in terms of a food source for juvenile salmonids. Macroinvertebrate diversity in the Springfield and Drumderry Streams was found to be reduced; this is evaluated to be as a result of both water quality pressures and morphology.

The most notable finding of the aquatic macroinvertebrate surveys was the record of the protected White-clawed crayfish, recorded in the Turnalaydan Stream (i.e. the Lough Corran outflow) during 2006 and the Toberscanavan Lough outflow stream during 2013. The White-clawed crayfish is Ireland's only crayfish species. Ireland is now thought to hold some of the best European stocks of this species, under least threat from external factors. Irish stocks are believed to be of substantial conservation importance (Reynolds, 1998). The White-clawed crayfish is protected in both European and Irish legislation; under the Wildlife Act (1976, Amendment 2000) and listed in Annex II and V of the EU Habitats Directive (1992). This species is listed as 'Endangered' in the IUCN Red List and is also listed under Appendix III of the Bern Convention. Although not recorded in the Drumfin River, Toberscanavan Lough or in Lough Corran during the current survey, it is considered possible that these waterbodies also support this species.

5 RECOMMENDATIONS

The proposed N4 realignment is located within the catchment of the Unshin River, which includes Lough Arrow at the upstream end. The Unshin River is listed as a candidate Special Area of Conservation (cSAC) with Atlantic salmon and otter as features of interest. A number of watercourses that would be crossed by or occur near to the proposed development ultimately drain into the Unshin; including the Drumderry Stream, the Drumfin River, the Turnalaydan Stream (the Lough Corran outflow) and the Toberscanavan Lough outflow stream. Any construction works taking place in the immediate vicinity of a watercourse has the potential to generate and release suspended solids and other pollutants. There is therefore the potential for pollution of the streams within the study area and fluvial habitats further downstream.

Under the Fisheries (Consolidation) Act, 1959, it is an offence to disturb the bed of a river. Under Section 3 of the Local Government (Water Pollution) Act, 1977 (as amended by Sections 3 and 24 of the 1990 Act) it is an offence to cause or permit any polluting matter to enter waters. The streams within the study area are important for the early life stages of salmon and trout and water quality needs to be protected.

Works adjacent to or over watercourses within the study area will be carried out outside of the salmonid / brook lamprey spawning seasons. Overall, no instream work will be undertaken during the period October to June. The publication '*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*' by Murphy (2004) and '*Maintenance and protection of the inland fisheries resource during road construction and improvement works*' by Kilfeather (2007), as well as the NRA's '*Guidelines for the crossing of watercourses during the construction of national road schemes*' (NRA, 2008) will be followed during the construction of new roads or instream works. Clear-span bridging is recommended as the preferable option for watercourse crossings, causing no changes to river bed and banks and no impact on fish migration. If culverts are required, where possible, arch-type, "bottomless" units should be used so that the natural stream bed can be retained. It is imperative that fish passage be maintained in the Drumfin River and the Turnalaydan Stream in particular, taking account of the salmonid population in these watercourses.

During construction, the contractor will be required to follow a Construction Environmental Management Plan (CEMP) and the Outline Erosion and Sediment Control Plan described in Chapter 4 of the EIS. This will include a detailed Construction Method Statement and Surface Water Management Plan in order to minimise the risk of contaminated runoff at the site. The method statement will be agreed in advance with the Inland Fisheries Ireland (IFI) and National Parks and Wildlife Service (NPWS). There will also be ongoing monitoring of construction works on the site by an independent environmental consultant.

The CEMP will also need to include provision for ensuring that invasive non-native species are not brought into the site. The National Roads Authority (NRA) '*Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads*' (NRA, 2010) is the key guidance here that is relevant for the current proposed works and needs to be taken into account when drawing up the CEMP.

During operation stage, the pollution impacts of road runoff, such as heavy metals, oil/diesel would be minimised, particularly close to sensitive aquatic receptors utilising constructed wetlands, oil/water separators, sedimentation tanks and lined attenuation ponds, as necessary.

6 PLATES

Plate 1 Electrical fishing on the Turnalaydan Stream (Site 3) in 2006.

Plate 2 Searching for White-clawed crayfish in the Drumfin River at Kilmorgan Bridge in July 2013 (Site 7).

Plate 3 Electrical fishing for juvenile lampreys in the Turnalaydan Stream upstream of Lough Corran in July 2013 (Site 5).

Plate 4 Electrical fishing on the Drumfin River (Site 6) at Behy Bridge in 2006.

Plate 5 Stretch of the Drumfin River upstream of the existing N4 (Site 6). Aquatic macroinvertebrate sampling was carried out here in 2012 and also in 2013.

Plate 6 Electrical fishing location on the Drumfin River at Kilmorgan Bridge (Site 3).

Plate 7 View upstream along the Springfield Stream (Site 8). This site was surveyed for aquatic macroinvertebrates adjacent to a local road during 2012.

Plate 8 The Lissycoyne Stream (Site 9) was surveyed for aquatic macroinvertebrates during 2012 and fish during the 2013 assessment.

Plate 9 Drumderry Stream flows into the Lough Arrow feeder stream at the southern end of the study area (Site 10, south of Castlebaldwin).

Plate 10 Drained section of the Drumderry Stream (Site 10). The only fish species recorded in this highly modified watercourse in 2012 was three-spined stickleback *Gasterosteus aculeatus*.

Plate 11 Electrical fishing in the Drumderry tributary south of Castlebaldwin (Site 11) in 2006.

Plate 12 Hand searching for White-clawed crayfish in Toberscanavan Lough during July 2013.

Plate 13 Annex II listed Atlantic salmon were recorded in the Markree Demesne Stream, the Turnalaydan Stream and the Drumfin River, tributaries of the Unshin River. Shown above is a sample form the Markree Demesne Stream.

Plate 14 Seven species of fish were recorded in the Markree Demesne Stream / Toberscanavan Lough outflow during the July 2013 assessment: Atlantic salmon *Salmo salar*, Brook lamprey *Lampetra planeri*, Eel *Anguilla anguilla*, Brown trout *salmo trutta*, Three-spined stickleback *Gasterosteus aculeatus*, Rudd *Scardinius erythropthalmus* and Perch *Perca fluviatilis.*

Plate 15 White-clawed crayfish *Austropotamobius pallipes,* a protected species listed under Annex II of the EU Habitats Directive (1992) was recorded in the Turnalaydan Stream and in the Toberscanavan Lough outflow in 2013. This species possibly occurs in the Drumfin River also.

Plate 16 European Eel *Anguilla anguilla* was recorded in the Drumfin River, the Turnalaydan Stream and in the Markree Demesne Stream / Toberscanavan Lough outflow in 2013.

Plate 17 Larvae of the pollution sensitive mayfly *Ephemera danica* was recorded in the Drumfin River (Site 6).

Plate 18 Mayfly larvae *Ecdyonurus dispar* were recorded in small numbers in the study area.

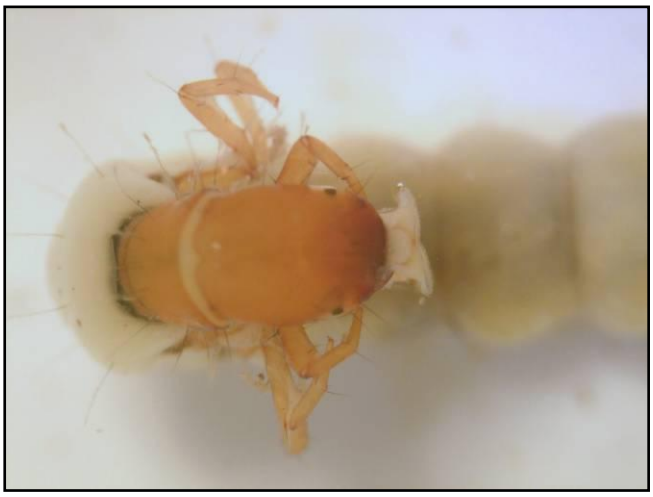

Plate 19 Larvae of the caseless caddisfly *Wormaldia occipitalis* were recorded in the Lissycoyne Stream (Site 5).

Plate 20 The snail *Lymnaea peregra* was recorded in Lough Corran while searching for White-clawed crayfish.

7 REFERENCES

Bohlin, T., Dellefors, C., and Faremo, U. (1982) Electrofishing for salmonids in small streams – aspects of sampling design. *Rep. Inst. Freshwat. Res., Drottningholm, 60:19-24.*

Brown, J. and Gallagher, P. (1981) Population estimates of juvenile salmonids in the Corrib system. *Fishery Leafley No. 115.*

Cowx IG & Fraser D (2003). Monitoring the Atlantic Salmon. *Conserving Natura 2000 Rivers Monitoring Series No. 7, English Nature, Peterborough.*

Greenberg, L.A. and Dahl, J. (1998) Effect of habitat type on growth and diet of brown trout (*Salmo trutta L.*) in stream enclosures. *Fisheries Management & Ecology 5: 331-348.*

Harvey, J. and Cowx, I. (2003) Monitoring the River, Sea and Brook Lamprey, *Lampetra fluviatilis, L. planeri* and *Petromyzon marinus*. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.

Haury, J, Ombredane, D, & Bagliniere, JL (1999) The habitat of the Brown Trout (*Salmo trutta* L.) in watercourses. *Biology and ecology of the brown and sea trout. 37-89. (1999).*

Heggenes, J, Saltveit, SJ (1996) Habitat selection by brown trout (*Salmo trutta*) and young Atlantic salmon(*S. salar*) in streams: Static and dynamic hydraulic modelling. *Regul. Rivers: Res. Mange., Vol. 12, No. 2-3, 155-169, 1996.*

Kelly-Quinn, M. and Bracken, J.J. (1989) Brown trout, *Salmo trutta* L., production in an Irish coastal stream. *Aquaculture and Fisheries Management* 19, 69–95.

Kilfeather, P.J., 2007. Maintenance and protection of the inland fisheries resource during road construction and improvement works. Southern Regional Fisheries Board, Clonmel, Co. Tipperary.

King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011) Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

MacCarthaigh (1997) Hydrological data. A listing of water recorders and summary statistics at selected gauging stations. *Environmental Protection Agency.*

McGarrigle, M.L., Bowman, J.J., Clabby, K.J., Lucy, P., Cunningham, M., MacCarthaigh, M., Keegan, M., Cantrell, B., Lehane, M., Clenaghan, C., Toner, P.F. (2002) Water Quality in Ireland 1998-2000. Second (Revised) Edition. *Environmental Protection Agency.*

Murphy, D.F. (2004). Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin, Ireland.

NRA (2008) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. National Roads Authority.

O'Connor W (2004) A survey of juvenile lamprey populations in the Moy catchment. Irish Wildlife Manuals, No. 15. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

O' Reilly, P. (2002) Rivers of Ireland – A fly fisher's guide. *5th Ed. Merlin Unwin Books.*

Reynolds, J.D. (1998). Conservation management of the white-clawed crayfish, *Austrpotamobius pallipes* Part 1. Irish Wildlife Manuals No. 1.

Toner, P., Bowman, K., Clabby, K., Lucey, J., McGarrigle, M, Concannon, C., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MaCarthaigh, M., Craig, M., and Quinn, R. 2005. Water Quality in Ireland 2001-2003. Environmental Protection Agency, Wexford.

8 APPENDIX 1 Consultation responses

North Western Regional Fisheries Board
Bord Iascaigh Réigiúnach an Iarthuaiscirt

Fisheries Ireland
Our Natural Heritage

Dr William O'Connor,
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Tait Business Centre,
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29 March 2010

RE: Sligo Road Scheme N4 Collooney to Castlebaldwin.

Dear Dr O'Connor,

I refer to your letter of 11 March 2010, regarding the proposed new road scheme between Collooney and Castlebaldwin in Co. Sligo.

The re-alignment of the N4 between Cloonmahon and Castlebaldwin will result in the crossing of a number of tributaries of the Unshin River. The Unshin River is an important salmonid fishery and contains a rich and varied population of flora and fauna. This clear limestone river is a prime salmon spawning water and also contains a healthy stock of large brown trout. As mentioned in the Board's previous correspondence with Ecofact, the electrical fishing survey of June 2006 highlighted the fisheries importance of a number of tributaries of the Unshin (e.g. Brickeen stream, Drumfin River and the Lough Corran outflow) that fall within the corridor of this proposed road re-alignment scheme. It is vital that the ecological and physico-chemical status of these streams, and the main Unshin River, is not adversely impacted upon by this road scheme.

Having reviewed the Study Area Map, it is apparent that there will be one major river crossing, namely the Drumfin River upstream of Behy Bridge. The proposed re-alignment of the N4 will also result in the crossing of a number of tributaries of the Unshin River. The Unshin River is prime salmonid habitat; hence the following information is relevant:

The impact of road development and improvement works on natural watercourses can be minimised by applying sound design principles and following good work practices. The most common and potentially serious impacts are as follows:

Discharge of polluting materials during construction and operational phase:

There are several types of water pollution that can occur during river crossings. Sedimentation can smother fish eggs and cause mortalities in fish of all ages, reducing abundance of food and impeding movement of fish. Certain types of construction materials (e.g. cement, concrete and grout) are toxic jto fish. There is also the potential for the release of oils and fuels, which can have a direct impact on fish, fish food and fish habitat. The following points are important:

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1. Prior to any earth works commencing, surface site drainage and silt control measures should be established. No run-off from machine servicing or concrete mixing areas should enter watercourses. Suitably designed and sited settlement ponds and filter channels should be utilised and maintained. All run-off from the working site or any areas of exposed soil should be channelled and intercepted at regular intervals for discharge to silt-traps or lagoons, with overflows directly to land rather than to a watercourse.

2. Any construction work that involves the pouring of concrete should only be carried out in dry weather conditions. Pumped concrete should be monitored carefully to ensure no accidental discharge to watercourses. Mixer washings or excess concrete should not be discharged to surface waters.

3. Watercourse banks should be left intact if possible. If they have to be disturbed, all practicable measures should be taken to prevent soils from entering the watercourse. All instream earthworks should be executed so as to minimise the suspension of solids.

4. Any stockpile areas for sands or gravels should be kept to a minimum size and well away from any watercourses. Fuels, oils, greases and hydraulic fluids must be stored in bunded compounds well away from any watercourses. Refuelling of machinery should be carried out off site. Where in-situ pumps have to be re-fuelled, this should only be carried out by trained personnel. No oil containment unit should be located within 10m of any watercourse, nor should the associated pipe work and fill area be located within 10m of any watercourse.

5. Fording of watercourses to gain access to the opposite bank should only be considered where no alternative option (e.g. use of a temporary bridge or culvert) exists and can be only be carried out following written agreement with the Board.

6. A maintenance schedule and operation procedure should be established by the contractor and relevant authorities for silt control and pollution control measures during the construction period. Any sub-contractors involved in the project must be fully briefed on all the project's environmental protection aspects. An Emergency Response Plan should also be produced, in the event of a major spill or other significant discharge of polluting matter to surface waters.

Instream works:

1. No instream works should be carried out between 1 October and 1 May because of the negative impact that such activity could have on spawning and juvenile salmonids. Instream work should be confined to dry weather periods during the summer months.

2. Where riverside works are proposed during the close season, they can only be carried out following written agreement with the Board regarding the exact methodology to be used.

3. Care should be taken to prevent disturbance or removal of bed material as this can cause loss of instream vegetation and food and may destroy spawning and nursery habitats. Disturbance of riparian vegetation should also be kept to a minimum in order to maintain shelter and a source of food (i.e. invertebrates) for the fish population in the stream.

4. If removal of bed material is required, then coarse aggregate material should be stockpiled for placement in the reformed or new channel.

Watercourse diversions:

1. The Board is opposed to permanent diversion of watercourses. In some circumstances, temporary diversion may be required to enable culverts to be run square-on to the road alignment. The new diversion channel should be designed to replicate the existing natural watercourse.

2. Any temporary diversions should be carried out in the dry, in isolation from the existing watercourse. They should provide passage for all migratory fish, should be non-eroding and should be of similar width and gradient to the natural stream channel.

3. Board staff must be present during such diversion operations, due to the possible requirement for fish salvage operations during these works.

Barriers to migratory fish movement:

Poorly designed bridges or culverts can be a physical or hydraulic barrier to fish movement, and are likely to obstruct or delay upstream fish passage unless the depths and velocities in them are within the capabilities of the species to be catered for. Entry and exit conditions are also critical for ease of fish passage:

1. The Board would recommend the use of a clear span bridge over the Drumfin River crossing upstream of Behy Bridge. Such structures leave the natural bed and banks undisturbed, whilst reducing the need for instream works.

2. The Board requests that arch-type bottomless culverts be the primary culvert of choice on the remaining crossings, as they allow for the natural streambed to be maintained. Round or oval culverts should be limited to short runs and temporary crossings. No sills or aprons should be installed during culvert construction.

3. The diameter of any culvert providing for the passage of fish should not be less than 900mm. The culvert should be installed so that it has a constant slope throughout its length, and should be installed so that the bottom (invert) is at least 500mm below the grade line of the natural stream bed. The depth at any point in the culvert should ideally be not less than 500mm, in order to allow for the safe passage of migratory fish (especially Atlantic salmon).

4. Culverts should be laid at a level and gradient that allows the upstream invert to remain drowned (by backwatering) under low flow conditions to a depth suitable for the easy passage of the largest species frequenting the stream (150mm for salmon). Pools should be formed at each end of the culvert, in order to provide take-off conditions for upstream migrants entering and leaving the culvert.

5. The Board would request on-site consultation with project personnel prior to the installation of any culverts.

The Board looks forward to reviewing the full Environmental Impact Statement in due course.

Yours sincerely

V Roche

VINCENT ROCHE
Chief Executive Officer
N4-Collooney-Castlebaldwin-310