Corkey Windfarm Repowering

Technical Appendix A8.1: Habitat and Peat Assessment

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SCOTTISHPOWER RENEWABLES

A8.1 Habitat and Peat Assessment

1. This section includes the detailed assessments that support the assessments of habitat and active peat in **Chapter 8: Ecology and Fisheries**. The coverage of each species is described using the DOMIN scheme, and is separated for vascular plants and bryophytes. The cover of peat-forming plants (*Sphagnum* and *Eriophorum* spp), atypical plants (e.g. grasses, rushes) and bare peat are provided, as per the NIEA guidance note on active peat. The 'modifications / hydrological conditions' column refers to any forms of anthropogenic disturbance, and to microtopography (hummocks and hollows). Finally, a decision is made on whether or not the habitat could be classified as active peat, and a rationale for the decision is provided.

Table 1 Active Peat Assessments at all proposed turbine locations

		DOMIN		Cover								
Location	**Peat**	**Vascular plants**	**Bryophytes**	**Sphagnum**	**Erio vagi**	**Erio angu**	**Total**	**Atypical species**	**Bare peat**	**Modifications / hydrological condition**	**Active peat?**	**Rationale**
Turbine 1 foundation	1.2	Call vulg 9, Eric cine 5, Erio vagi 3, Vacc myrt 2, Empe nigr 2, Erio angu 1	Hypn jutl 7, Rhyt lore 4, S. subn 3	subn <5	<5	<1	5 - 10	20	0	Beside steep vertical bank	N	Low cover of peat-forming species, higher cover of atypical species (Erica cinerea) hydrology severely modified
Turbine 2 hardstand	0	Existing hardstand platform										
Turbine 2 foundation	1.1	Call vulg 7, Moli caer 5, Erio vagi 4, Erio angu 2, Eric tetr 2, Pote erec 1, Poly serp 1	Hypn jutl 7, S. capi 4, Hylo sple 4, Rhyt lore 4, S. subn 3, Pleu schr 1	capi 5 subn <5	10	<1	15 - 20	0	0	Uneven ground	N	Low cover of peat-forming species
Turbine 2 hardstand	0.3	Call vulg 9, Moli caer 4, Junc squa 4, Erio vagi 2, Erio angu 1	Hypn jutl 8, S. capi 4, S. subn 4, Rhyt lore 4	capi 5 subn 5	<1	<1	10	0	5	Hummock in uneven area	N	Low cover of peat-forming species, shallow peat layer
Turbine 3 foundation	1.0	Call vulg 9, Erio vagi 4, Moli caer 4, Empe nigr 3, Vacc myrt 1, Eric tetr 1	Hypn jutl 7, Rhyt lore 6, S. capi 4, Hylo sple	capi 5	5	0	10	0	0	Uneven, eroding, sloping ground	N	Low cover of peat-forming species
Turbine 3 hardstand	0.8	Call vulg 10, Erio vagi 5, Moli caer 2, Eric cine 2, Empe nigr 2, Eric tetr 2	Hypn jutl 6, S. capi 5	capi 15	15	0	30	<5	0	Uneven ground	N	Low cover of peat-forming species
Turbine 4 foundation	0.2	Call vulg 8, Junc squa 5, Nard stric 5, Erio angu 3, Erio vagi 3, Anth odor 3	Rhyt squa 8, Hypn jutl 5	0	<5	<1	<5	40	0	Sloping ground	N	Low cover of peat-forming species, high cover of atypical species (Juncus squarrosus, Nardus stricta, Anthoxanthum odoratum), shallow peat layer
Turbine 4 hardstand	0.3	Call vulg 6, Nard stri 6, Care bine 5, Junc squa 5, Erio angu 3, Care pani 3, Antho odor 3	Rhyt squa 5, Hypn jutl 5	0	0	<5	<5	>50	0	Sloping ground	N	Low cover of peat-forming species, high cover of atypical species (Nardus stricta, Juncus squarrosus, Care binervis), shallow peat layer
Turbine 5 foundation	0.4	Call vulg 7, Eric cine 6, Erio vagi 3, Empe nigr 3, Erio angu 2	Rhyt lore 8, Hypn jutl 5, S. capi 3	capi <5	<5	<1	5 – 10	30	0	Sloping ground	N	Low cover of peat-forming species, high cover of atypical species (Erica cinerea), shallow peat layer
Turbine 5 hardstand	0.2	Desc flex 8, Anth odor 6, Junc arti 5, Holc lana 5, Card prat 2	Rhyt squa 8, Hylo sple 7, Pleu schr 4, Thui tama 3	0	0	0	0	100	0	Sloping ground	N	No peat-forming species, high cover of atypical species, shallow peat layer

Table 2 Active Peat Assessment at Turbine 2 and its associated infrastructure (35 plots)

		DOMIN		Cover								
Location	Peat	Vascular plants	Bryophytes	Sphagnum	Erio vagi	Erio angu	Total	Atypical species	Bare peat	Modifications / hydrological condition	Active peat?	Rationale
C01	0.7	Call vulg 8, Erio vagi 5, Eric cine 4, Empe nigr 3, Moli caer 3, Luzula multiflora 1	Rhyt lore 7, Hylo sple 6, Hypn jutl 6, S. capi 3	capi <5	20	0	20 - 25	5	0	Hummock on uneven ground	N	Low cover of peat-forming species, hydrology severely modified
C02	0.2	Call vulg 8, Erio angu 6, Empe nigr 4, Erio vagi 3, Care pani 3, Junc squa 2, Nard stri 1, Pote erec 1, Poly serp 1	S. capi 5, Hypn jutl 5, Rhyt lore 4, S. papi 3, S. cusp 3	capi 15 papi <5 cusp <5	<5	30	50 - 55	<5	0	Flush in cutover area	Y	High cover of peat-forming species, although peat layer is shallow and habitat is highly modified
C03	1.7	Call vulg 10, Erio vagi 5, Eric tetr 3, Empe nigr 3	Hypn jutl 9, S. subn 4, Rhyt lore 4, Thui tama 2, Poly comm 1	subn 5	15	0	20	0	0	N.A.	N	Low cover of peat-forming species
C04	1.0	Call vulg 9, Erio vagi 3, Moli caer 3, Empe nigr 3, Erio angu 1, Vacc myrt 1	Hylo sple 7, Rhyt lore 6, Hypn jutl 5, S. capi 4	capi 10	<5	<1	10 - 15	0	0	Hummock on uneven ground	N	Low cover of peat-forming species, hydrology severely modified
C05	1.0	Call vulg 8, Erio vagi 4, Empe nigr 4, Eric tetr 2, Erio angu 1, Vacc myrt 1	Hypn jutl 8, Rhyt lore 5, Hylo sple 4, Poly comm 1	0	10	<1	10	0	0	Sloping ground	N	Low cover of peat-forming species
C06	0.2	Call vulg 7, Erio angu 5, Moli caer 5, Erio vagi 4, Tric germ 2, Empe nigr 2, Eric tetr 2, Junc squa 1	S. cusp 7, S. papi 3, Rhyt lore 3, S. dent 2	cusp 40, papi <5 dent <1	10	20	70 - 75	<1	0	Flush in cutover area	Y	High cover of peat-forming species, although peat layer is shallow and habitat is highly modified
C07	1.5	Call vulg 10, Erio vagi 4, Vacc myrt 2, Eric tetr 1	Hypn jutl 6, Hylo sple 6, S. subn 5, Rhyt lore 5	subn 15	5	0	20	0	0	Dry area at top of steep facebank	N	Low cover of peat-forming species, hydrology severely modified
C08	0.4	Call vulg 9, Erio vagi 5, Moli caer 5, Erio angu 1, Pote erec 1	Hypn jutl 6, S. capi 5, Rhyt lore 4, S. subn 3, S. fall 2, Poly comm 1	capi 20 sub <5 fall <5	15	<1	40	0	0	Hummock in flushed area	Y	Moderate cover of peat-forming species, no atypical species, hydrology mostly intact
C09	0.5	Call vulg 8, Erio vagi 4, Moli caer 4, Empe nigr 3, Vacc myrt 1	Hypn jutl 6, Hylo sple 4, Rhyt squa 4, Rhyt lore 4, S. subn 3	subn <5	5	0	5 - 10	0	0	Hummock on uneven ground	N	Low cover of peat-forming species, shallow peat layer
C10	0.2	Erio vagi 5, Call vulg 5, Tric germ 5, Erio angu 3, Eric tetr 2	S. cusp 9, S. dent 2, Campylopus introflexus 1	cusp 80 dent <1	15	<5	95	0	0	Flush in cutover area	Y	High cover of peat-forming species, although peat layer is shallow and habitat is highly modified
C11	1.0	Call vulg 9, Erio vagi 5, Empe nigr 3, Eric tetr 2, Vacc myrt 1	S. subn 8, Hypn jutl 5, Rhyt lore 4	subn 75	15	0	90	0	0	Hummock on uneven ground	Y	High cover of peat-forming species, no atypical species, deep peat, hydrology mostly intact
C12	0.7	Call vulg 8, Erio vagi 4, Tric germ 3, Erio angu 1, Eric tetr 1	S. papi 5, S. capi 2, S. subn 2	papi 15 capi <1 subn <1	5	<1	20 - 25	0	0	Cutover	N	Low cover of peat-forming species
C13	1.3	Call vulg 9, Erio vagi 5, Empe nigr 3	Thui tama 5, Hypn jutl 5, Rhyt squa 4, Rhyt lore 4, S. capi 3, S. subn 3	capi <5 subn <5	15	0	20	0	0	Dry area at top of steep facebank	N	Low cover of peat-forming species

C14	0.7	Call vulg 10, Erio vagi 3, Empe nigr 2, Eric tetr 2	Hypn jutl 6, S. subn 5, Rhyt lore 4, Pleu schr 2	subn 25	<5	0	25 - 30	0	0	Uneven ground	N	Moderate cover of peat-forming species, but only Sphagnum subnitens is present
C15	1.3	Erio vagi 7, Call vulg 6, Moli caer 4, Erio angu 3, Care pani 2	S. cusp 7, S. capi 4, S. fall 4, Rhyt lore 4, Hypn jutl 4, Rhyt squa 2	cusp 40 capi 5 fall 5	40	<5	90 - 95	0	0	Slope	Y	High cover of peat-forming species, no atypical species, deep peat, hydrology mostly intact
C16	0.4	Call vulg 10, Erio vagi 4, Erio angu 2, Tric germ 2, Moli caer 1	Hypn jutl 6, S. capi 4, Rhyt lore 4, S. papi 2, Poly comm 2	cap 5 papi <1	5	0	10	0	0	Flush in cutover area	N	Low cover of peat-forming species, shallow peat layer
C17	0.9	Call vulg 8, Erio vagi 5, Eric cine 3, Empe nigr 3, Eric tetr 3, Erio angu 1, Vacc myrt 1	Hypn jutl 8, Rhyt lore 6, S. subn 3	subn <5	25	<1	25 - 30	0	0	Hag between two drains	N	Moderate cover of peat-forming species, but hydrology severely modified
C18	1.0	Call vulg 9, Erio vagi 3, Empe nigr 3, Eric tetr 2, Vacc myrt 2	Hypn jutl 8, Rhyt lore 4, Hylo sple 3	0	<5	0	<5	0	0	Dry area at top of steep facebank	N	Low cover of peat-forming species, hydrology severely modified
C19	0.2	Call vulg 7, Empe nigr 4, Erio vagi 3, Erio angu 4, Moli caer 3, Eric cine 2, Pote erec 1, Junc squa 1, Vacc myrt 1	Hypn jutl 6, Rhyt lore 5, Raco lanu 4, Hylo sple 3, S. capi 2	capi <1	<5	5	5 - 10	<1	<1	Uneven ground	N	Low cover of peat-forming species, shallow peat layer
C20	1.7	Call vulg 10, Erio vagi 5, Empe nigr 3, Eric tetr 2, Vacc myrt 1	Hypn jutl 6, S. capi 5, S. subn 4, Hylo sple 3, Rhyt lore 3	capi 20 subn 5	15	0	40	0	0	Sloped area near steep facebank	Y	Moderate cover of peat-forming species, deep peat, no atypical species, hydrology mostly intact
C21	1.5	Call vulg 10, Erio vagi 4, Eric cine 3, Empe nigr 3, Vacc myrt 3	Hypn jutl 8, Rhyt lore 5, S. subn 4	subn 5	5	0	10	0	0	Hag on edge of cutaway / eroded area	N	Low cover of peat-forming species, hydrology severely modified
C22	1.5	Erio vagi 8, Call vulg 7, Tric germ 4, Eric tetr 2, Empe nigr 2, Erio angu 1, Vacc myrt 1	Hypn jutl 7, Rhyt lore 6, S. capi 5, S. palu	capi 20 palu <1	60	<1	80	0	0	Flush in cutover area	Y	High cover of peat-forming species, no atypical species, deep peat, hydrology mostly intact
C23	0.3	Call vulg 9, Moli caer 4, Junc squa 4, Erio vagi 2, Erio angu 1	Hypn jutl 8, S. capi 4, S. subn 4, Rhyt lore 4	capi 5 subn 5	<1	<1	10	0	5	Hummock in uneven area	N	Low cover of peat-forming species, shallow peat layer
C24	1.2	Call vulg 9, Erio vagi 5, Empe nigr 3, Eric tetr 2	S. capi 7, S. subn 4, Rhyt lore 3, Pleu schr 2, Hypn jutl 1, Poly comm 1	capi 40 subn 10	20	0	70	0	0	Hummock in uneven area	Y	High cover of peat-forming species, no atypical species, deep peat, hydrology mostly intact
C25	1.4	Call vulg 10, Erio vagi 4, Eric cine 4, Empe nigr 3, Tric germ 2, Vacc myrt 2	Hypn jutl 8, Rhyt lore 4, Hylo sple 3	0	5	0	5	0	0	Hag	N	Low cover of peat-forming species, hydrology severely modified
C26	2.0	Call vulg 10, Erio vagi 4, Empe nigr 3, Eric tetr 2	Hypn jutl 6, Rhyt lore 5, S. capi 3, Hylo sple 2, Pleu schr 2, Poly comm 2	capi <5	5	0	5 - 10	0	0	Hag	N	Low cover of peat-forming species, hydrology severely modified
C27	0.3	Call vulg 10, Erio vagi 4, Erio angu 2, Eric tetr 1	Hypn jutl 5, S. cusp 4, S. capi 4, Rhyt lore 3, Poly comm 2, Rhyt squa 2	capi 10 cusp 10	5	<1	25	0	0	Flush in cutover area	N	Moderate cover of peat-forming species, but shallow peat layer, and habitat is modified

C28	0.9	Call vulg 8, Erio vagi 5, Erio angu 3, Care pani 3, Pote erec 3	S. capi 7, Hypn jutl 6, Rhyt lore 5, Pleu schreb 2	capi 40	10	<5	50 - 55	0	0	Flush in cutover area	Y	High cover of peat-forming species, no atypical species, moderate peat depth, hydrology mostly intact
C29	1.1	Call vulg 7, Moli caer 5, Erio vagi 4, Erio angu 2, Eric tetr 2, Pote erec 1, Poly serp 1	Hypn jutl 7, S. capi 4, Hylo sple 4, Rhyt lore 4, S. subn 3, Pleu schr 1	capi 5 subn <5	10	<1	15 - 20	0	0	Uneven ground	N	Low cover of peat-forming species
C30	0.9	Call vulg 9, Erio vagi 6, Empe nigr 2, Eric tetr 2, Vacc myrt 1	Hypn jutl 9, Rhyt lore 4	0	30	0	30	0	0	Uneven ground	N	Moderate cover of Eriophorum vaginatum, but no other peat-forming species present, and habitat is more representative of dry heath
C31	0.5	Call vulg 8, Agro cani 7, Erio angu 4, Tric germ 3, Eric tetr 2, Pote erec 2	Hypn jutl 8, Rhyt lore 4, Thui tama 2	0	0	5	5	50	0	Cutover / eroded	N	Low cover of peat-forming species, high cover of atypical species (Agrostis canina), shallow peat layer
C32	0.6	Erio vagi 9, Call vulg 5, Erio angu 3	S. capi 5, Hypn jutl 5, S. papi 4, S. cusp 4, Rhyt lore 4, Poly comm 2	capi 20 papi 5 cusp 5	80	<5	110 - 115	0	0	Flush in cutover area	Y	High cover of peat-forming species, no atypical species, hydrology mostly intact
C33	1.6	Call vulg 10, Empe nigr 5, Erio vagi 3, Vacc myrt 2, Moli caer 1	Hypn jutl 6, Hylo sple 5, Rhyt lore 5	0	<5	0	<5	0	0	Hag in cutover / eroded area	N	Low cover of peat-forming species, hydrology severely modified
C34	1.7	Call vulg 9, Erio vagi 4, Empe nigr 3, Eric tetr 2	Hypn jutl 8, Rhyt lore 4, S. capi 4, S. papi 3, Poly comm 2	capi <5 papi <5	10	0	15	0	0	Uneven ground	N	Low cover of peat-forming species
C35	1.0	Call vulg 10, Erio vagi 4, Empe nigr 4, Fest ovin 3, Erio angu 2, Moli caer 2, Vacc myrt 1	Hypn jutl 8, Poly comm 5, S. capi 4, Rhyt lore 4	capi 5	5	<1	10	0	0	Flush enriched by runoff from hardstand	N	Low cover of peat-forming species
										Total	Y N	11 (31%) 24 (69%) The majority of the area is <u>not</u> active peat

Table 3 Active Peat Assessment at Turbine 3 and its associated infrastructure (32 plots)

		DOMIN		Cover								
Location	**Peat**	**Vascular plants**	**Bryophytes**	**Sphagnum**	**Erio vagi**	**Erio angu**	**Total**	**Atypical species**	**Bare peat**	**Modifications / hydrological condition**	**Active peat?**	**Rationale**
A01	0.2	Call vulg 7, Moli caer 7, Erio vagi 4, Erio angu 4, Eric cine 3, Empe nigr 2, Agro cani 2, Pote erec 1	Hypn jutl 7, Rhyt lore 5, Hylo sple 3, Thui tama 2	0	5	5	10	<5	0	Uneven ground, steep slope	N	Low cover of peat-forming species, shallow peat layer
A02	1.0	Eric cine 8, Call vulg 4, Moli caer 4, Erio angu 4, Erio vagi 3, Eric tetr 2	Rhyt lore 7, Hypn jutl 7	0	<5	5	5 - 10	70	0	Hag in cutover	N	Low cover of peat-forming species, atypical species abundant (Erica cinerea), hydrology severely modified
A03	0.6	Call vulg 10, Erio vagi 5, Eric tetr 2, Moli caer 2, Empe nigr 2, Erio angu 1	Hypn jutl 8, Rhyt lore 5, S. subn 2	subn <1	15	<1	15	0	0	Uneven ground	N	Low cover of peat-forming species

A04	0.8	Call vulg 9, Vacc myrt 4, Erio vagi 4, Agro cani 4, Moli caer 2, Erio angu 1	Hypn jutl 5, Thui tama 4, Hylo sple 4, Rhyt lore 4	0	10	<1	10	0	0	Hummock in uneven area	N	Low cover of peat-forming species
A05	0.5	Call vulg 6, Desc flex 6, Erio vagi 5, Erio angu 4, Agro cani 4, Moli caer 3, Anth odor 4, Pote erec 2, Gali saxa 1	Hypn jutl 6, Thui tama 6, Rhyt lore 5, Hylo sple 4	0	20	10	30	40	0	Hummock beside flush	N	Moderate cover of peat-forming species, but also of atypical species (Deschampsia flexuosa, Agrostis canina), shallow peat layer
A06	0.4	Call vulg 7, Erio vagi 7, Erio angu 4, Pote erec 3, Eric tetr 2, Poly serp 1	S. capi 7, Rhyt lore 3, Rhyt squa 3, Hypn jutl 3, S. papi 2	capi 40 papi <1	40	5	85	0	0	Flush enriched by runoff from hardstand	Y	High cover of peat-forming species, although peat layer is shallow and habitat is highly modified
A07	0.7	Moli caer 6, Desc flex 6, Erio vagi 6, Call vulg 5, Erio angu 2	Hypn jutl 6, Rhyt lore 5, S. capi 4, S. subn 3, Thui tama 3	capi 10 subn <5	30	<1	40 - 45	30	0	Flush enriched by runoff from hardstand	N	Moderate cover of peat-forming species, but also of atypical species (Deschampsia flexuosa)
A08	0.3	Erio angu 8, Call vulg 6, Erio vagi 3, Care pani 3	S. capi 6, S. cusp 4, Rhyt lore 3, S. papi 2	capi 30 cusp 10 pap <5	<5	75	120	0	0	Flush enriched by runoff from hardstand	Y	High cover of peat-forming species, although peat layer is shallow and habitat is highly modified
A09	0.6	Call vulg 8, Erio vagi 5, Erio angu 4, Empe nigr 3, Vacc myrt 1	Hypn jutl 8, Rhyt lore 6	0	20	5	25	0	0	Hummock in uneven area	N	Low cover of peat-forming species
A10	0.5	Call vulg 8, Moli caer 6, Erio vagi 5, Eric cine 4, Erio angu 3, Anth odor 2, Poly serp 1	Hypn jutl 6, Rhyt lore 3	0	15	<5	15 - 20	5	0	Hummock beside flush	N	Low cover of peat-forming species, shallow peat layer
A11	0.6	Call vulg 9, Erio vagi 4, Empe nigr 4, Moli caer 2, Erio angu 1, Vacc myrt 1	Hypn jutl 6, Hylo sple 6, Rhyt lore 5, S. capi 4, S. subn 4	capi 5 subn 5	5	<1	15	0	0	Top of cutover bank	N	Low cover of peat-forming species, hydrology severely modified
A12	0.5	Call vulg 9, Erio vagi 5, Agro cani 3, Empe nigr 3, Eric cine 3, Erio angu 1	Hylo sple 7, Rhyt lore 5, Thui tama 4, Hypn jutl 4	0	15	<1	15	0	0	Uneven ground, slope	N	Low cover of peat-forming species, shallow peat layer
A13	0.5	Call vulg 7, Eric cine 7, Erio vagi 5, Erio angu 2, Moli caer 2, Vacc myrt 1,	Hypn jutl 6, S. capi 5, Hylo sple 5, Rhyt lore 4	capi 20	25	<5	45 - 50	40	0	Uneven ground	N	Moderate cover of peat-forming species, but also of atypical species (Erica cinerea), shallow peat layer
A14	1.2	Call vulg 9, Erio vagi 4, Agro cani 3, Eric cine 2, Eric tetr 2, Moli caer 1, Erio angu 1	S. capi 6, Rhyt lore 6, Hypn jutl 5	capi 30	10	<1	40	<5	0	Hummock in flushed area	Y	Moderate cover of peat-forming species, few atypical species, hydrology mostly intact
A15	1.0	Moli caer 8, Call vulg 7, Erio vagi 4	Hypn jutl 6, S. capi 4, Phyt lore 3, Thui tama 3	cap 5	10	0	15	0	0	Flush on sloping ground	N	Low cover of peat-forming species
A16	0.3	Erio angu 9, Call vulg 6, Junc squa 4, Eric tetr 1, Erio vagi 1	S. cusp 7, S. capi 5, Hypn jutl 5	cusp 40 capi 15	<1	80	135	<5	5%	Flush in cutover / eroded area	Y	High cover of peat-forming species, although peat layer is shallow and habitat is highly modified
A17	0.5	Call vulg 8, Erio vagi 4, Moli caer 4, Agro cani 3, Erio angu 2, Eric cine 2, Eric tetr 2	S. capi 7, S. papi 6, Rhyt lore 3, Hypn jutl 3	capi 40 papi 30	<1	5	75	<5	0	Hummock in flushed area	Y	High cover of peat-forming species, although peat layer is shallow and habitat is highly modified
A18	0.5	Call vulg 9, Eric cine 4, Erio vagi 4, Empe nigr 3, Erio angu 1, Vacc myrt 1	Rhyt lore 5, Hypn jutl 5, S. capi 4	capi 10	5	<1	15	5	0	Uneven ground, near drain	N	Low cover of peat-forming species, shallow peat layer

A19	1.4	Call vulg 10, Erio vagi 4, Eric cine 3, Empe nigr 3, Vacc myrt 2	Rhyt lore 7, Hypn jutl 7	0	10	0	10	5	0	Dry area at top of steep facebank	N	Low cover of peat-forming species
A20	0.3	Erio angu 5, Tric germ 5, Junc squa 5, Erio cagi 3, Call vulg 3, Care pani 3	S. cusp 7, Hypn jutl 4, S. dent 3, S. capi 3	cusp 50 capi <5 dent <5	<5	20	75 - 80	20	0	Flush in cutover / eroded area	Y	High cover of peat-forming species, although peat layer is shallow and habitat is highly modified
A21	0.8	Call vulg 8, Eric cine 5, Erio vagi 4, Vacc myrt 2, Moli caer 1	S. capi 8, Hypn jutl 6, Rhyt lore 4	capi 70	5	0	75	25	0	Uneven ground, slope	Y	High cover of peat-forming species, atypical species (Erica cinerea) not abundant
A22	1.1	Call vulg 10, Erio vagi 5, Empe nigr 4, Eric cine 3, Vacc myrt 2	Hypn jutl 8, Rhyt lore 7, Hylo sple 4, Poly comm 2	0	5	0	5	<5	0	Uneven ground	N	Low cover of peat-forming species
A23	1.0	Call vulg 9, Erio vagi 4, Moli caer 4, Empe nigr 3, Vacc myrt 1, Eric tetr 1	Hypn jutl 7, Rhyt lore 6, S. capi 4, Hylo sple	capi 5	5	0	10	0	0	Uneven, eroding, sloping ground	N	Low cover of peat-forming species
A24	0.8	Call vulg 10, Erio vagi 5, Moli caer 2, Eric cine 2, Empe nigr 2, Eric tetr 2	Hypn jutl 6, S. capi 5	capi 15	15	0	30	<5	0	Uneven ground	N	Low cover of peat-forming species
A25	0.4	Call bulg 8, Care pani 5, Erio vagi 4, Erio angu 4, Junc squa 3, Pote erec 2	Rhyt lore 5, S. capi 4, Hylo sple 4, Poly comm 3, S. dent 2	capi 5, dent <1	10	5	20	<5	0	Flush on sloping ground	N	Low cover of peat-forming species, shallow peat layer
A26	0.3	Call vulg 8, Erio angu 6, Erio vagi 4, Eric cine 3	S. capi 5, S. papi 4, Odon spha 4, Hypn jutl 4, Rhyt lore 3	capi 20 papi 5	5	30	60	<5	0	Hummock in flushed area	Y	High cover of peat-forming species, although peat layer is shallow and habitat is highly modified
A27	1.0	Call vulg 7, Eric cine 7, Erio angu 3	Raco lanu 9, Hypn jutl 6	0	0	<5	<5	40	5%	Hag in cutover / eroded area	N	Low cover of peat-forming species,
A28	1.0	Call vulg 9, Eric cine 5, Moli caer 4, Erio vagi 3	Hypn jutl 7, Hylo sple 4, Rhyt lore 3	0	<5	0	<5	15	0	Uneven ground	N	Low cover of peat-forming species
A29	0.8	Call vulg 9, Eric cine 5, Erio vagi 4, Empe nigr 3, Moli caer 1	Hypn jutl 9, Rhyt lore 4	0	5	0	5	20	0	Hag in cutover / eroded area	N	Low cover of peat-forming species
A30	0.4	Call vulg 10, Erio vagi 5, Eric cine 2, Vacc myrt 2	Rhyt lore 6, Hypn jutl 6, Poly comm 2	0	20	0	20	<1	0	Uneven ground	N	Low cover of peat-forming species, shallow peat layer
A31	0.5	Erio angu 4, Call vulg 4		0	0	5	5	0	90%	Bare, eroded peat on side of hag	N	Plot is mostly bare peat, hydrology severely modified
A32	0.8	Call vulg 10, Erio vagi 4, Empe nigr 4, Tric germ 3, Erio angu 2	Hypn jutl 7, Rhyt lore 3, Hylo sple 3, Pleu schr 2	0	5	<1	5	0	0	Hag in eroded area	N	Low cover of peat-forming species. High level of disturbance
										Total	Y N	8 (25%) 24 (75%) The majority of the area is <u>not</u> active peat

Corkey Windfarm Repowering

Technical Appendix A8.2: Habitats Regulation Assessment

Appendix - Volume 3
June 2019

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SCOTTISHPOWER RENEWABLES

Non-Technical Summary

1. The aim of the report is to identify, quantify and evaluate the impacts of the Development on Natura 2000 sites. It will assist the planning authority with an Appropriate Assessment for the project, which is a requirement of the *Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995* (as amended).

2. The Development is within the catchment of the River Main, which provides a distant hydrological connection to the 'Lough Neagh and Lough Beg' Special Protection Areas (SPA). It is also within the flight range of the 'Antrim Hills' SPA, which is designated for breeding hen harrier and merlin. In order to assist the planning authority with their Appropriate Assessment, this document includes: a description of relevant Natura 2000 sites, an appraisal of potential source-pathway-receptor relationships, an assessment of potential impacts, details of proposed avoidance / mitigation measures, and an assessment of residual impacts.

3. A range of hydrological mitigation measures will be implemented during the initial decommissioning, construction, operation and decommissioning phases of the Development in order to prevent the pollution of local watercourses, and any associated impacts on the 'Lough Neagh and Lough Beg' SPA. These measures have been designed by the project hydrologist and are outlined in full in **Chapter 7: Hydrology, Hydrogeology, Geology, Soils and Peat**, but they are summarised in this document in order to assist with the Appropriate Assessment process. Subject to the successful implementation of the mitigation measures, the hydrologist has concluded that there will be no significant residual effects on receiving waters or aquatic fauna. The ornithologist has concluded that there is no risk of impacts on the qualifying interests of the Antrim Hills SPA. Consequently, we conclude that the Development will not adversely affect the integrity of any Natura 2000 sites.

1 Introduction

1.1 Background to Appropriate Assessment

4. Approximately 6.5% of the land area of Northern Ireland is included in the European Network of Natura 2000 sites, which includes Special Protection Areas (SPAs) to protect important areas for birds, and Special Areas of Conservation (SACs) to protect habitats and non-avian fauna. Legislative protection for these sites is provided by the *European Council Birds Directive* (79/409/EEC) and the *E.C. Habitats Directive* (92/43/EEC, as amended), which are transposed into Northern Irish law by the *Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995* (as amended).

5. To ensure compliance with these regulations, the competent authority (Northern Irish planning authorities and other public bodies) must consider the potential impacts of any development on the integrity of the Natura 2000 network. Regulation 43 states that the competent authority must carry out an 'appropriate assessment' of the implications of any development on Natura 2000 sites, and "*shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of a European site*". To assist the competent authority with this assessment, the applicant is often required to provide supporting information in a document known as a Habitats Regulations Assessment.

6. The first stage of the assessment is a simple screening exercise to determine whether the development has potential to affect any Natura 2000 sites. If there is any risk of a significant effect, either alone or in combination with other plans or projects, the development should proceed to the second stage of the process, which is known as 'Appropriate Assessment' (AA). An AA is a detailed assessment of any potential impacts on Natura 2000 sites, and may include details of mitigation measures that will be employed to avoid or minimise impacts.

1.2 Statement of authority

7. This assessment was carried out by the principal ecologist of NM Ecology Ltd. He has eleven years of professional experience, including eight years as an ecological consultant, one year as a local authority biodiversity officer, and two years managing an NGO overseas. He has an MSc in Ecosystem Conservation and Landscape Management from NUI Galway and a BSc in Environmental Science from Queens University Belfast.

8. He regularly carries out ecological surveys and impact assessments for developments throughout Ireland and Northern Ireland, including wind farms, infrastructural projects (roads, water mains, powerlines, etc), and a range of commercial and residential developments. He is a member of the Chartered Institute of Ecology and Environmental Management, and operates in accordance with their code of professional conduct.

1.3 Methods

9. This document is a Habitats Regulations Assessment (HRA), which is submitted as part of an Environmental Statement (ES) for the Development. All of the information required for an Appropriate Assessment can be found in **Chapter 8: Ecology and Fisheries**, **Chapter 9: Ornithology** and **Chapter 7: Hydrology, Hydrogeology, Geology, Soils and Peat**, but for ease of reference we have summarised all relevant information in this document.

10. This document has been prepared with reference to the following guidelines:

- *The Habitats Regulations: a guide for competent authorities* (Department of the Environment, Northern Ireland, 2002);
- *Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4), E.C.*, 2002;
- *Guidelines for Ecological Impact Assessment in the U.K and Ireland: Terrestrial, Freshwater, Coastal and Marine* (Chartered Institute of Ecology and Environmental Management, 2018).

11. A desk-based study was conducted using data from the following sources:

- Other chapters of the ES;
- Qualifying Interests of Natura 2000 sites from the Northern Ireland Environment Agency (www.doeni.gov.uk/niea/protected_areas_home) and the Joint Nature Conservation Committee (jncc.defra.gov.uk/protectedsites/);
- Bedrock, soil, subsoil and aquifer maps from the Geological Survey of Northern Ireland Geoindex, and information on water quality from the NIEA River Basin Plan Interactive Map; and
- Other relevant planning policy and guidance, including the extant Development Plan which is The Northern Area Plan 2016, and other relevant documents from the Causeway Coast and Glens Borough Council, and details of permitted or proposed developments from the Northern Ireland Planning Portal (www.planningni.gov.uk/index.htm).

12. All web-based resources were accessed between March 2017 and January 2019. The Site was visited on a regular basis throughout 2017 and 2018.

1.4 Receiving environment

13. The underlying bedrock geology is basalt, which is a poor aquifer. Superficial geology is predominantly peat, with localised pockets of glacial till. The Site is in the catchments of the Killagan Water and Cloghmills Water (part of the Neagh-Bann River Basin District) and the Bush River (part of the North Eastern River Basin District). The Killagan Water is classified as having moderate overall status while the Bush River and Cloghmills Water are classified as having good overall status. Further details are provided in **Chapter 7: Hydrology, Hydrogeology, Geology, Soils and Peat**.

2 Description of Natura 2000 sites

2.1 Identification of Natura 2000 sites within the zone of influence

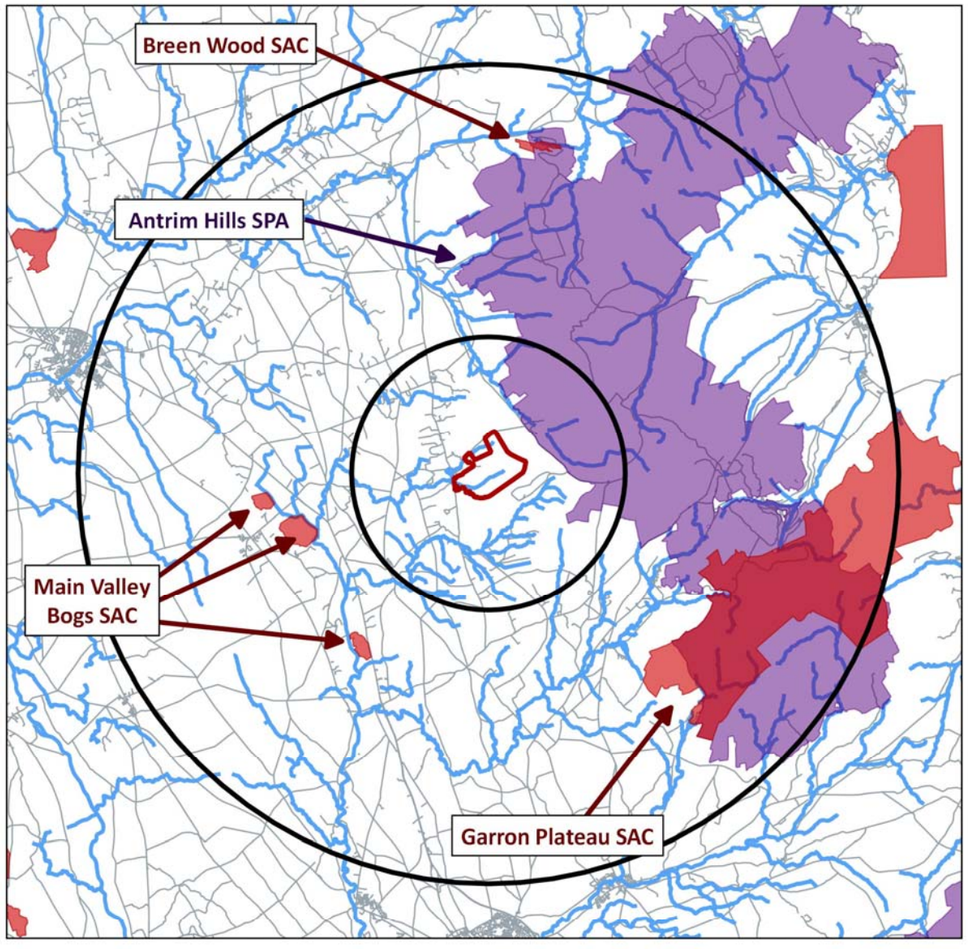
14. The Site is not within or adjacent to any Natura 2000 sites. A map of Natura 2000 sites within 15 km of the Site is provided in **Figure 1**, and details of each site are provided in **Table 1.**

Figure 1	Natura 2000 sites
Project	Corkey Windfarm Repowering Project
Applicant	ScottishPower Renewables
Date	05-04-2019

NM Ecology Ltd - Ecological Consultants
Website: www.nmecology.com
Email: info@nmecology.com
Tel: 087-6839771

Site location
- Site boundary (scoping stage)
- Buffer zones (5km & 15km)
- Watercourses
- Roads

Natura 2000 sites
- Special Areas of Conservation
- Special Protection Areas



NM ECOLOGY

Table 1: Natura 2000 sites within 15 km of the centre of the Site

Site name	Distance	Qualifying Interests
Antrim Hills SPA	0.8 km north-east	**Special Conservation Interests:** • Hen harrier (breeding) • Merlin (breeding)
Main Valley Bogs SAC	5.2 km west	**Annex I Habitats:** • Active raised bogs
Garron Plateau SAC	8 km south-east	**Annex I Habitats:** • Blanket bogs • Alkaline fens • Oligotrophic standing waters • Natural dystrophic lakes and ponds • Northern Atlantic wet heaths with *Erica tetralix* • Transition mires and quaking bogs **Annex II Species:** • Marsh saxifrage (*Saxifraga hirculus)*
Breen Wood SAC	10 km north	**Annex I Habitats:** • Old sessile oak woodlands • Bog woodland **Annex II Species:** • None
Lough Neagh & Lough Beg SPA	Approx. 40 km downstream via the River Main	**Special Conservation Interests:** • Whooper swan (wintering) • Bewick's swan (wintering) • Golden Plover (wintering) • Goldeneye (wintering) • Pochard (wintering) • Scaup (wintering) • Tufted duck (wintering) • Great-crested grebe (breeding, passage migrant, wintering) • Common tern (breeding) • Black-headed gull (breeding)

2.2 Appraisal of potential pathways for indirect impacts on Natura 2000 sites

15. Indirect impacts on Natura 2000 sites can occur if there is a viable pathway between the source (the Site) and the receptor (the habitats and species for which a Natura 2000 site has been designated). The most common pathway for impacts is surface water: for example, if a pollutant is washed into a river and carried downstream into a Natura 2000 site that has been designated for aquatic habitats and/or fauna. Other potential pathways are groundwater, air (e.g. sound waves or airborne dust), or land (e.g. flow of liquids, vibration). The zone of effect for hydrological impacts can be several kilometres, but for air and land it is rarely more than one hundred metres. The magnitude of impacts (e.g. the concentration of pollutants) usually decreases as the distance between source and receptor increases. An appraisal of potential pathways between the Development and nearby Natura 2000 sites is provided below.

16. The Antrim Hills SPA is located 0.8 km northeast of the Site Boundary. The majority of the SPA, and the areas of greatest importance to breeding hen harrier and merlin, are in the uplands of the Antrim Mountains, which are separated from the Operational Corkey Windfarm by the valley of the Bush River. This acts as a topographical barrier that would prevent any flow of surface water or groundwater from the Development to the SPA. The distances involved are also too great for pathways via land or air. On this basis, the risk of indirect impacts on this SPA via conventional pathways can be ruled out. However, the Site is potentially within the flight range of hen harrier and merlin, as discussed in the following extract from **Chapter 9: Ornithology** of the ES: "*The data collected here indicates a small amount of annual flight activity of hen harriers and merlin, and transits within 500m of the proposed development.*"

17. The Main Valley Bogs SAC is located approx. 5.2 km west of the Site. The Killagan Water / River Main superficially appears to provide a hydrological pathway between the site and the SAC (the watercourse is located to the west of the Site in Figure 1), but in practice the river does not interact with the SAC. The qualifying interests of the SAC – raised bogs – are self-contained hydrological units that are fed entirely by rainwater, and are topographically isolated from nearby rivers, so the river does not provide a viable hydrological pathway to the SAC. The distances involved are also too great for groundwater, air or land pathways. On this basis, the risk of indirect impacts on this SAC can be ruled out.

18. The Garron Plateau SAC and Breen Wood SAC are both located 8 to 10 km from the Site. The Garron Plateau SAC is located in a separate tributary of the River Main, and the Breen Wood SAC is located in a separate river catchment, so there are no surface water pathways between the Site and either SAC. The distances involved are too great for groundwater, air and land pathways, so the risk of indirect impacts on both SACs can be ruled out.

The River Main provides a very distant hydrological connection between the Site and the 'Lough Neagh and Lough Beg' SPA, via approximately 40 km of watercourse. This is considered to be a rather tenuous hydrological pathway, because the intervening waters would dilute any pollutants to very low concentrations before they could reach the SPA. However, if a precautionary approach is adopted, there is a risk that pollution associated with the Development could contribute to poor water quality in Lough Neagh, which could reduce the quality of the habitat for the over-wintering, passage migrant and breeding birds for which the SPA was designated. All other pathways for impacts on this SPA can be ruled out due to distance.

19. In summary, the Site is within the flight range of the 'Antrim Hills' SPA, and a distant hydrological pathway was identified to the 'Lough Neagh and Lough Beg' SPA via the River Main. No potential pathways were identified to any other Natura 2000 sites. Although there are also distant hydrological connections to other designated sites downstream of Lough Neagh and the River Bann, any measures taken to avoid or minimise impacts on the River Main would also avoid or minimise impacts on the other designated sites. Therefore, detailed assessment of the other downstream designated sites is considered unnecessary.

3 Description of the development

3.1 Characteristics of the development

20. Construction will commence with the decommissioning of the Operational Corkey Windfarm, which will involve the removal of all existing turbines, and some redundant sections of access road. The Development will then be constructed, comprising five wind turbines with a maximum blade-tip height of up to 137m, and associated hardstanding areas, access roads, substation, permanent meteorological mast, grid connection and an energy storage area. Three construction compounds will be used temporarily during construction works, and some temporary, small-scale construction work will be required along the transport route in order to facilitate the delivery of turbine components. Detailed descriptions and drawings of the proposed works can be reviewed in the ES **Chapter 3: Development Description**.

3.2 Embedded mitigation

21. Embedded mitigation measures are set out within the Outline Decommissioning / Construction Environmental Management Plan (Outline DCEMP) (provided as **Technical Appendix A3.1**). This document is supplemented by the Water Construction and Environmental Plan (WCEMP), provided as **Technical Appendix A7.2** and which will be appended to the Outline DCEMP, which sets out site-specific pollution-prevention measures. They include established and effective good practice methods, to which the Developer will be committed as part of a planning consent.

22. In other sections of the ES the Outline DCEMP and WCEMP are considered to form an inherent part of the Development, and effects are assessed subject to these measures. However, Appropriate Assessment requires a precautionary approach to the implementation of mitigation, and for the purposes of this Habitat Regulations Assessment, we do not consider embedded mitigation (as outlined in **Technical Appendices A3.1 and A7.2**) in Stage 1 of the AA process. Instead, the hydrological mitigation is treated as traditional mitigation measures in Stage 2.

3.3 Plans or Projects in the surrounding area (potential in-combination effects)

3.3.1 Plans

The regional development plan for the Site is the Northern Area Plan 2016, specifically the sections relevant to Ballymoney Borough Council. The only reference to wind energy developments relates to Areas of Significant Archaeological Interest, and no other aspects of the plan were identified that could lead to potential in-combination effects with the Development. Other plans relevant to renewable energy developments are discussed in **Chapter 5 of the ES**; no potential in-combination effects were identified in any of these plans.

3.3.2 Other developments

23. The Site is located in a rural setting surrounded by agricultural land, farm buildings and one-off houses. It is a settled area and is not subject to significant development pressure. The Northern Ireland planning portal was searched for live or recently-approved applications in the surrounding area, and relevant developments are discussed below.

24. Permission was granted in 2018 for a new permanent access road for the Operational Corkey Windfarm (planning reference: LA01/2018/0724/F) from Reservoir Road to the northeast of the Site, and the development has now been constructed and is in use. The design of the road included drainage proposals to avoid pollution of watercourses, and it was subject to Appropriate Assessment, for which it was concluded that there was no risk of impacts on local watercourses or Natura 2000 sites. Therefore, this development provides no risk of in-combination effects.

25. Permission was granted in 2012 for a single 250 kW turbine (planning reference: D/2012/0059/F) in the west of the Study Area. However, the permission had a five-year validity and was not constructed during this period, so it has lapsed.

26. Permission was granted in August 2018 for a poultry unit with capacity for 32,000 laying hens, located approximately 400 m to the south-west of the Study Area (planning reference LA01/2017/0273/F). The application included procedures for the collection of waste, and for its disposal in accordance with the Nitrates Directive. It is noted in the officer's report that "*the proposal would not be likely to have a significant effect on the features of any European site*". Therefore, it is not considered to pose a risk of in-combination effects.

27. No other pending or recently-approved developments were identified within 500 m of the Site Boundary.

4 Assessment of potential impacts

28. Impact assessments for watercourses, ecology and birds are provided in ES **Chapters 7**, **8 and 9, respectively**. A brief summary of these impact assessments is provided below, but reference should be made to relevant chapters of the ES for further details.

4.1 Direct effects (construction, operation and decommissioning phases)

29. The Site is not within or adjacent to any Natura 2000 sites, so there is no risk of habitat loss, fragmentation or any other direct effects.

4.1.1 Impacts on birds within the Antrim Hills SPA

30. The SPA is located more than 800 m from the boundary of the Development, and neither of the qualifying interests of the SPA – hen harrier and merlin – has been recorded nesting or roosting in the Site or its immediate surroundings. Therefore, there is no risk of direct or indirect impacts on either species during decommissioning/construction works.

4.2 Indirect effects (decommissioning / construction phases)

4.2.1 Suspended sediments

31. Suspended sediments refer to silt, mud or other fine sediments that become dissolved in water. Sediment can be carried into waterbodies by rainwater runoff from exposed ground or sediment stock-piles, during de-watering of excavations (groundwater or surface water), or when installing culverts in watercourses. If the initial decommissioning and construction stages of the Development caused the release of significant quantities of suspended sediments in the River Main catchment, they could potentially be carried downstream into the Lough Neagh and Lough Beg SPA. It is noted that the SPA is located more than 40 km downstream, and thus that any suspended sediments would be diluted to very low concentrations before they could reach the SPA. It is highly unlikely that suspended sediments would affect any of the Special Conservation Interests of the SPA. However, on a precautionary basis, and without consideration of embedded mitigation, it is possible that suspended sediments produced during the initial decommissioning / construction works could contribute to diffuse pollution in the lake.

32. A Peat Slide Risk Assessment (PSRA) is included in **Technical Appendix A7.1**. Within the Development footprint, some localised low risk zones were identified, but the majority of the Site has a generally-negligible hazard rank. On this basis, in the absence of mitigation, the Development is considered to result in a potential effect of negligible significance, and would therefore not be significant in accordance with the EIA Regulations. Therefore, there is not considered to be a risk of sudden releases of suspended sediments from peat slides, and thus no negative effects on the Lough Neagh and Lough Beg SPA.

4.2.2 Other pollutants

33. The construction of the Development will involve the pouring of concrete for turbine foundations, and will require fuels for vehicles; both substances are highly toxic to aquatic life. Potential effects on water quality are an issue of risk management, because if the Development proceeds as intended, there should be no release of cement or hydrocarbon pollutants into nearby waterbodies. However, it is possible that accidental or unplanned events could cause localised releases of pollutants in the Site, which could be washed into watercourses and carried downstream.

34. As noted above, the Lough Neagh and Lough Beg SPA is located more than 40 km downstream, so any pollutants would be diluted to very low concentrations before they could reach the SPA. However, on a precautionary basis, and without consideration of embedded mitigation, it is possible that trace quantities of pollutants produced during the initial decommissioning / construction works could contribute to diffuse pollution in the lake.

4.3 Indirect effects (operational phase)

4.3.1 Impacts on birds within the Antrim Hills SPA

35. Potential impacts on the qualifying interests of the Antrim Hills SPA are discussed in **Chapter 9: Ornithology**. An extract from the chapter is provided below:

36. *"The data collected here indicates a small amount of annual flight activity of hen harriers and merlin, and transits within 500m of the proposed development. Since flights of both were at negligible risk of collision (Appendix A9.3) and both hen harrier and merlin are present breeding in the wider area, a negligible magnitude effect is predicted based on published research and site specific metrics including adequate set-back distances to nearby nest and/or roost sites (Appendix A9.1).*

37. *The proximity of the proposed turbines at Corkey are further than all of the research findings and distances for avoidance of disturbance / displacement effects for both hen harrier and merlin, and there are negligible predicted impacts of disturbance / displacement or collision. Therefore, no significant ieffects are predicted on the site features, hen harrier and merlin at the Antrim Hills SPA."*

4.3.2 Suspended sediments, peat slides and other pollutants

38. No significant releases of suspended sediments or other pollutants are anticipated during the operation of the Development. As a result, there is no risk of impacts on the Lough Neagh and Lough Beg SPA.

4.4 Indirect effects (final decommissioning phase)

4.4.1 Impacts on birds within the Antrim Hills SPA

39. Neither hen harrier nor merlin has been recorded nesting or roosting in the vicinity of the Development, so there is no risk of direct or indirect impacts on the SPA during decommissioning works.

4.4.2 Suspended sediments, peat slides and other pollutants

40. Impacts during the decommissioning of the Development would be similar in character to impacts during the initial decommissioning / construction phases, although the works will be lesser in extent and thus the magnitude of impacts will be less.

4.5 Potential cumulative / in-combination impacts (all phases)

41. No live or recently-approved planning applications were identified that could lead to in-combination effects with the Development.

5 Proposed mitigation measures

5.1 Pollution-prevention measures (construction and decommissioning phases)

42. A range of hydrological mitigation measures have been proposed for the initial decommissioning / construction phases of the Development, which are described in the outline Decommissioning / Construction Environmental Management Plan (**Technical Appendix A3.1: Outline DCEMP**,) and the Water Construction and Environmental Plan (**Technical Appendix A7.2: WCEMP).** In other sections of the ES these documents are described as embedded mitigation, and thus are considered to form an inherent part of the Development. However, Appropriate Assessment requires a precautionary approach to the

implementation of mitigation, so for the purposes of this Habitat Regulations Assessment, the content of the Outline DCEMP and WCEMP are considered to be traditional mitigation measures.

43. In summary, the hydrological mitigation measures for the initial decommissioning / construction phases of the Development, as outlined in the Outline DCEMP and WCEMP are:

- Buffer zones for watercourses, and restrictions on works within these zones;
- Measures for the control of exposed sediments;
- A system of interceptor drains and settlement ponds to control suspended sediments;
- Procedures for the storage of cement (and related materials), for the pouring of concrete, and the cleaning of equipment;
- Procedures for the storage of hydrocarbons, for the refuelling of vehicles, and for responses to any spills; and
- Monitoring and maintenance of the implementation of these measures.

44. The system of interceptor drains and settlement ponds will remain in place during the operation of the Development, and will be monitored and maintained as required.

6 Residual Impacts

45. Residual impacts on surface water are summarised in **Chapter 7: Hydrology, Hydrogeology, Geology, Soils and Peat** as follows:

46. *"*[Subject to the implementation of] *the mitigation measures described in Technical Appendix 7.2, all identified potential effects have been assessed as being of negligible significance. The mitigation measures proposed are established measures that are widely used in construction projects and which the Applicant and its contractors are well used to undertaking. Given the levels of certainty in the success of application of the mitigation measures and their effectiveness, it is appropriate that the mitigation measures form an inherent part of the Development and are taken into account and assumed to be fully effective in the determination of this application.*

47. *No significant residual effects are predicted for all phases of the Development, and are therefore not significant in terms of the EIA Regulations."*

48. It is concluded in **Chapter 9: Ornithology** of the ES that the Development will have no direct or indirect impacts on the qualifying interests of the Antrim Hills SPA.

7 Conclusion

49. In this Habitats Regulations Assessment we provide supporting information to assist the local authority with an Appropriate Assessment of the Development. In a worst-case scenario there is a risk of adverse impacts on the qualifying interests of one site, the 'Lough Neagh and Lough Beg' SPA. A series of good practice hydrological mitigation measures have been recommended by a specialist hydrologist (refer to **Chapter 7** for further details), which will avoid or minimise the risk of significant negative effects on the special conservation interests of the SPA. As a result, we conclude that the Development will not adversely affect the integrity of any Natura 2000 sites.

Corkey Windfarm Repowering

Technical Appendix A8.3: Bat Report

Volume 3 – Technical Appendices
June 2019

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SCOTTISHPOWER RENEWABLES

1 Introduction

1.1 Assessment brief

1. The aim of this report is to identify, quantify and evaluate the effects of the Development on bat species. It forms part of **Chapter 8: Ecology and Fisheries** of the Environmental Statement (ES).

2. This document provides the results of a series of bat surveys that were carried out at the Site in the spring, summer and autumn of 2017. Based on these findings, an assessment of potential risks to local bat populations is provided.

1.2 Statement of authority

3. All surveying and reporting was carried out by the principal ecologist of NM Ecology Ltd. He has eleven years of professional experience, including eight years as an ecological consultant, one year as a local authority biodiversity officer, and two years managing an NGO overseas. He has an MSc in Ecosystem Conservation and Landscape Management from NUI Galway and a BSc in Environmental Science from Queens University Belfast.

4. He is a member of the Chartered Institute of Ecology and Environmental Management, and operates in accordance with their code of professional conduct. He regularly carries out bat surveys for development projects throughout Ireland and Northern Ireland, particularly for windfarms. He has carried out bat surveys for more than ten years, and has completed a number of training courses in bat surveying and mitigation.

2 Assessment Methodology

2.1 Scoping

5. Survey methods were developed with reference to the *NIEA Specific Requirements: Bat Surveys* (NIEA, 2017)[1], and the Bat Conservation Trust (BCT) *Bat Surveys for Professional Ecologists: Good Practice Guidelines* (3rd edition: Collins et al. 2016[2], and Chapter 10 of the 2nd edition guidelines: Hundt *et al.* 2012[3]). It is noted that the Bat Conservation Trust guidelines have recently been superseded by *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation* (Scottish Natural Heritage, 2019)[4], but the SNH guidelines had not been published when the surveys were carried out in 2017, so all survey methods discussed in this report are based on the Bat Conservation Trust guidelines.

6. The Study Area for bat assessments was the Indicative Developable Area, i.e. the locations in which turbines would be located, as shown on Figure 3.2 of the ES, plus an allowance of 50 m micrositing. This is because Wind Turbines provide a potential source of effects on bats, but other aspects of infrastructure (e.g. internal roads) do not pose a risk. Following walkover surveys of the Study Area, it was considered to have relatively low suitability for bats, as there were no potential roost features within the site and surroundings, all habitat features in the vicinity of the proposed turbine locations were of relatively low-value for foraging bats (i.e. heathland and blanket bog), there were no significant linear habitat features (e.g. hedgerows or treelines) within the Site, and because it is exposed to high winds for most of the year (hence its suitability for wind turbines). Therefore, the Site was initially considered to have low suitability for bats, and the minimum survey effort outlined in Table 10.2 of the BCT 2nd edition guidelines was proposed. This would involve a minimum of five nights of automated detectors surveys and one transect survey during each of the three survey seasons (spring, summer and autumn).

7. However, in order to provide a more accurate baseline assessment of the Site, the applicant elected to increase the survey effort for automated-detector surveys to 30 nights in spring, summer and autumn. Following the installation of a meteorological mast in August 2017, some sampling of bat activity at a height of 45 m above ground level was undertaken. Transect surveys were carried during the spring, summer and autumn survey periods, as per the BCT 3rd edition guidelines.

2.2 Automated detector surveys

8. Automated-detector surveys were carried out using *Song Meter SM4BATZC* detectors (Wildlife Acoustics Inc.), with external microphones mounted on a cane at a height of 1.5 m above ground level. The proposed locations for new wind turbines had not been determined at the time of surveying, so detectors were arranged to provide a broad coverage of the Study Area; including the northern, southern, eastern and western slopes of the hill, and all relevant habitat types. The same sampling locations were used for all surveys. A seventh microphone was installed at a height of approximately 45m on the temporary met mast in August 2017, allowing monitoring of bat activity at height in the September 2017 sampling period.

9. Weather data was collected on-site for the duration of the sampling period. The original meteorological mast for the windfarm was installed in 1994 and had ceased to function by the time of survey, and a temporary met mast was not installed until August 2017, so a portable weather station was put in place for the duration of surveys (Aercus Instruments, model WS2083). Average readings for each survey night are presented in Appendix 2.

2.3 Transect surveys

10. Transect surveys were carried out to identify important feeding areas and commuting routes in the Study Area. Surveys started at sunset and lasted for a period of 2-3 hours, and the total ground coverage was approximately 6 to 7 km. As noted above, the final turbine locations had not been determined at the time of survey, so the transects covered representative sections of the Study Area. All surveys were undertaken using an *EM3+* bat detector (Wildlife Acoustics, USA) and an Anabat Express detector in transect mode, allowing sonograms to be recorded for later analysis.

2.4 Roost surveys

11. There is only one building within the boundary of the Study Area: the existing substation of the Operational Corkey Windfarm, which is an industrial structure that is considered to be of negligible value for bats. There are no mature trees, or any other built structures, within or adjacent to the Study Area. Therefore, it was not considered necessary to carry out any surveys for bat roosts.

2.5 Data analysis

2.5.1 Species identification

12. Sonograms from automated detectors were obtained in the 'zero-crossing' format and viewed using AnalookW software (Corben 2014). During transect surveys, bats were identified acoustically in the field and confirmed by sonograms displayed on the EM3+ detector, but calls were also recorded on an Anabat Express for confirmation. Species were identified with reference to *British Bat Calls: A Guide to Species Identification* (Russ 2012)[5], based primarily on frequency and call shape, but occasionally with reference to call slope for *Myotis* spp.

13. It is acknowledged that *Myotis* spp. have very similar calls, and that the classification of sonograms can be imprecise, so all *Myotis* records in this document should be considered as *conferre* records, i.e. *Myotis* cf *daubentonii*. In a similar manner, there can be overlaps in call frequency between *Pipistrellus* spp, particularly at frequencies of 50 kHz. If a bat call could not be confidently identified to species level, it was recorded as an unidentified bat, or identified only to genus level (e.g. *Myotis* spp.). Social calls were also classified as unidentified bats unless they closely matched the examples provided in Russ (2012).

2.5.2 Calculation and comparison of bat activity indices

14. At present there is not a standard system to categorise bat activity as low, moderate or high, because activity levels vary depending on the species involved and the location of a site. In other parts of the UK the *Ecobat* tool (managed by the Mammal Society, Lintott et al. 2018) can be used to benchmark activity levels based on other data collected in the region, but there is not currently a large enough dataset from Northern Ireland to provide reliable results. Data from Britain cannot be applied to Northern Ireland, due to differences in the relative abundances of some species, notably Leisler's bat.

15. Therefore, for the purposes of this report we use a bespoke system to discuss and compare levels of bat activity at the Site, as outlined in the **Table 1**. For ease of comparison, bat activity levels are classified into four categories based on a simple count of bat passes in any night, and cells are coloured using shades of blue. For the purposes of this assessment, any species that regularly has more than 50 bat passes per night (i.e. moderate to high activity) is considered to have a significant level of activity, which would warrant further consideration in an impact assessment.

16.

[1] Northern Ireland Environment Agency, 2017. NIEA Specific Requirements: Bat Surveys. Available online at https://www.daera-ni.gov.uk/publications/bat-surveys-specifications
[2] Collins, J., 2016. *Bat surveys for professional ecologists: good practice guidelines* (3rd edition). Bat Conservation Trust, London.
[3] Hundt, L., 2012. *Bat Surveys: Good Practice Guidelines document*. (2nd edition) Bat Conservation Trust, London
[4] Scottish Natural Heritage (in association with Natural England, Natural Resources Wales, RenewableUK, Scottish Power Renewables, Ecotricity Ltd, the University of Exeter and the Bat Conservation Trust), 2019. *Bats and onshore wind turbines: survey, assessment and mitigation*. Available online at https://www.nature.scot/professional-advice/planning-and-development/renewable-energy-development.
[5] Russ, J.M., 2012. *British Bat Calls: A Guide to Species Identification*. Pelagic Publishing, Exeter, UK

Table 1: Terminology and colour-scheme used to categorise bat activity levels

Category	Number of bat passes
Negligible	≤9
Low	10 - 49
Moderate	50 - 99
High	≥100

It should be noted that activity levels can only be compared within a species and not between species, due to differences in the detection distances for each species and their flight characteristics. For example, if there is low activity by brown long-eared bats (a species with short-range echolocation pulses) and moderate activity by Leisler's bats (which has long-range echolocation pulses), it does not necessarily mean that Leisler's bats are more abundant than brown long-eared bats at that location.

3 Baseline Description

3.1 Automated detector surveys

17. As noted in Section 2.2, the applicant elected to carry out a significantly higher level of automated-detector surveying than would usually be undertaken for a site with low suitability for bats. This comprised a total of 92 survey nights, with 31 in spring (25th April – 8th of May, and 24th May – 9th June), 31 nights in mid-summer (1st – 31st July), and 30 nights in autumn (1st – 30th September). Six locations were sampled in each period, with a seventh detector attached to a microphone at 45 m height on the meteorological mast in September, giving a total of 582 survey nights throughout the study. This is considered to be a very high level of survey effort in comparison to the levels recommended in the BCT survey guidelines (2nd edition, 2012). Survey results are summarised below, and presented in full in Appendix 1.

3.1.1 Spring

18. There was a total of 362 bat passes over the 31-night sampling period, giving an average of 1.9 bat passes per location per night. All six sampling locations had less than one bat pass per night on average. This is considered to be a negligible level of bat activity.

19. The vast majority of passes were Leisler's bat (163 passes, 45% of all passes) and common pipistrelle (160, 44%). Other species included: soprano pipistrelle (14 passes, 4%), *Myotis* sp. (7 passes, 2%), and brown long-eared bat (6 passes, 2%). 12 passes (3%) were very faint or could not be identified to species level, and were listed as unidentified bats.

20. Weather conditions during the survey period were rather variable, covering the transition from spring into early summer. Average nightly temperatures were very low at the start of the survey period, with a minimum of 1 ºC on the first night, and rarely exceeding 7 ºC until the 6th of May. Temperatures in late May were higher, with an average of over 17 ºC on the 26th of May, but temperatures dropped again to approx. 7 – 9 ºC in early June. Average wind speeds were below 5 m/s on most of the survey nights, but wind speeds were higher in early June.

21. The nights of highest bat activity were the 7th of May (107 passes) and 24th May (96 passes). Average nightly wind speeds were 2.7 m/s and 3.1 m/s respectively, which is below the standard cut-in speed of wind turbines.

3.1.2 Summer

22. There was a total of 657 bat passes over the 31-night sampling period, giving an average of 3.5 bat passes per location per night. Sampling locations D1 to D5 had less than one bat pass per night on average, and D6 had 1.6 passes/night (refer to Figure 1 below). This is considered to be a negligible level of bat activity at all locations.

23. The majority of passes were Leisler's bat (444 passes, 67.5% of all passes), followed by common pipistrelle (175 passes, 26.5%), *Myotis* sp. (25 passes, 4%), soprano pipistrelle (2 passes, <1%), and unidentified bats (11 passes, 2%).

24. Weather conditions during the survey period were mild, with average nightly temperatures of 10.8 ºC throughout the sampling period, and a minimum of 8.6 ºC. Wind speeds were moderate, with an average of 5.4 m/s, and occasionally reaching average speeds of over 10 m/s. The nights of highest bat activity were the 7th (127 passes) and 17th of July (151 passes). Average nightly wind speeds on these nights were 3.4 m/s and 2.9 m/s respectively.

3.1.3 Autumn

25. There was a total of 2,113 bat passes over the 30-night sampling period, giving an average of 10.0 bat passes per location per night. Sampling location D2 had an average of 4.3 passes per night, D3 had an average of 2 passes per night, and D5 had an average of 1.2 passes per night; all other sampling location had less than one bat pass per night on average. This is considered to be a low level of bat activity at sampling locations D2, D3 and D5, and a negligible level of activity at all other locations.

26. The majority of passes were Leisler's bat (993 passes, 47% of all passes) and common pipistrelles (85 passes, 42%), followed by soprano pipistrelles (85 passes, 4%) *Myotis* sp. (107 passes, 5%), Nathusius pipistrelle (1 passes, <1%), and unidentified bats (39 passes, 2%).

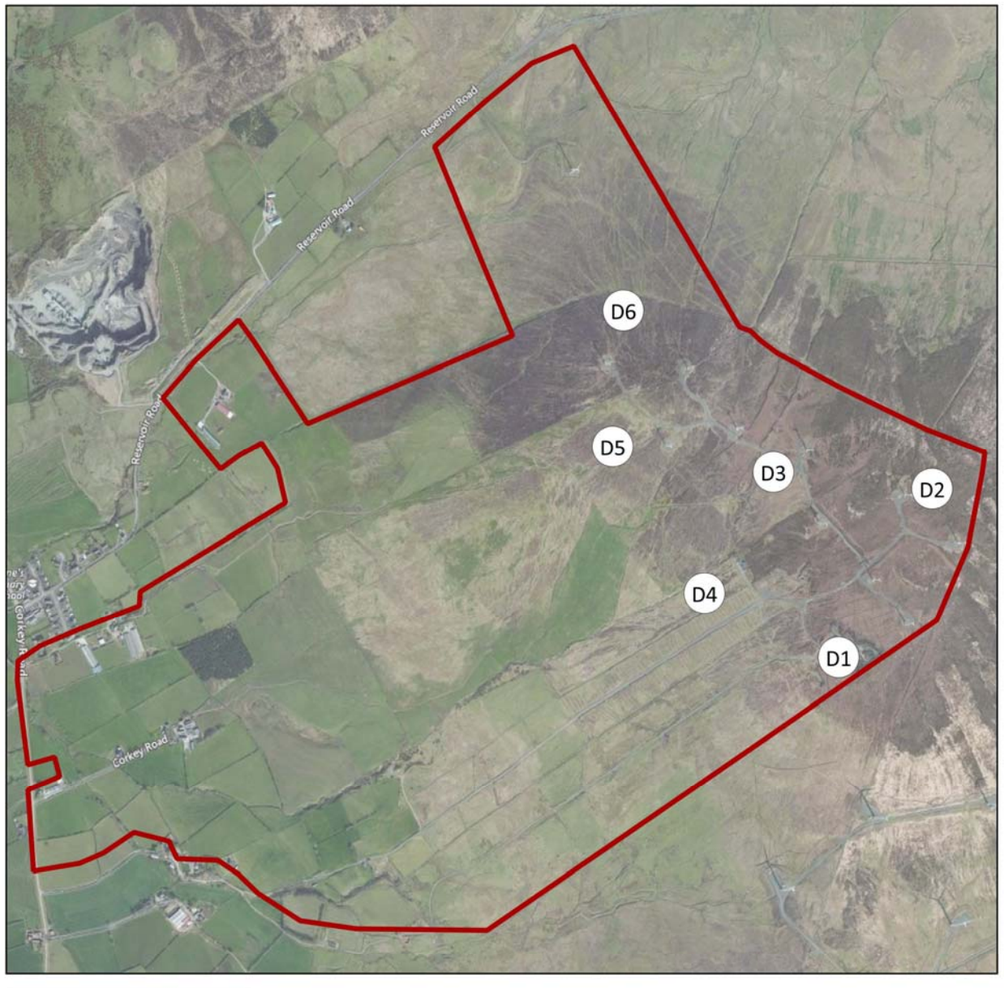
27. There was considerable temporal variation in bat activity: four nights had high activity (>100 passes), three nights had moderate activity (50 – 100 passes), five nights had low activity (10 – 50 passes), nine nights had negligible activity, and nine nights had no activity. This is likely to be due to variation in weather conditions during the sampling period, particularly wind speed.

28. Average nightly temperatures remained quite mild during the sampling period, with average nightly temperatures of 9.3 ºC throughout the sampling period, and rarely dropping below 8 ºC. Wind speeds were higher than in previous months, with an average of 8.5 m/s, and occasionally reaching average speeds of over 16 m/s. The nights of highest bat activity were the 1st (668 passes), 17th (497 passes), 18th (195 passes) and 24th (443 passes) of September. Average nightly wind speeds were 3.8, 4.4, 3.9 and 1.0 m/s respectively.

Figure 1	Automated surveys for bats
Location	Corkey Windfarm, Co. Antrim
Applicant	ScottishPower Renewables
Date	April - September 2017

NM Ecology Ltd - Ecological Consultants
Website: www.nmecology.com
Email: info@nmecology.com
Tel: 087-6839771

○ Locations of static detectors



NM ECOLOGY

0 200 400 600 800 1000 m

3.1.4 Weather conditions

29. Wind speed and temperature were collected throughout the survey period using a portable weather station. Average temperature and wind speed recordings for each survey night are presented in Appendix 2. The Irish climate is highly variable, even during summer months, and the survey period covered a range of weather conditions. Each of the survey periods included periods of high suitability for bats (e.g. high temperatures and low winds), periods of low suitability (low temperatures and high winds), and a gradient of intermediate conditions. This is considered to be representative of natural conditions, and to provide a balanced dataset.

3.2 Transect surveys

3.2.1 Spring

30. The survey was carried out on the 8th of May 2017. Post-sunset temperatures were 9 to 11 ºC, wind speeds were approximately 2 to 3 m/s, and there was no rain. Sunset was at 21:12, so the survey started at 21:15 and ended at 23:50. The surveyors started at the base of the hill in the west of the Study Area, then followed a loop around the southern part of the existing wind farm, passed a number of the operational turbines, proceeding to the north of the Study Area, and then descended the hill toward the west(see Figure 2).

31. No bats were recorded during the survey.

3.2.2 Summer

32. The survey was carried out on the 1st of August 2017. Post-sunset temperatures were 12 – 16 ºC, wind speeds were approximately 1 to 2 m/s, and there was no rain. Sunset was at 21:26, so the survey started at 21:30 and ended at 00:10. The survey route was adjusted to focus on the Indicative Developable Area on the crest of the hill. The surveyors started on the north-western slope of the hill, then followed a loop around the northern part of the existing wind farm, past a number of the operational turbines, proceeding to the east of the Study Area, and then returning via the southern slope (see Figure 3).

33. 69 bats were recorded, of which 42 were common pipistrelles, 18 were Leisler's bat, and 9 were soprano pipistrelles. Over the two-hour sampling period, this gives a Bat Activity Index (BAI) of 34.5 bat passes per hour. Most of the activity was recorded in the northern part of the Study Area around the crest of the hill; however, this is also the part of the Study Area that was surveyed first, and there is often a peak of bat activity immediately after sunset, so this may have influenced the spatial arrangement of records. Most of the pipistrelles were observed flying at a height of approx. 2 to 3 m above ground level, but none of the Leisler's bats were observed, so it is likely that they were flying at a height of above 5m.

3.2.3 Autumn

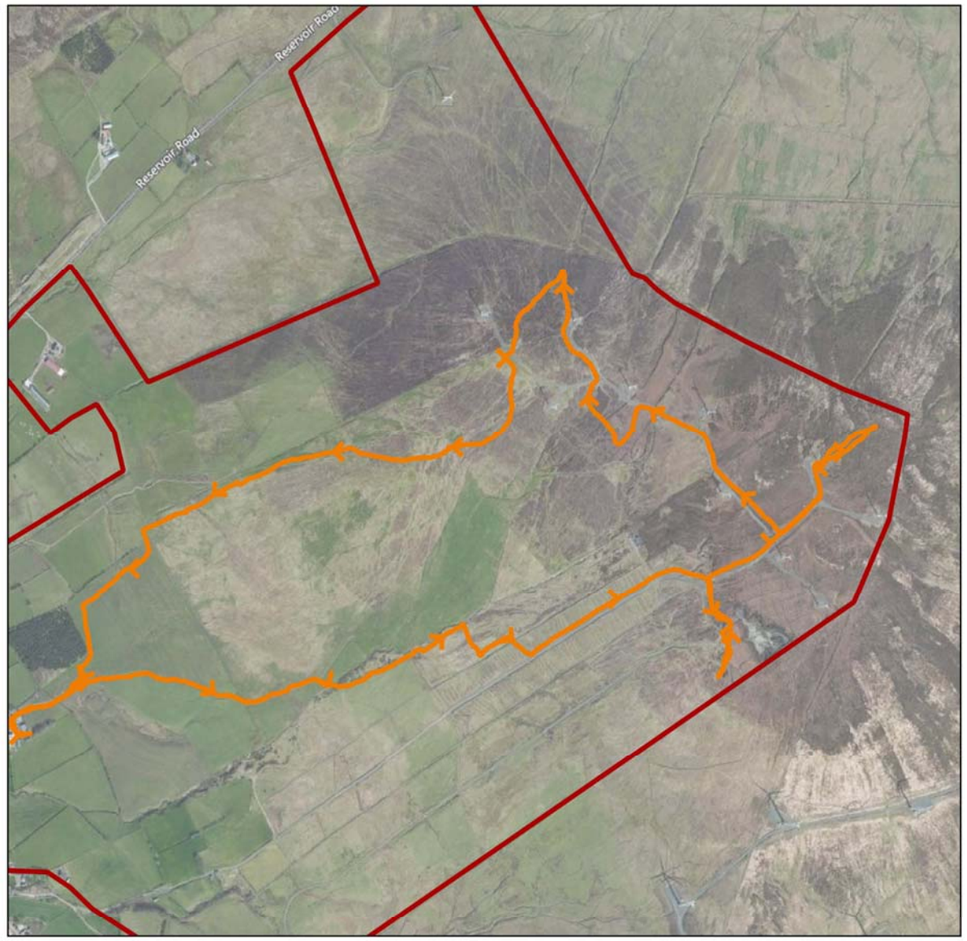
34. The survey was carried out on the 3rd of October 2017. Post-sunset temperatures were 12 to 14 ºC, wind speeds were approximately 5 to 6 m/s, and there was no rain. Sunset was at 18:59, so the survey started at 18:45 and ended at 21:20. The survey route followed approximately the same route as the summer transect, but was carried out in the opposite direction (see Figure 4).

35. Only one bat was encountered during the survey: a *Myotis* bat on the lower slopes of the hill in the west of the Study Area near the end of the survey. No bats were recorded at any of the proposed turbine locations .

Figure 2	Transect survey - spring
Location	Corkey Windfarm, Co. Antrim
Applicant	ScottishPower Renewables
Date	08 May 2017

NM Ecology Ltd - Ecological Consultants
Website: www.nmecology.com
Email: info@nmecology.com
Tel: 087-6839771

Transect route

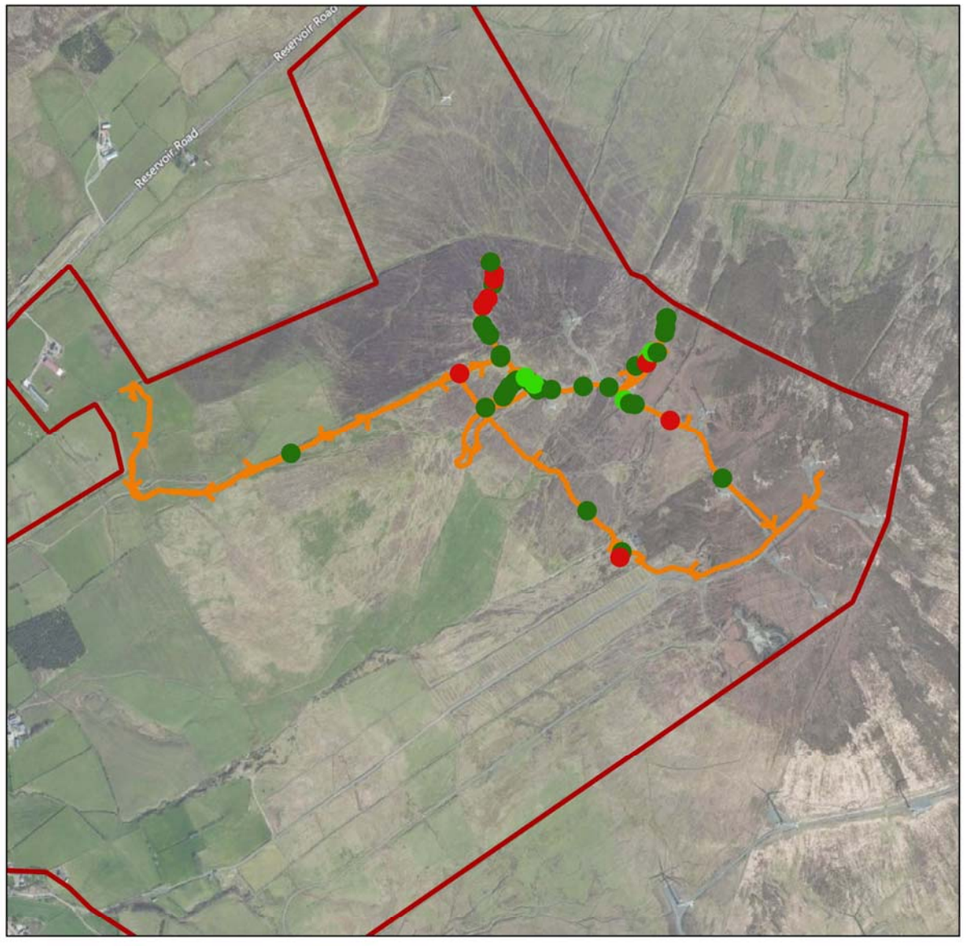


NM ECOLOGY

Figure 3	Transect survey - summer
Location	Corkey Windfarm, Co. Antrim
Applicant	ScottishPower Renewables
Date	01 August 2017

NM Ecology Ltd - Ecological Consultants
Website: www.nmecology.com
Email: info@nmecology.com
Tel: 087-6839771

Bats recorded
- Leisler's bat
- Soprano pipistrelle
- Common pipistrelle
- Transect route



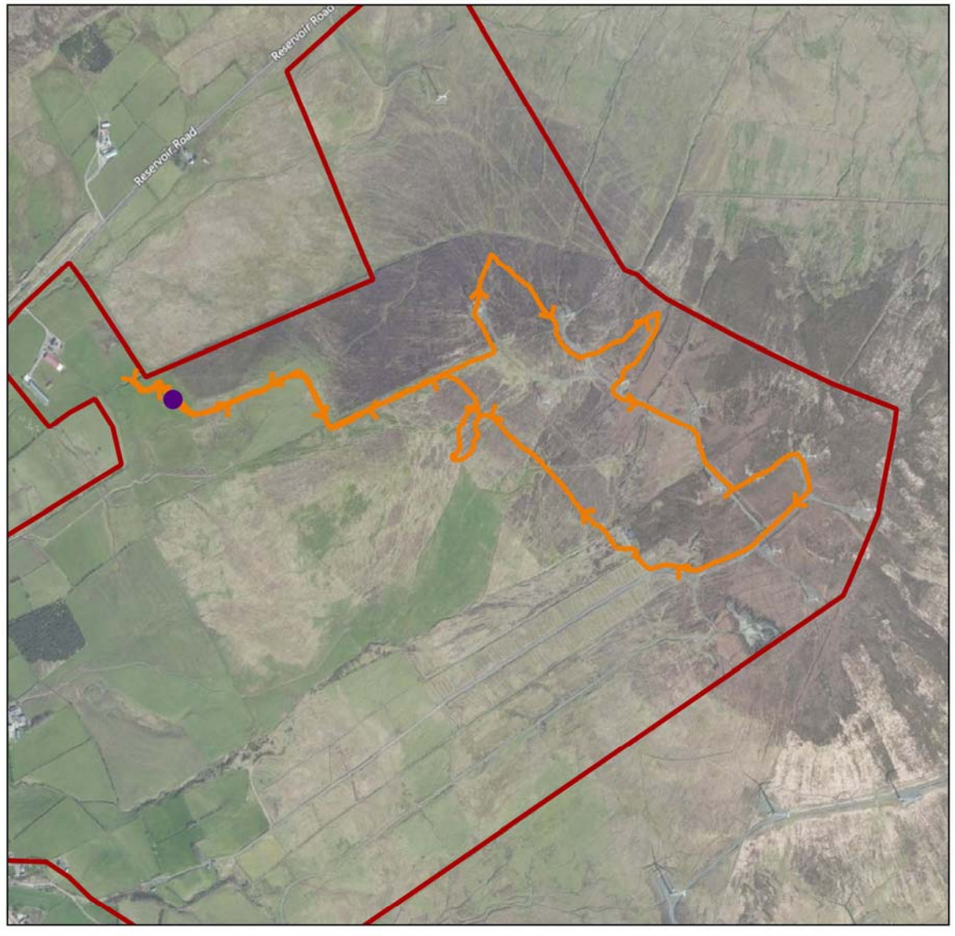
NM ECOLOGY

0 200 400 600 800 1000 m

Figure 4	Transect survey - autumn
Location	Corkey Windfarm, Co. Antrim
Applicant	ScottishPower Renewables
Date	03 October 2017

NM Ecology Ltd - Ecological Consultants
Website: www.nmecology.com
Email: info@nmecology.com
Tel: 087-6839771

Bats encountered
- Myotis sp.
- Transect route



NM ECOLOGY

0 200 400 600 800 1000 m

3.3 Data analysis

3.3.1 Species summaries

36. Research studies have shown that, due to their different behaviour and flight style, bat species are affected differently by wind turbines (Rodrigues et al., 2014[6], SNH 2019). Of the eight bat species that are regularly recorded in Northern Ireland, four species – Leisler's bat, common pipistrelle, soprano pipistrelle and Nathusius' pipistrelle – are considered to have a high risk of collisions from wind turbines (SNH 2019). The other four species – *Myotis* species and brown long-eared bats – typically fly at very low heights, and are considered to have little or no risk of collisions. To facilitate comparisons between the sampling locations and months, summaries for the four high-risk species are provided below.

3.3.1.1 Leisler's bat

37. Leisler's bat was the most frequently-recorded species in this study, comprising 51% of all records. The highest counts were in September, but there was not a clear temporal pattern to the dataset. In all months, the highest counts were recorded on nights of low wind speeds, typically less than 4 m/s. There was no clear spatial pattern to activity levels, as bats were recorded at all sampling locations in approximately similar numbers, and the nights of moderate and high activity were not clustered at a particular location. A summary of the counts at each location on each sampling night are provided in **Table 2**.

38. Using the activity categories outlined in Section 2.5, there was negligible activity on 93.6% of nights, low activity on 5.6% of nights, moderate activity on 0.5% of nights, and high activity on 0.3% of nights. Overall, this indicates that Leisler's bat does not use the Study Area in significant numbers on a regular basis. Even though there were some nights of moderate or high activity, there was no spatial or temporal pattern in the data, so the Study Area does not appear to be an important feeding area or commuting route for this species.

3.3.1.2 Common pipistrelle

39. This was the second most-frequently-recorded species in this study, comprising 39% of all records. As above, the highest counts were in September, and typically occurred on nights of low wind speeds, typically less than <4 m/s. There was no clear spatial pattern to activity levels, as bats were recorded at all sampling locations in approximately similar numbers. However, the counts at ground level at sampling location D1 (referred to as D1 G in Table 3 were very low, and no bats were recorded at a height of 45 m (referred to as D1 H in Table 3). A summary of the counts at each location on each sampling night are provided in **Table 3**.

40. There was negligible activity on 95.3% of nights, low activity on 4.2% of nights, moderate activity on 0.2% of nights, and high activity on 0.3% of nights. As above, this indicates that common pipistrelles do not use the Study Area in significant numbers on a regular basis, and that the Study Area is not an important feeding area or commuting route for this species.

3.3.1.3 Soprano pipistrelle

41. This was the third most-frequently-recorded species in this study, comprising 3% of all records. A summary of the counts at each location on each sampling night are provided in **Table 4**. There was negligible activity on 99.7% of nights, low activity on 0.3% of nights, and no nights of moderate or high activity. This clearly indicates that the Study Area is of negligible importance for soprano pipistrelles.

3.3.1.4 Nathusius pipistrelle

42. Only a single Nathusius pipistrelle was recorded during this study, so it can be concluded that the Study Area is of negligible importance for this species.

3.3.2 Bat activity at height

43. Sampling location D1 was sampled both at ground level and a height of 45m on the temporary meteorological mast. The only species recorded at height was Leisler's bat, for which there were 52 passes over the 30-night sampling period, in comparison to the 73 Leisler's passes that were recorded at ground level. The detection distance for Leisler's bat is estimated to be approx. 20 – 40 m, so it is likely that many bats would have been recorded simultaneously by both microphones. Overall, it indicates that there was more bat activity close to the ground than at height.

44. No pipistrelles were recorded at height, even though 98 common pipistrelle and 11 soprano pipistrelle passes were recorded at ground level during the sampling period. The detection distance for pipistrelle bats is estimated to be approx. 10 – 20 m, so low-flying bats are unlikely to be recorded on the microphone at 45 m height. Therefore, pipistrelle activity was significantly higher near ground level than at height.

[6] Rodrigues, L., et al. 2014. *EUROBATS Publication Series No. 6: Guidelines for consideration of bats in wind farm projects, Revision 2014*. UNEP/EUROBATS Secretariat, Bonn, Germany

Table 2: Summary of Leisler's bat counts at each location on each sampling night. The location codes correspond to Figure 1, with 'D1 G' recorded at ground level, and 'D1 H' recorded at a height of 45 m on the meteorological mast

	Apr					May										May							Jun								
Location	25	26	27	28	29	30	1	2	3	4	5	6	7	8		24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9
D1 G	0	0	0	0	0	0	0	0	0	0	0	10	2	0		22	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D2	0	0	0	0	0	0	0	0	0	0	0	0	18	0		10	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
D3	0	0	0	0	0	0	0	1	0	0	0	16	0	0		6	0	0	0	0	0	3	0	0	4	0	0	0	0	0	0	0
D4	0	0	0	0	0	0	0	0	0	0	0	0	7	0		0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
D5	0	0	0	0	0	0	0	0	0	0	0	10	0	0		18	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
D6	0	0	0	0	0	0	0	0	0	0	0	3	0	0		13	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0

	June					July																											
Location	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
D1 G	0	7	0	0	0	0	2	0	2	0	0	0	0	0	26	2	0	0	0	0	0	71	0	0	0	34	3	4	0	0	0	0	0	0	0	3
D2	0	0	0	6	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	23	6	0	0	0	0	0	0	0	0	0	1	0	2	
D3	0	0	0	1	0	0	0	0	0	0	1	0	9	0	4	0	0	0	0	0	0	8	0	0	0	0	0	6	2	0	0	0	3	1	0	1
D4	0	3	0	0	0	0	0	0	2	0	0	0	0	0	21	0	2	0	0	0	0	35	0	0	0	39	0	2	0	0	0	0	0	0	0	0
D5	0	0	0	3	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	2
D6	0	0	0	4	0	0	3	0	0	1	0	0	0	0	3	4	0	0	1	0	1	8	0	0	0	0	6	15	0	1	3	0	5	0	38	23

	Sept																												
Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D1 G	14	0	0	3	0	0	0	0	8	0	2	0	0	0	3	0	39	0	0	0	0	0	0	4	0	0	0	0	0	0
D1 H	8	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	21	3	0	0	0	0	0	17	0	0	0	0	0	0
D2	294	0	0	0	0	0	0	28	14	0	4	0	0	0	0	0	33	30	0	0	0	0	0	45	0	0	0	0	0	0
D3	30	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	82	15	0	0	0	0	0	112	0	0	0	0	0	0
D4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	34	0	0	0	0	0	0
D5	7	0	0	0	0	14	13	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	61	0	0	0	0	0	0
D6	6	0	0	16	14	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3: Summary of common pipistrelle counts at each location on each sampling night.

	Apr					May									May								Jun								
Location	25	26	27	28	29	30	1	2	3	4	5	6	7	8	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9
D1 G	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
D2	0	0	0	0	0	0	0	0	0	0	0	1	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D3	0	0	0	0	0	0	0	0	0	0	0	2	19	0	8	0	0	0	2	0	12	0	0	0	0	0	0	0	0	0	0
D4	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
D5	0	0	0	0	0	0	0	0	0	0	0	3	11	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D6	0	0	0	0	0	0	0	0	0	0	0	1	18	0	5	0	0	0	23	15	0	0	0	0	3	0	0	0	0	0	0

	June					July																												
Location	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
D1 G	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0
D2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	2	0	0	
D3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	
D4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
D5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	2	0	0	0	0	0	0	1	0	0	
D6	0	0	0	0	0	0	0	0	0	0	0	122	8	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	6	0	1	0	0	1	6	0

	Sept																												
Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D1 G	32	0	1	3	0	9	2	0	4	0	1	0	0	0	0	0	25	8	0	0	0	1	0	12	0	0	0	0	0	0
D1 H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D2	204	0	0	1	1	2	4	0	15	0	0	0	3	0	0	1	79	43	1	0	0	3	0	14	0	0	0	0	0	0
D3	16	0	0	0	2	4	0	0	1	0	0	0	0	0	0	0	45	31	0	0	1	0	0	31	0	0	0	0	0	0
D4	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	45	28	0	0	0	1	0	14	0	0	0	0	0	0
D5	9	0	0	3	3	2	0	0	0	0	0	0	0	0	0	0	49	18	0	0	0	2	0	22	0	0	0	0	0	0
D6	2	0	0	3	8	14	18	18	9	0	0	0	0	0	0	1	3	2	0	0	2	2	0	7	0	0	1	0	0	0

Table 4: Summary of soprano pipistrelle counts at each location on each sampling night.

	Apr					May									May								Jun								
Location	25	26	27	28	29	30	1	2	3	4	5	6	7	8	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9
D1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D6	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	June					July																												
Location	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
D1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
D5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D6	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Sept																												
Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D1 G	6	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
D1 H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D2	18	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	1	1	0	0	0	0	0	3	0	0	0	0	0	0
D3	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0	0	1	0	0	1	0	0	0	0	0	0
D4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	6	0	0	0	0	0	0
D5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	1	0	2	0	0	0	0	0	0
D6	0	0	0	1	0	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.4 Overall conclusions

45. A series of automated-detector and transect surveys were carried out in the Study Area, using a survey effort that was significantly in excess of the levels recommended in the Bat Conservation Trust guidelines (2nd edition, 2012). The only species recorded in significant numbers were Leisler's bat and common pipistrelle; all other species had negligible activity. Although there were some nights of moderate and high activity for Leisler's bats and common pipistrelles, the vast majority (90%) of nights had negligible activity (i.e. < 10 bat passes). Activity levels were strongly related to wind speed, and the nights of moderate or high activity generally occurred when wind speeds were less than 4 m/s; it should be noted that this is below the cut-in speed for modern wind turbines.

46. On this basis, it is concluded that the Study Area is not used by any bat species on a regular basis as a feeding area or commuting route. There is a high degree of confidence in this conclusion, because the survey had a high level of survey effort, and covered all key periods of the activity season.

47. The ecological value of the Study Area can be categorised using the valuation system of the CIEEM Guidelines (refer to **Chapter 8: Ecology and Fisheries**). The Study Area does not support any of the preferred habitats of bats – woodland, hedgerows, rivers and lakes – and there are no built structures or mature trees in the Study Area that would be suitable for a maternity roost. On this basis, and considering that the Study Area is only used by bats on an occasional basis, the Study Area is considered to be of negligible ecological value for bats.

48. Nonetheless, it is noted that all bat species receive strict protection under the *Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995* (S.I. 1995/380, as amended), under which it is an offence to kill, injure or disturb any bat species. In accordance with policy NH 2 of the Department of the Environment's *Planning Policy Statement 2: Natural Heritage* (DOENI, 2013), planning permission will only be granted for a development that is not likely to harm any protected species (subject to suitable mitigation measures).

4 Assessment of Potential Effects

4.1 Decommissioning/Construction phase

49. Site clearance works will involve the removal of low-growing vegetation and soils in the footprint of all works. This will predominantly take place on heathland and grassland vegetation, which is of negligible value for feeding and commuting bats. No trees, hedgerows or other linear habitats will be removed, so there will be no severance or disturbance of commuting routes or feeding areas. Therefore, habitat loss during site clearance works will not cause any significant adverse effects on bats.

4.2 Operation phase

50. Although bat fatalities have been reported from operational windfarms in North America and parts of Europe for almost twenty years, evidence from the British and Irish Isles has only begun to emerge in recent years. The key reference in this regard is a large-scale study by researchers at Exeter University that was published by Mathews et al. in 2016[7], which was based on bat activity and corpse searches at 46 operational wind farms throughout the British Isles. Bat carcasses were found at two-thirds of these sites, of which 48% of fatalities were common pipistrelles, 40% were soprano pipistrelles and 10% were noctule bats (which are closely related to Leisler's bats). The estimated casualty rates, which were corrected for predator removals and the efficiency of the searchers, ranged from 0 to 5.25 bats per turbine per month, and from 0 to 77 bats per site per month, during the period of the survey. The nights of highest pipistrelle activity were considered to have the highest likelihood of casualties, although bat fatalities were only recorded in one third of locations. In the Mathews et al. (2016) study, 'high activity' was defined as a night with more than 50 bat passes, which is equivalent to the moderate and high activity categories used in this assessment.

51. Two species were recorded in significant numbers (i.e. moderate or high activity) during automated detector surveys in the Study Area - Leisler's bats and common pipistrelles - both of which are considered to have a high collision risk from wind turbines (SNH 2019). However, moderate or high activity of these species was recorded on less than 1% of sampling nights, and there was no temporal or spatial pattern to the dataset, so it was concluded that neither species uses the Study Area as a feeding area or commuting route on a regular basis. Furthermore, the nights of moderate or high activity were typically recorded on nights with average wind speeds of less than 4 m/s, which is below the cut-in speed of modern wind turbines.

52. Based on the profile of bat activity collected in pre-construction surveys, there is not considered to be a significant risk of collision-related fatalities during the operation of the Development. Therefore, the operation of the Development will have a negligible effect on foraging and commuting bats.

4.3 'Do nothing scenario'

53. If the Development does not proceed, the Study Area is expected to remain in the baseline condition (i.e. the Operational Corkey Windfarm) and to be used by common bat species at the levels recorded in 2017. The conservation status of all bat species in Ireland is understood to be stable, so no decline in bat activity is predicted.

5 Proposed mitigation measures

54. The Development is not expected to have any effect on bats during the decommissioning/construction or operation phases, so there will be no requirement for avoidance or mitigation measures.

6 Residual impacts

55. As the Development will have no effect on bats, there will be no difference from the 'Do nothing scenario'. It is expected that bats will continue to use the Study Area at the levels recorded in 2017.

7 Monitoring

56. Current best practice for the monitoring of bat populations at wind farms (as outlined in the Scottish Natural Heritage 2019 guidelines), is that "*post-construction monitoring is normally only required at developments where the mitigation involves turbine curtailment*". As the proposed development will not involve curtailment, and is expected to have a negligible effect on foraging and commuting bats, no monitoring will be necessary.

[7] Mathews, F., Richardson, S., Lintott, P., Hosken, D., 2016. *Understanding the Risk to European Protected Species (bats) at Onshore Wind Turbine Sites to inform Risk Management*. Exeter University, England.

Appendix 1: Breakdown of automated detector survey results

Table A1. Detailed breakdown of bat records from the spring surveys, expressed as the total numbers of bat passes of each species per turbine per night

		Apr						May										Jun																
Location	**Species**	**25**	**26**	**27**	**28**	**29**	**30**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
D1	L												10	2		22		2																36
	CP											2		2				1		1														6
	SP												1																					1
	Total	0	0	0	0	0	0	0	0	0	0	2	11	4	0	22	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	43
D2	L													18		10				3														31
	CP												1	15																				16
	SP												2																					2
	UP												3																					3
	UnID												1	1																				2
	Total	0	0	0	0	0	0	0	0	0	0	0	7	34	0	10	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	54
D3	L								1				16			6						3			4								30
	CP												2	19		8				2		12											43
	SP													2																				2
	MD																			1														1
	Total	0	0	0	0	0	0	0	1	0	0	0	18	21	0	14	0	0	0	3	0	15	0	0	4	0	0	0	0	0	0	0	76
D4	L													7						4														11
	CP			2										2						4														8
	MN															1																		1
	Total	0	0	2	0	0	0	0	0	0	0	0	0	9	0	1	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	20
D5	L												10			18				1														29
	CP												3	11		7	1																	22
	SP													1																					1
	UP													1																					1
	UnID															1																			1
	Total	0	0	0	0	0	0	0	0	0	0	0	13	13	0	26	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	54
D6	L												3			13							10											26
	CP												1	18		5				23	15					3								65
	SP													8																					8
	MN															3										1								4
	MY																				1													1
	BLE															2						3			1									6
	UnID																			2	2					1								5
	Total	0	0	0	0	0	0	0	0	0	0	0	4	26	0	23	0	0	0	25	18	3	10	0	1	5	0	0	0	0	0	0	115
Overall total		**0**	**0**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**53**	**107**	**0**	**96**	**1**	**3**	**0**	**41**	**18**	**18**	**10**	**0**	**5**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**362**

** Species codes are as follows: L – Leisler's bat; CP – common pipistrelle; SP – soprano pipistrelle; UP – Unidentified pipistrelle; NP – Nathusius' pipistrelle; MD – Daubenton's bat; MN – Natterer's bat; MY – unidentified Myotis species; BLE – brown long-eared bat; UnID – unidentified bat.*

Table A2. Breakdown of bat records from the summer surveys

		July																													
Location	**Species**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**Total**
D1	L		2		2						26	2						71				34	3	4								3	147
	CP				2													2				5											9
	UnID																				1												1
	Total	0	2	0	4	0	0	0	0	0	26	2	0	0	0	0	0	73	0	0	1	39	3	4	0	0	0	0	0	0	0	3	157
D2	L				2													23	6											1		2	34
	CP								1									1								1				2			5
	MD																				1												1
	Total	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	24	6	0	1	0	0	0	0	1	0	0	0	3	0	2	40
D3	L						1		9		4							8						6	2				3	1		1	35
	CP																	1												1			2
	UnID																1																1
	Total	0	0	0	0	0	1	0	9	0	4	0	0	0	0	0	1	9	0	0	0	0	0	6	2	0	0	0	3	2	0	1	38
D4	L				2						21		2					35				39		2									101
	CP										1																1						2
	SP																							1									1
	UnID												1																					1
	Total	0	0	0	2	0	0	0	0	0	22	0	3	0	0	0	0	35	0	0	0	39	0	3	0	0	1	0	0	0	0	0	105
D5	L								3		2																			4	4	2	15
	CP								1						1						1	2								1			6
	UnID																																0
	Total	0	0	0	0	0	0	0	4	0	2	0	0	0	0	1	0	0	0	0	1	2	0	0	0	0	0	0	5	4	2		21
D6	L		3			1					3	4			1		1	8					6	15		1	3		5		38	23	112
	CP							122	8								4	2						6		1			1	6		1	151
	SP								1																									1
	MN	1												1		1						1									1		5
	MY	2	2		2			1	1		1	3	3	1		1								1								1	19
	UnID						1	4	1			1																1						8
	Total	3	5	0	2	1	1	127	11	0	4	8	3	2	1	2	5	10	0	0	0	1	6	22	0	2	3	1	6	6	39	25	296
Overall Total		**3**	**7**	**0**	**10**	**1**	**2**	**127**	**25**	**0**	**58**	**10**	**6**	**2**	**1**	**3**	**6**	**151**	**6**	**0**	**3**	**81**	**9**	**35**	**2**	**3**	**4**	**1**	**9**	**16**	**43**	**33**	**657**

Table A3. Breakdown of bat records from the autumn surveys

		Sept																													
Location	**Species**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**Total**
D1 G	L	14			3					8		2				3		39							4							73
	CP	32		1	3		9	2		4		1						25	8				1		12							98
	SP	6					2			1												1	1									11
	MY																	3	2			1			3							9
	MN																	1														1
	UnID	2																														2
	Total	54		1	6		11	2		13		3				3		68	10			2	2		19							194
D1 H	L	8														2	1	21	3						17							52
	Total	8														2	1	21	3						17							52
D2	L	294							28	14		4						33	30						45							448
	CP	204			1	1	2	4		15				3			1	79	43	1			3		14							371
	SP	18								2				1				1	1						3							26
	MY						1											27				1			1							30
	MN																	4							1							5
	UnID	4				1								1				5	2													13

Location	Species	Sept 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
	Total	520			1	2	3	4	28	31		4		5			1	149	76	1		1	3		64							893
D3	L	30					1											82	15						112							240
	CP	16				2	4			1								45	31			1			31							131
	SP	10																6	2			1			1							20
	UP																		1													1
	NP																	1														1
	MY	2																4							12	2					1	21
	MN																	1							5							6
	UnID	2																1	1													4
	Total	60				2	5			1								140	50			2			161	2					1	424
D4	L																	6							34							40
	CP						2											45	28				1		14							90
	SP																	3	1						6							10
	UP																		1													1
	MY																2	1							2							5
	MN																								3							3
	UnID	1															1		3						1							6
	Total	1					2										3	55	33				1		60							155
D5	L	7					14	13									1	3							61							99
	CP	9			3	3	2											49	18				2		22							108
	SP																	7					1		2							10
	MY																								22						1	23
	UnID																		3						6							9
	Total	16			3	3	16	13									1	59	21				3		113						1	249
D6	L	6			16	14											3	2														41
	CP	2			3	8	14	18	18	9							1	3	2			2	2		7			1				90
	SP				1		1		6																							8
	MY	1																				1			1							3
	MN																									1						1
	UnID							1									1								1							3
	Total	9			20	22	15	19	24	9							5	5	2			3	2		9	1		1				146
Overall Total		**668**		**1**	**30**	**29**	**52**	**38**	**52**	**54**		**7**		**5**		**5**	**11**	**497**	**195**	**1**		**8**	**11**		**443**	**3**		**1**			**2**	**2113**

Appendix 2: Summary of weather conditions

Table A4. Summary of average nightly temperature and wind speed

Season	Date	Temperature (°C)	Wind speed (m/s)
Spring	25/04/2017	1.0	3.0
	26/04/2017	4.4	1.4
	27/04/2017	5.2	2.3
	28/04/2017	5.3	3.2
	29/04/2017	6.9	4.3
	30/04/2017	7.1	4.6
	01/05/2017	7.1	3.7
	02/05/2017	7.0	3.7
	03/05/2017	6.6	4.3
	04/05/2017	5.8	5.9
	05/05/2017	5.3	5.0
	06/05/2017	8.5	0.9
	07/05/2017	7.4	2.7
	08/05/2017	8.4	0.0
	24/05/2017	14.2	3.1
	25/05/2017	15.8	5.7
	26/05/2017	17.4	5.4
	27/05/2017	9.8	8.1
	28/05/2017	8.9	3.1
	29/05/2017	10.7	3.8
	30/05/2017	7.1	2.1
	31/05/2017	10.5	9.8
	01/06/2017	10.1	5.4
	02/06/2017	9.5	3.7
	03/06/2017	7.0	5.0
	04/06/2017	7.2	3.8
	05/06/2017	7.9	9.6
	06/06/2017	7.6	9.6
	07/06/2017	9.7	4.1
	08/06/2017	9.7	5.8
	09/06/2017	10.8	8.6
Summer	01/07/2017	8.9	6.4
	02/07/2017	10.3	5.9
	03/07/2017	8.9	4.4
	04/07/2017	9.4	3.8
	05/07/2017	12.3	5.6
	06/07/2017	13.0	5.2
	07/07/2017	8.6	3.4
	08/07/2017	11.4	4.2
	09/07/2017	9.1	3.4
	10/07/2017	8.6	1.5
	11/07/2017	9.7	2.5
	12/07/2017	11.3	5.3
	13/07/2017	9.3	5.5
	14/07/2017	12.3	8.0

	15/07/2017	10.3	3.9
	16/07/2017	9.9	4.8
	17/07/2017	15.0	2.9
	18/07/2017	15.0	8.5
	19/07/2017	8.9	4.9
	20/07/2017	9.2	4.1
	21/07/2017	10.8	4.5
	22/07/2017	11.8	4.1
	23/07/2017	12.0	2.3
	24/07/2017	11.2	5.1
	25/07/2017	12.4	6.0
	26/07/2017	8.8	7.8
	27/07/2017	9.8	11.6
	28/07/2017	10.3	10.5
	29/07/2017	12.6	5.9
	30/07/2017	13.7	7.5
	31/07/2017	10.8	6.4
Autumn	01/09/2017	9.1	3.8
	02/09/2017	11.6	16.4
	03/09/2017	13.5	8.5
	04/09/2017	11.4	8.6
	05/09/2017	8.7	7.3
	06/09/2017	10.2	7.1
	07/09/2017	8.7	8.1
	08/09/2017	9.2	8.5
	09/09/2017	9.2	7.3
	10/09/2017	8.9	10.0
	11/09/2017	8.3	7.4
	12/09/2017	6.5	5.6
	13/09/2017	8.2	9.3
	14/09/2017	8.6	11.4
	15/09/2017	7.5	9.2
	16/09/2017	6.4	6.2
	17/09/2017	8.0	4.4
	18/09/2017	8.3	3.9
	19/09/2017	11.7	12.0
	20/09/2017	8.3	4.9
	21/09/2017	7.6	10.3
	22/09/2017	9.5	10.0
	23/09/2017	11.9	11.6
	24/09/2017	10.6	1.0
	25/09/2017	10.7	9.1
	26/09/2017	11.9	14.0
	27/09/2017	10.0	6.3
	28/09/2017	10.2	14.3
	29/09/2017	6.2	10.4
	30/09/2017	7.9	9.0

Corkey Windfarm Repowering

Technical Appendix A8.4: Fisheries & Aquatic Ecology

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A8.4 Fisheries & Aquatic Ecology

1 Introduction

1. This Appendix to the Environmental Statement (ES) evaluates the effects of the Development on the Fisheries and Aquatic Ecology resource. This assessment was undertaken by Paul Johnston Associates. The assessment will consider the potential significant effects of the Development during the following phases of the Development:

- Decommissioning of the Operational Corkey Windfarm (Initial Phase of the Development);
- Construction of the Development (likely to occur in tandem with the above phase);
- Operation of the Development; and
- Decommissioning of the Development (Final Phase).

2. The decommissioning of the Operational Corkey Windfarm and the construction of the Development is likely to occur partly in tandem and would have a lesser effect than if the two processes were to arise at different times. This represents a worst-case scenario for assessment purposes. Any effects arising as a result of the future decommissioning of the Development are considered to be no greater than the effects arising when these two phases are combined.

3. This Appendix includes the following elements:

- Legislation, Policy and Guidance;
- Assessment Methodology and Significance Criteria;
- Baseline Description;
- Assessment of Potential Effects;
- Mitigation and Residual Effects;
- Cumulative Effect Assessment;
- Summary of Effects;
- Statement of Significance; and
- Glossary.

2 Legislation, Policy and Guidance

4. The following guidance, legislation and information sources have been considered in carrying out this assessment:

5. EU legislation relevant to fisheries and the water environment in member states:

- EC Habitats Directive (92/43/EEC);
- EU Water Framework Directive (2000/60/EC) (incorporating standards from the Fish Directive (Consolidated) (2006/44/EC); repealed in 2013); and
- European Eel Regulation (EC) 1100/2007.

6. Domestic legislation relevant to fisheries and the water environment in Northern Ireland:

- Fisheries (Northern Ireland) Act 1966;
- The Environment (Northern Ireland) Order 2002;
- The Water (Northern Ireland) Order 1999;
- Drainage (Northern Ireland) Order 1973 and The Drainage (Amendment) (Northern Ireland) Order 2005;
- Environment (Northern Ireland) Order 2002;
- Nature Conservation and Amenity Lands (Amendment) (Northern Ireland) Order 1989;
- Water (Northern Ireland) Order 1999;
- Water Environment (Water Framework Directive) (Northern Ireland) Regulations 2003;
- Wildlife (Northern Ireland) Order 1985; and
- Wildlife and Natural Environment Act (Northern Ireland) 2011.

7. Under the provisions of the Fisheries Act (NI) 1966, DAERA Inland Fisheries has responsibility for the conservation, protection, development and improvement of salmon and inland fisheries in Northern Ireland.

8. Policy with regard to Atlantic salmon and European eel in this region is set out in the following:

- Braid & Main Local Management Area Plan;
- Atlantic Salmon Management Strategy for Northern Ireland and the Cross-Border Foyle and Carlingford catchments to meet the objectives of NASCO resolutions and agreements, 2008–2012 (DCAL); and
- Neagh Bann River Basin District Eel Management Plan (DEFRA).

9. Specific guidance relevant the proposed development includes:

- Requirements for Protection of Fisheries Habitat during Development Works at River Sites (DCAL);
- Culvert Design and Operation Guide (C689) (CIRIA, 2010);
- Environment Agency Policy Regarding Culverts: Technical Guidance on Culverting Proposals (EA, 1999);
- PPG1: General guide to the prevention of pollution;
- PPG2: Above ground oil storage tanks;
- PPG3: Use and design of oil separators in surface water drainage systems;
- PPG4: Treatment and disposal of sewage where no foul sewer is available;
- PPG5: Works and maintenance in or near water;
- PPG6: Working at construction and demolition sites;
- PPG7: Refueling facilities;
- PPG8: Safe storage and disposal of used oils;
- PPG13: Vehicle washing and cleaning;
- PPG18: Managing fire water and major spillages;
- PPG21: Pollution incident response planning; and
- PPG26: Storage and handling of drums & intermediate bulk containers.

3 Assessment Methodology and Significance Criteria

3.1 Scoping Responses and Consultations

10. Consultation for this ES topic was undertaken with the organisations shown in **Table 1**.

Table 1: Consultation Responses

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
DAERA Inland Fisheries	Meeting 31/0717	Highlighted that the redevelopment and extension of turbine placement may increase risk of waterborne pollutants entering watercourses to detriment of existing aquatic ecology and fisheries habitat. Advised that potential risks should be identified, assessed and mitigation assigned where judged necessary.	Points addressed at 6.2.1, 6.2.2, 7.1.1 & 7.1.2 in this document; also refer to Outline DCEMP for ES and WCEMP Technical Appendix A7.2

3.2 Scope of Assessment

11. The fisheries and aquatic ecology assessment involved desktop review of relevant information/data, field surveys, data processing, analysis and interpretation. Current fisheries data and relevant conservation information on the River Main

catchment is assimilated and supplemented through site specific fisheries and ecological surveys of the Development covering the principal watercourses within and downstream of the Site Boundary.

12. Field survey procedures consisted of walkover surveys of the principal watercourses, assessments of physical habitat conditions, measurement of basic chemistry parameters, collection of benthic invertebrate samples for assessment of biological quality, and a fish stock survey by electrofishing.

13. The key issues for the assessment of potential effects relating to the Development are:

- Temporary effects arising from the initial decommissioning/construction phases such as the elevation of suspended sediments or the obstruction of fish passage;
- Permanent effects such as loss of habitat; and
- Indirect effects, including effects on fish and aquatic habitats out with the Site Boundary due to waterborne sediments or other polluting materials.

3.3 Study Area / Survey Area

14. The study area focussed on the streams draining the area within the Site Boundary, each of which form the headwaters of the Killagan Water which subsequently connects to the River Main. Field survey work was carried out on these streams both within the Site Boundary, downstream of the Site Boundary, and in the subsequent reach of the Killagan Water. The desk assessment includes an evaluation of fisheries in the wider catchment of the River Main **(Figure 1)**.

4 Baseline Survey Methodology

4.1 Desk Study

15. A desk study was carried out to assimilate baseline information relating to salmonid fisheries, ecological status (under Water Framework Directive (WFD)) and water quality (chemical and biological) for the Study Area. The following sources were consulted/used:

- DAERA Inland Fisheries;
- Northern Ireland Environment Agency (NIEA); Water Management Unit (WMU) (Rivers and Lakes Team) https://www.daera-ni.gov.uk/articles/water-framework-directive;
- NIEA - Protected Areas https://www.daera-ni.gov.uk/topics/biodiversity-land-and-landscapes/protected-areas; and
- Joint Nature Conservation Committee (JNCC) www.jncc/defra.gov.uk.

4.1.1 Environmental data

16. Environmental monitoring data for the River Main was provided by DAERA Northern Ireland Environment Agency (NIEA).

4.1.2 Conservation status

17. Information on the conservation status of the River Main was accessed through DAERA and JNCC web sources.

4.2 Field Survey: Stream Quality

18. Survey sites were selected on the three streams within the Study Area. For each site, baseline water chemistry, physical habitat and aquatic ecology were assessed.

4.2.1 Chemical Water Quality: Basic Parameters

19. A series of basic water quality parameters were measured at each site using portable meters to provide an outline profile of chemical quality. Turbidity was measured using a EUTECH NT-100 turbidimeter, which records in Nephelometric Turbidity Units (NTU). pH was measured using a WTW 3110 pH meter, dissolved oxygen with a Hanna Oxy-Check oxygen meter, and conductivity with a Hanna HI86303 conductivity meter; temperature measurements were made with both the pH and oxygen meters.

20. Turbidity was used as a proxy indicator of suspended solids as it can be measured quickly in the field. However, there is no universal relationship between turbidity and suspended solids, and accurate computation of suspended solids concentrations from turbidity would require that a calibration exercise be carried out on a site-specific basis.

4.2.2 Physical Habitat

21. River physical habitat (substratum type, depth, flow velocity) was assessed based on the fully quantitative method developed by DAERA Inland Fisheries Division and the AgriFood and Biosciences Institute (AFBI). At each site, surveys consisted of a 40 m stream reach with 25 sampling points across five equidistant cross-sectional transects except on very narrow (<0.3 m width) and overgrown streams where it was difficult to observe the riverbed; on these streams, up to 12 transects (1-3 sampling points per transect) were surveyed in each reach.

22. At each sampling point, flow velocity was recorded at 60% depth using a Geopacks flow meter, with water depth measured using the meter's impeller stick; substrate was visually assessed using a bathyscope with the dominant substrate type recorded according to a modified Wentworth Scale (Bain *et al*. 1985[1]; **Table 2**).

Table 2: Substrate classification and scoring based on the Wentworth system (from Bain *et al*. 1985)

Substrate type	Size Class (mm)	Score
Sand/silt	<2	1
Gravel	2-16	2
Pebble	17-64	3
Cobble	65-256	4
Boulder	>256	5
Irregular Bedrock	-	6

23. The following physical characteristics also were measured:

- Stream width at each transect;
- Substrate composition (visually estimated as per Bain *et al*., 1985); and
- Percentage of deposited fine sediment (<2mm grain) on the river bed as per Clapcott et al. (2011)[2], with the dominant fine sediment type (sand, silt, clays) determined by running the grain through the observer's fingers.

24. The classification system of Bain *et al* (1985) was used to summarise the composition of substrate in a reach based on two indices:

- Coarseness index (CI) – calculated as the mean dominant substrate score; and
- Heterogeneity (SD) – calculated as the standard deviation of the mean CI.

25. These indices show how coarse or smooth the substrate of a reach is and if it is comprised of a mixture or is dominated by a particular substrate class **(Table 3)**.

Table 3: Substrate description inferred from sample data (from Bain *et al*. 1985)

Mean substrate score (CI)	Heterogeneity (SD)	Inferred substrate description
3.2	1.96	Heterogeneous, smooth and rough
5.0	0.00	Homogeneous, coarse
1.25	0.44	Nearly homogeneous, smooth
3.25	0.85	Heterogeneous, intermediate coarseness
5.05	0.69	Heterogeneous, coarse

Aquatic Ecology

26. Stream benthic communities are sensitive to a range of environmental conditions including fine sediment, and have taxa with relatively long lifespans that integrate stressor effects over longer timescales than may be indicated by physico-chemical parameters alone (Extence *et al*. 2013[3]).

[1] Bain M., Finn J. and Brooke, H. (1985). Quantifying stream substrate for habitat analysis studies. N Am J Fish Manage 5, 499-500.
[2] Clapcott, J.E., Young, R.G., Harding, J.S., Matthaei, C.D., Quinn, J.M. and Death, R.G. (2011) Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute, Nelson, New Zealand.

27. Baseline ecology of the streams within and draining the Study Area was assessed by sampling the benthic macroinvertebrate community during in August 2017 using a standard three minute kick sample (hand held 1mm mesh pole net); the method is recommended by the United Kingdom Technical Advisory Group (UK-TAG) for assessing the condition of the quality element "benthic invertebrates" for WFD reporting (WFD-UKTAG, 2014).

28. Where possible, samples were collected from riffle/run habitats, fixed in 4% formalin for 1 week, followed by preservation in 70% ethanol prior to sorting and identification.

29. In the laboratory, macroinvertebrates were spread across a 4 x 5, 20-square grid sorting tray to facilitate identification and to estimate relative abundance. Abundant taxa were counted in a subset of 5 squares and scaled to whole sample estimates as recommended in Murray-Bligh (2002)[4]. Less abundant taxa were counted in all grid squares.

4.3 Field Survey: Fisheries Habitat

30. An outline assessment of the streams draining the Study Area was carried out in July 2017 and consisted of walkover surveys recording general characteristics to provide an outline assessment for these watercourses. This was then complimented through a fish stock survey by electrofishing.

31. The descriptive terminology used in the survey is based on the Life Cycle Unit method (Kennedy, 1984[5]) currently used by DAERA Inland Fisheries (see also DANI advisory leaflet No 1). In summary, habitat type is recorded as:

- Nursery (shallow rock/cobble riffle areas for juvenile fish - fry/parr);
- Holding (deeper pools/runs for adult fish);
- Spawning (shallow gravel areas for fish spawning); and
- Unclassified (unsuitable for fish – shallow bedrock areas or heavily modified sections of channel).

4.4 Field Survey: Juvenile Fish Stocks

32. Monitoring of fish stocks by DAERA and AFBI tends not to include sampling sites in the upper reaches of tributaries in most river systems. Therefore, this part of the fisheries assessment considered the principal streams draining the Study Area and set out to obtain details on salmonid distribution in areas of the Main catchment not covered in routine sampling by DAERA.

33. A juvenile fish stock survey of the streams draining the site and the immediate reach of the Killagan Water was carried out by electrofishing at selected locations in September and October 2017.

34. Electrofishing was carried out according to a semi-quantitative methodology described by Crozier and Kennedy (1994)[6]. The procedure involves two operators fishing continuously in an upstream direction for five minutes at each sampling location, using an E-Fish 500 W single anode electrofishing backpack (EF-500B-SYS). The system operates on 24 V input and delivers a pulsed DC output of 10 to 500 W at a variable frequency of 10 to 100 Hz. Output voltage and frequency are adjusted according to the electrical conductivity at the survey site.

35. All fish were caught using a dip net and retained for general inspection and length measurement before being returned to the water live. Any additional Age 0 salmonids observed but not captured were also recorded. This method is consistent with DAERA and AFBI monitoring procedures.

36. The semi-quantitative electrofishing method has been calibrated separately for trout and salmon based on extensive studies in river reaches of known juvenile salmonid density. This has resulted in the development of an abundance classification system (Abundance Index) for salmon with five categories: Absent, Poor, Fair, Good, Excellent **(Table 4a)**. The Abundance Index for trout has six classifications: *Absent, Poor, Poor/Fair, Moderate, Good, Excellent* **(Table 4b)**.

Table 4a: Semi-quantitative abundance categories for age 0 salmon, as developed by Crozier and Kennedy (1994); Kennedy (*unpublished data*)

Fry (0+) nos.	Density (No/100m2)	Abundance/ quality category
0	0	Absent
1 – 4	0.1 – 41.0	Poor
5 – 14	41.1 – 69.0	Fair
15 – 24	69.1 – 114.6	Good
25+	114.6+	Excellent

Table 4b: Semi-quantitative abundance categories for age 0 trout, as developed by Crozier and Kennedy (1994); Kennedy (*unpublished data*)

Fry (0+) nos.	Density (No/100m2)	Abundance/ quality category
0	0	Absent
0 – 1	0.1 – 7.0	Poor
2 – 3	7.1 - 16.5	Fair
4 – 8	17 - 31	Moderate
9 – 17	32 - 59.9	Good
18+	60+	Excellent

4.5 Methodology for the Assessment of Effects

37. The assessment of effects was derived from methodologies outlined by:

- The Design Manual for Roads and Bridges specifically with regard to Road Drainage and the Water Environment, Volume 11, Section 3, Part 10 HD45/09 (DMRB, 2009[7]); and
- Institute of Environmental Management and Assessment guidelines (IEMA, 2004).

38. The significance of the potential effects of the Development has been classified by professional consideration of the sensitivity of the receptor and the magnitude of the potential effect. The assessment of effects was primarily based on their effect on salmonids either directly or upon their habitats.

4.5.1 Sensitivity of Receptors

39. The sensitivity of the baseline conditions, including the importance of environmental features on or near to the Site or the sensitivity of potentially affected receptors, was assessed in line with best practice guidance, legislation, statutory designations and / or professional judgement.

40. Using the information assembled through the baseline assessment, the fisheries significance/sensitivity of each watercourse was graded according to the generic methodology for environmental sensitivity outlined in the Design Manual for Roads and Bridges (2009). **Table 5** details the framework applied in determining the sensitivity and this evaluation was used as the basis for the assessment of effects and the specification of any necessary mitigation requirements with regard to fisheries and the aquatic environment.

[3] Extence C.A., Chadd R.P., England J., Dunbar M.J., Wood P.J. & Taylor E.D. (2013) The assessment of fine sediment accumulation in rivers using macro-invertebrate community response. River Research and Applications, 29,17–55.
[4] Murray-Bligh, J. (2002) *UK Invertebrate Sampling and analysis for EU-Star project*. EU- STAR(http://www.eu-star.at/pdf/RivpacsMacroinvertebrateSamplingProtocol.pdf)
[5] Kennedy GJA (1984) The ecology of salmon habitat re-instatement following river drainage schemes. IFM Annual Study Course, Magee College, Londonderry, 18pp.
[6] Crozier WW & Kennedy GJA (1994) Application of semi-quantitative electrofishing to juvenile salmonid stock surveys. Journal of Fish Biology 45, 159-164.
[7] DMRB (2009) Design Manual for Roads and Bridges. Road Drainage and the Water Environment, Volume 11, Section 3, Part 10 HD45/09.

Table 5: Framework for Determining Sensitivity of Receptors

Sensitivity	Definition	Typical Examples
Very High	Attribute has a high quality and rarity on a regional or national scale	WFD Class 'High'. Site protected/designated under EC or UK habitat legislation (SAC, ASSI, salmonid water)/Species protected by EC legislation. Watercourse containing salmon and supporting a nationally important fishery or river ecosystem.
High	Attribute has a high quality and rarity on a local scale	WFD Class 'Good'. Species protected under EC or UK habitat legislation. Watercourse containing salmon or trout and supporting a locally important fishery or river ecosystem.
Medium	Attribute has medium quality and rarity on a local scale	WFD Class 'Moderate'. Watercourse containing trout and upstream of locally important fishery or river ecosystem.
Low	Attribute has low quality and rarity on a local scale	WFD Class 'Poor'. Watercourse without salmon or trout but upstream of locally important fishery or river ecosystem.
Negligible	Attribute has very low quality and rarity on a local scale	WFD Class 'Poor'/unspecified.

4.5.2 Magnitude of Effect

41. The magnitude of potential effects was identified through consideration of the Development, the degree of change to baseline conditions predicted as a result of the Development, the duration and reversibility of an effect and professional judgement, best practice guidance and legislation.

42. The criteria for assessing the magnitude of an effect are presented in **Table 6** which includes a consideration of the timescale of the effect (short, medium or long term).

Table 6: Framework for Determining Magnitude of Effects

Magnitude	Definition	Type and Scale of Effect
High	Results in loss of attribute and/or quality and integrity of the attribute	Loss or extensive change to a fishery. Loss or extensive change to a designated Nature Conservation Site. Major alteration to fish population levels in catchment as a whole, through fish mortality, habitat destruction or barrier to migration. Duration: long-term (>5 years).
Medium	Results in effect on integrity of attribute, or loss of part of attribute	Partial loss in productivity of a fishery. Appreciable alteration to fish population levels in specific sub-catchment or zone. Duration: medium-term (1-5 years).
Low	Results in some measurable change in attribute's quality or vulnerability	Minor loss in productivity of a fishery. Minor alteration to fish population levels in specific sub-catchment or zone. Duration: short-term (up to 1 year).
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	Unlikely to affect the integrity of the water environment. No measurable alteration to fish population levels.

4.5.3 Significance of Effect

43. The sensitivity of the asset and the magnitude of the predicted effects was used as a guide, in addition to professional judgement, to predict the significance of the likely effects. The correlation of magnitude against the sensitivity of the receptor determines a qualitative expression for the significance of the effect. The standard matrix shown in **Table 7** summarises the guideline criteria for assessing the significance of effects. The greater the sensitivity or value of a receptor or resource, and the greater the magnitude of the effect, the more significant the effect.

Table 7: Framework for Assessment of the Significance of Effects

Magnitude of Effect	Sensitivity of Receptor				
	Very High	High	Medium	Low	Negligible
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

44. Effects predicted to be of Major or Moderate significance are considered to be 'significant' in the context of the EIA Regulations (shaded light green in the above table), and will require mitigation. Those effects assessed as Low or Negligible are not considered to be significant in terms of the EIA.

45. **Table 8** lists the four significance categories indicating a description of the typical effects in each case.

Table 8: Framework for Determining Sensitivity of Receptors

Significance category	Descriptor of effects
Major	These beneficial or adverse effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging effect and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Moderate	These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Minor	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.
Negligible	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

5 Baseline Description

46. The study focussed on three streams draining the Site into the Killagan Water. Field survey work was therefore carried out both within the Site Boundary and in the immediate downstream reaches of the drainage streams and the adjoining reach of the Killagan Water.

5.1 Designated Sites

47. The Development is not located within the boundary of any statutory or non-statutory designated sites of international, national or local nature conservation importance. The downstream Killagan Water and the adjoining River Main are not subject to any equivalent designation.

5.2 EU Water Framework Directive Classification

5.2.1 River Main

48. The Development is located in the Killagan Water sub-catchment of the River Main. The Killagan Water flows in a westerly direction to join with the Main near Clogh Mills**;** the location of the Site within the Killagan sub-catchment and the River Main catchment is shown in **Figure 1**. The River Main is 45 km in length, has a catchment area of more than 700 km^2 and flows into Lough Neagh. The fish fauna is dominated by Atlantic salmon and brown trout. In 1974, an extensive programme of arterial drainage and channelisation was undertaken on the Main system and this scheme continued to the late 1980's (Essery & Wilcock 1986[8]).

49. Under the Water Framework Directive, the Main is assigned to the Neagh Bann River Basin District, an international River Basin District which incorporates the River Bann system including Lough Neagh and its tributaries, all rivers draining into Carlingford Lough, and the Co Louth rivers draining to the East coast. The Lough Neagh system, including the Main catchment, drains to the north via the River Bann and discharges to the sea between Portstewart and Castlerock on the north coast **(Figure 2)**.

5.2.2 Ecological Status

50. To achieve the ecological objectives of the Water Framework Directive (WFD), River Basin Management Plans (RBMPs) have been implemented through a series of Local Management Areas (LMA) during the initial 2010 to 2015 planning cycle and now extending into the subsequent 2016-21 cycle.

51. The Site lies almost entirely within the Braid and Main LMA, with the Site located in the waterbody defined as Killagan Water (UKGBNI1NB030302212). Proceeding downstream from the Site there is sequential hydrological connection between the following waterbodies in the Braid & Main LMA (ecological status as assessed in 2015 is noted):

- Killagan Water (UKGBNI1NB030302212): Moderate
- River Main (Dunloy) (UKGBNI1NB030308244): Good
- River Main (Glarryford) (UKGBNI1NB030308210): Moderate
- River Main (Cullybackey) (UKGBNI1NB030302158): Good
- River Main (Slaght) (UKGBNI1NB030302160): Moderate
- River Main (Randalstown) (UKGBNI1NB030302150): Moderate

52. The ecological assessment for these waterbodies in 2015 is summarised in **Table 9** which indicates the overall classification and status with regard to each of the principal parameters monitored.

Table 9: Classification of individual quality elements contributing to overall WFD status of relevant water bodies in Braid and Main LMA, 2015 (Source: DAERA).

Parameter	Killagan W	R Main (Dunloy)	R Main (G'ford)	R Main (C'backey)	R Main (Slaght)	R Main (R'stown)
Benthic Invertebrates	Good	High	High	High	High	High
Macrophytes	High	Good	Moderate	High	High	High
Phytobenthos	High	High	Good	Good	Good	Good
Fish	Moderate	-	-	-	Moderate	Moderate
BOD*	High	Good	Good	High	High	High
Temperature*	High	High	High	High	Good	Good
Dissolved oxygen	High	Good	Good	High	High	High
pH	High	High	High	High	High	High
SRP	Good	Good	Good	Good	Moderate	Moderate
Ammonia	Good/High	Good/High	Good/High	Good/High	Good/High	Good/High
Hydrological regime	High	Good	High	High	Good	High
Morphological regime	-	-	-	-	Good	Good

[8] Essery C. I. & Wilcock D. N. (1990) The impact of channelization on the hydrology of the upper River Main, County Antrim, Northern Ireland—a long term case study. *Regulated Rivers: Research and Management* **5**, 17–34.

Parameter	Killagan W	R Main (Dunloy)	R Main (G'ford)	R Main (C'backey)	R Main (Slaght)	R Main (R'stown)
Overall Status	**Moderate**	**Good**	**Moderate**	**Good**	**Moderate**	**Moderate**

53. A small area at the northern end of the Study Area to the north of the proposed T3 falls into the River Bush catchment and the waterbody defined as River Bush (Ballyhoe) (UKGBNI1NE040405127). This area does not have turbines proposed within it; the area has been included solely as an access option.

54. For the current planning cycle to 2021, NIEA has developed a series of RMBPs for each River Basin District including Neagh Bann RBD. These documents set out the latest assessment of pressures and effects on the water environment, describe the progress NIEA made towards achieving objectives for 2015, and explain the significant water management issues that still need to be addressed.

5.2.3 Water Quality Monitoring

55. Chemical and biological quality of individual water bodies are monitored by NIEA Water Management Unit on a regular basis to comply with statutory monitoring for Water Framework Directive reporting. There are currently five monitoring stations for chemical and biological quality on the main channel of the River Main catchment and a single station on the Killagan Water.

5.2.4 Chemical Quality

56. Summary results for a selection of chemical quality parameters at the nearest NIEA monitoring station on the Killagan Water at Killagan Bridge, approximately 7km downstream of the Site are presented in **Table 10**.

Table 10: Selected Chemical Monitoring Data from the Killagan Water at Killagan Bridge, D046213, Site code 10202 (Source: NIEA).

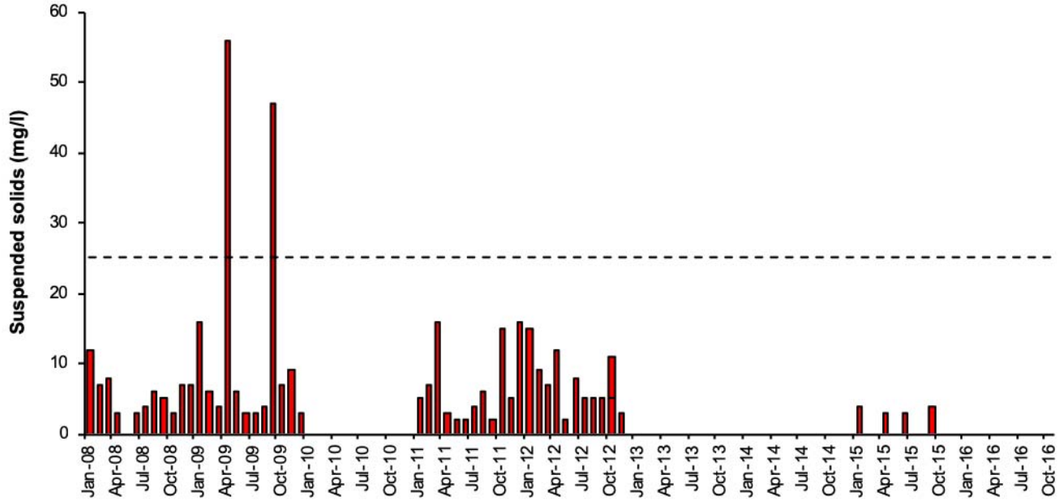
Year	Parameter	pH	Cond (µs/cm)	DO (mg/l)	DO (%sat)	BOD (mg/l)	NH3 (mg/l)	P-Sol (mg/l)	S.Solids (mg/l)
2015	Min	7.8	353	10.6	92	<1	<0.001	0.02	3
	Max	8.2	400	11.8	101	<2	0.001	0.06	4
	Mean	8.0	378	11.2	96	<2	0.001	0.04	3.5
2016	Min	7.3	216	10.4	86	<2	<0.001	0.03	
	Max	8.1	402	11.7	96	<2	0.001	0.07	
	Mean	7.9	335	10.9	92	<2	0.001	0.05	

57. In general, pH appears to be relatively stable and remains within a range satisfactory for salmonid fisheries - the variation in pH is most likely related to flow conditions. The combination of consistently high dissolved oxygen and low biological oxygen reflects an absence of organic inputs.

58. Conductivity is an indication of the amount of dissolved salts in the water and typically increases in a downstream direction as a river flows through progressively richer lowland areas picking up different materials and receiving inputs from various tributaries and discharges. At this location the variation in conductivity is probably related to flow conditions.

59. Of particular relevance to salmonid fish, is suspended sediments as it has significant potential to impact on both directly on the fish and also on their habitat. The variation in suspended solids measured intermittently over a nine-year period in the Killagan Water is illustrated in **Figure 3**.

Figure 3: Monthly measurements of turbidity in the Killagan Water at Killagan Bridge, 2008-16 (Source: NIEA).



60. During the sampling period the level of suspended solids was generally below 10 mg/l in and exceeded the WFD guideline for salmonid fish (25 mg/l) in only two of 51 samples during the nine-year period. These figures are indicative of generally low levels of sediment run-off in the Killagan catchment with any rises in suspended solids most likely due to spate conditions following periods of heavy or sustained rainfall.

5.2.5 Biological Quality

Summary results for the most recent biological quality monitoring in the Killagan at Killagan Bridge under the original BMWP system in 2008-12 are presented in **Table 11** (results were not available in the updated BMWP form developed by Walley and Hawkes (1997)[9] and recommended for WFD monitoring); this indicates the total number of invertebrate taxa identified (No. taxa) at each site, total bioscore (BMWP bioscore), and average score per taxon (ASPT). These results have informed the *Good* standard of biological quality as shown for this waterbody in **Table 9**.

Table 11: Biological Monitoring Data from Killagan Water, 2008-12 (Source: NIEA).

Site	Date	BMWP score	No. Taxa	ASPT
Killagan Water at Killagan Bridge **D046213** **Site code 10202**	03/03/2008	72	15	4.8
	15/09/2008	83	18	4.61
	09/03/2009	109	19	5.74
	14/09/2009	66	13	5.08
	09/03/2011	107	19	5.63
	01/09/2011	81	17	4.76
	05/03/2012	111	20	5.55
	05/09/2012	74	15	4.93

5.2.6 EC Fish Directive

61. The EC Freshwater Fish Directive (Consolidated) 2006/44/EC (FWFD) set physical and chemical water quality objectives for salmonid waters and cyprinid waters, specifically with regard to dissolved oxygen, ammonia, pH and total zinc.

62. The Fish Directive was repealed by the Water Framework Directive at the end of 2013, and the ecological status defined in the WFD sets the same protection to waterbodies designated for fish under the original directive. Areas designated under the Fish Directive have become areas designated for the protection of economically significant aquatic species under WFD and placed on the Register of Protected Areas.

63. The main stem channel of the River Main along with all of its major tributaries including the Killagan Water are designated as “salmonid” under the Surface Waters (Fish Life Classification) Regulations (Northern Ireland) 1997.

5.3 Significant Freshwater Species

5.3.1 Atlantic salmon

64. The salmon is an anadromous species having both a freshwater stage and a marine stage to its life cycle. The species is listed under Annexe II of the Habitats Directive and was added to the UK Biodiversity Action Plan (BAP) list in 2007 as a priority species for conservation action. More recently the salmon achieved an IUCN threat status of Vulnerable in the Irish Red List No 5 (King *et al*, 2011)[10].

65. Northern Ireland’s Atlantic salmon management strategy is aligned to the agreement reached by the North Atlantic Salmon Conservation Organisation (NASCO) and its Parties to adopt and apply a precautionary approach to the conservation, management and exploitation of the salmon resource and the environments in which it lives. Northern Ireland, through the UK and EU, is a Party to NASCO.

66. Atlantic salmon stocks in general are in serious decline and southern stocks, including some in North America and Europe, are threatened with extinction. As a conservation measure DCAL (now DAERA) introduced a series of regulations in March 2014 to implement mandatory catch and release for salmon angling and to prohibit commercial salmon netting.

67. The Main is one of seven Index Rivers utilised by DAERA to provide the basis for salmon management throughout Northern Ireland. Each river has been chosen to represent a different catchment type and provides key information on stock levels to inform regional policy.

5.3.2 Lamprey

68. There are three species of lamprey in Northern Ireland:

- Brook lamprey (*Lampetra planeri*);
- River lamprey (*Lampetra fluvi*atilis); and
- Sea lamprey (*Petromyzon marinus*).

69. Sea and River lampreys are parasitic and migrate between the freshwater and marine environments, returning to freshwater to breed. In contrast, Brook lamprey are resident in freshwater throughout their life cycle and are non-parasitic. Brook lamprey are widely distributed in Northern Ireland but River and Sea lamprey have a more limited distribution (Goodwin *et al*, 2009). For example, sea lamprey do not occur in the River Main or any of the Lough Neagh tributaries due to an impassable barrier on the Lower River Bann; but a landlocked variety of River lamprey is present in the lough and migrates into the tributaries to spawn. However, there is no data available on the distribution of River or Brook lamprey in the River Main.

70. All three species are designated under Annex II of the EU Habitats Directive (Directive 92/43/EEC) although none are listed as a site selection feature in five large river SACs in Northern Ireland.

5.3.3 Eel

71. The European eel stock has been in rapid decline throughout its range since around 1980. This has led to the passing of the European Eel Regulation (EC) 1100/2007 which aims to return the European eel stock to more sustainable levels of adult abundance and juvenile eel recruitment. Member States are required to implement Eel Management Plans for the recovery of the stock through action by specific measures in each eel river basin, in this case the Neagh Bann River Basin District.

72. The European eel is not listed under Annexe II but has recently been added to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species in the category of Critically Endangered (King *et al*, 2011).

[9] WFD-UKTAG (2014). UKTAG River Assessment Method: Benthic Invertebrate Fauna. Invertebrates (General Degradation): Walley, Hawkes, Paisley & Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT).

[10] 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.

73. There is no data available on the distribution of eel in the River Main catchment.

5.3.4 Brown trout

Brown trout are a priority species for conservation action in Northern Ireland, as required under the Wildlife and Natural Environment Act (Northern Ireland) 2011. They are widely distributed in the River Main catchment and a small proportion of the stock migrates to sea and returns to freshwater to spawn.

74. A unique variety of Brown trout, the Dollaghan, occurs in Lough Neagh and most of its tributaries including the Main. The life cycle is similar to the Sea trout in that spawning and the juvenile life stages take place in the inflowing rivers, with subsequent migration to the lough where a period of rapid growth is followed by a return migration to natal rivers to spawn. These fish can grow to a large size (3-5 kg), and are highly sought after by anglers.

5.4 Salmon Stock Data

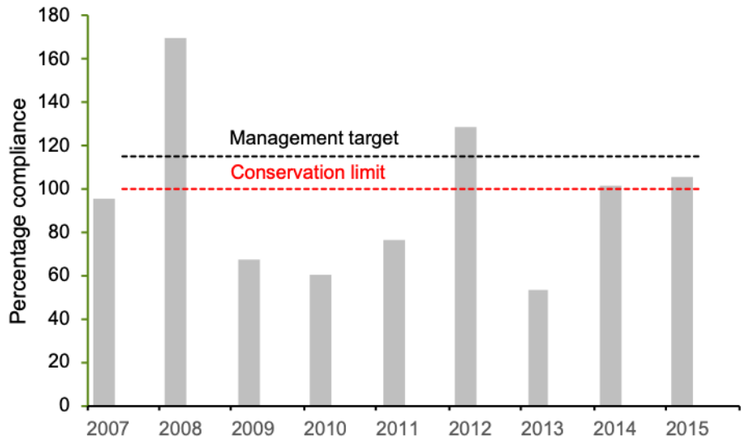
75. A fish counter on the River Main at Randalstown weir provides a partial count of adult fish returning to the river spawn. Along with annual catchment-wide surveys of juvenile salmon abundance, there is a significant accumulation of data on the local stock of fish.

5.4.1 Adult Salmon Runs and Conservation Limits

76. A key factor in assessing the status of salmon stocks is determination of Conservation Limits for individual river systems. The Conservation Limit for Atlantic salmon is defined by NASCO as: "*the spawning stock level that produces long term average maximum sustainable yield as derived from the adult to adult stock and recruitment relationship*". In simpler terms the Conservation Limit for a river is the number of spawning salmon required to ensure that salmon are reproducing in sufficient quantities to produce the next generation of fish.

77. DAERA and AFBI have established a management target for each of the Index Rivers including the River Main. The management target is a precautionary abundance reference point and represents 115% of the conservation limit. Annual returns of wild adult salmon to the Main are computed from partial counts of adult fish at the counting installation at Randalstown and percentage compliance with the conservation limit since 2000 is shown in **Figure 4**. This data indicates considerable variability in the annual return of adult fish, and that conservation limit has been achieved in only three of the last nine years. Declining runs of adult fish are attributed to a significant reduction in natural survival of young salmon during the marine phase (Kennedy, *pers comm*).

Figure 4: River Main: percentage compliance with conservation limit and management target, 2007-15 (Source: DAERA/AFBI)

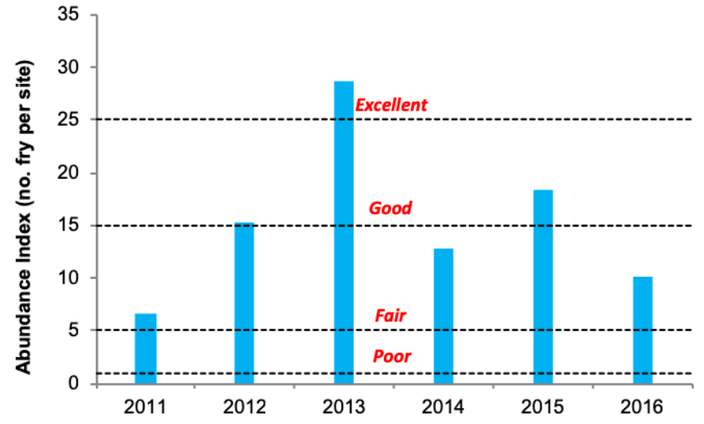


5.4.2 Juvenile stocks

78. Trends in abundance of juvenile salmon and trout in the Index Rivers are monitored by DAERA/AFBI using the semi-quantitative electrofishing methodology (Crozier & Kennedy, 1994). This methodology has been used to develop a recruitment index for Atlantic salmon based on the abundance categories indicated in **Table 4a**. A threshold of 15 salmon fry per 5-minute sample has been adopted as a target level of recruitment for monitored rivers in Northern Ireland. This is equivalent to the *Good* abundance category shown in **Table 4a**.

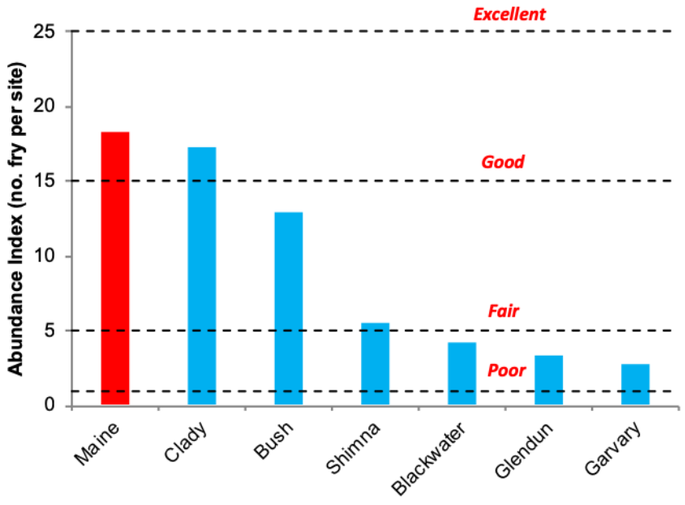
79. The mean relative abundance of salmon fry for 2011-16 is shown in **Figure 5** indicating that the Recruitment Index has been achieved in only three of the last six years to reach a *Good* classification for the river.

Figure 5: Salmon fry Recruitment Index for the Main, 2011-16 (Source: DAERA/AFBI).



80. Salmon fry abundance across the seven Index Rivers in Northern Ireland is illustrated in **Figure 6** which indicates that the Main was the most productive river in 2015.

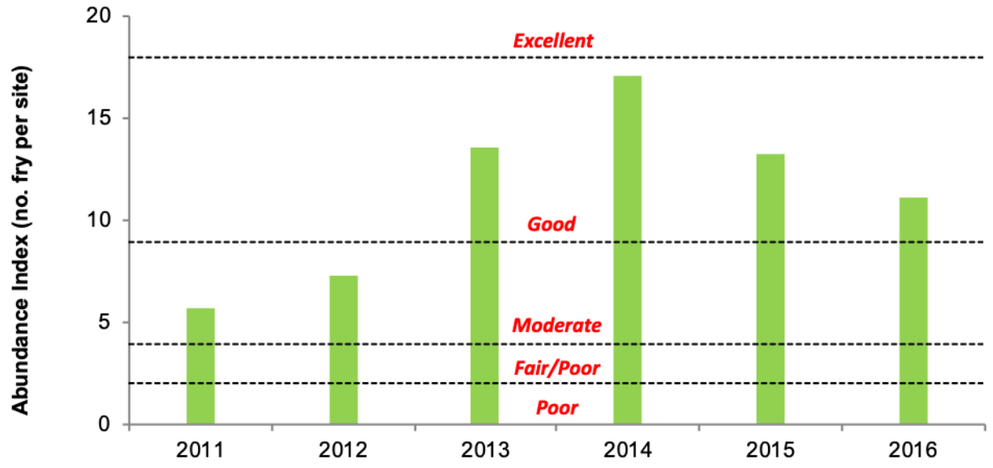
Figure 6: Salmon fry Abundance Index for the seven Index Rivers, 2015 (Source: DAERA/AFBI).



5.5 Brown Trout

81. Juvenile trout are also recorded during annual electrofishing surveys at the same locations as for salmon**.** The Abundance Index for 2011-16 is illustrated in **Figure 7** with abundance categories *Poor* to *Excellent* as determined for trout fry by Kennedy (*unpublished data*). Trout are distributed over the full extent of the catchment and *Good* abundance has been achieved in each of the last four years for which data is available.

Figure 7: Average trout fry abundance in the Main, 2011-16 (Source: DAERA/AFBI).



82. The average numbers of trout and salmon (2011-16) detected at DAERA monitoring sites on the Killagan Water which are hydrologically connected to the Site are indicated in **Table 12**. The location of these sites is shown along with average Abundance Indices in **Figure 8**.

Table 12: Average fry abundance indices at survey sites on the Killagan River, 2011-16; listed upstream to downstream (Source: DAERA)

Site ID	Trout		Salmon	
	Age 0	Age 1	Age 0	Age 1
1	0	0	14	1
2	0	0	6	3
3	0	0	8	0
4	0	0	5	3
5	0	0	8	1
6	0	0	15	1
7	0	0	14	1
8	0	0	5	2
9	0	0	6	4
10	0	0	4	1
11	0	0	1	3
12	0	1	0	4
13	1	0	1	1

83. This data demonstrates that:

- Salmon are absent from this sub-catchment apart from isolated individuals at the most downstream reach; and
- Trout are distributed throughout the Killagan Water with greater abundance in the middle and upstream reaches.

5.6 Angling

84. The River Main is an important salmon and trout angling system with good quality fishing both on the main channel and tributary rivers, the Clogh Water, Braid Water and Kells Water. Most of the fishing is administered by local angling clubs although some reaches are retained by riparian owners, while the lower stretch adjoining Lough Neagh is retained by Shanes Castle Estate.

85. Adult salmon enter the river in July if there has been sufficient rainfall to stimulate their advance through the Lower Bann and Lough Neagh, and fish can be caught up to the end of the season on 31 October. Migratory trout (dollaghan) tend to run the river from August onwards and there is also a native stock of brown trout.

86. The Maine Enhancement Partnership was formed by local angling clubs and fishery owners during the 1990s with the objective of improving fish stocks in the system. MEP was the forerunner of the recently formed Maine Rivers Trust which seeks "*to conserve, protect, rehabilitate and improve the rivers, streams and watercourses of the Maine rivers catchment".*

87. Leading angling clubs and fishery owners in the area are: Braid Angling Club, Glenravel & Clough Angling Club, Gracehill Galgorm & District Angling Club, Kells Connor & Glenwherry Angling Club, Maine Angling Club, Randalstown Angling Club, Demesne Anglers (Shanes Castle Estate).

5.7 Site Survey: Fisheries Habitat

5.7.1 Site Drainage and Local Hydrology

88. As noted above the Development lies almost entirely within the River Main and specifically, the Killagan sub-catchment. The Site area is drained three streams flowing in a south-westerly direction and all merging in the area of Drumrankin Bridge **(Figure 9)**. Two of the streams are un-named and are referred to in this report as the Northern and Middle Streams; the third stream, Killagan Water is referred to as the Southern Stream. In this report, these streams are referred to as the Northern, Middle and Southern Streams. Site drainage and hydrology are described in more detail in Chapter 7, Hydrology, Hydrogeology, Geology, Soils and Peat.

5.7.2 General Description / Observations

5.7.2.1 Northern Stream

89. The Northern Stream flows largely to the north of the Site Boundary but drains a significant northern-western area of the Site including the area surrounding T3 and the associated infrastructure e.g. the access track. In the section which traverses the Site area, the stream approximately 1m wide with substrate materials suitable for juvenile trout and salmon, but it has a relatively steep gradient **(Plate 1)**.

Plate 1: Northern stream

Plate 2: Northern stream

90. Downstream of the Site and just north of Reservoir Road there are waterfalls **(Plate 2)** which may prevent any upstream progression of fish beyond this point. The findings of the electrofishing survey would support this view. The stream then follows a course of approximately 500 m, mostly behind housing on the north side of Corkey village, to Corkey Road **(Plate 3)**, and a further 220 m to join with the Killagan Water just west of Corkey Road; in this reach the stream is 1½ -2 m wide and bed-slope is much reduced.

Plate 3: Northern stream

Plate 4: Middle stream

5.7.2.2 Middle Stream

91. The Middle Stream flows in a south-westerly direction from the north-eastern corner of the Study Area (near the Onsite Substation and Control Building for the Operational Corkey Windfarm) joining with the Southern Stream (Killagan) near Drumrankin Bridge at the western edge of the Study Area. The Middle Stream drains the area surrounding T1, T2, T4 and T5, and the associated infrastructure. In the initial reach adjacent to the sub-station, it is <½ m wide with a soft substrate and steep bed-slope, generally unsuitable for fish habitation.

92. After approximately 250 m the gradient eases leaving an incised stream ½ -1m wide with good quality coarse substrate and depth to 30 cm, clearly suitable for fish **(Plate 4)**. However, a major waterfall 4-5 m high after a further 850 m is impassable to fish and is the upstream limit of trout distribution in this stream **(Plate 5)**. In the initial reach downstream of the waterfall the Middle Stream is up to 2 m wide with a substrate of gravel, cobble and sand with occasional outcrops of bedrock **(Plate 6)**.

Plate 5: Middle stream

Plate 6: Middle stream

93. Proceeding further downstream stream habitat improves to give an excellent spawning and nursery stream with a sequence of riffles and tumbling pools **(Plate 7)**. Subsequent electrofishing confirmed that trout are present up to the waterfall but no further upstream in this watercourse.

Plate 7: Middle stream

Plate 8: Southern stream

5.7.2.3 Southern Stream (Killagan Water)

94. The Southern Stream is the largest of the three drainage streams but only drains a small area in the southern part of the Study Area, with a small tributary receiving drainage water from the area to the south of the proposed T5 including the current access track. This small tributary is of reasonable quality but is devoid of fish due to a significant waterfall **(Plate 8)** near the confluence with the Southern Stream. The Southern Stream or Killagan Water in this reach is 1½ - 1¾ m wide with a substrate of cobble, boulder and sand, and a riffle-glide-pool sequence **(Plate 9)**. However, the electrofishing survey indicated a trout population of relatively low density in this reach.

Plate 9: Southern stream

Plate 10: Southern stream

95. Downstream of this reach the stream flows through some densely wooded sections either side of the farm at Moneyneagh **(Plate 10)**, swinging north-west to join with the Middle Stream after approximately 1.25 km - habitat quality in this reach is good with a substrate of cobble, boulder and sand yielding a riffle-glide-pool sequence in a channel of 1½ - 2 m width **(Plate 11)**. However, the electrofishing survey demonstrated that fish density remains relatively low.

96. Beyond the confluence with the Middle Stream, the Killagan (Southern Stream) proceeds a further 300m to Drumrankin Bridge at Corkey Road, and a further 420 m before it is joined by the Northern Stream.

Plate 11: Southern stream

Plate 12: Killagan Water

5.7.2.4 Killagan Water

97. The Killagan Water, incorporating the three streams draining the Study Area, is 2-3 m wide with a good quality substrate containing an abundance of cobble and gravel, which supports a good stock of juvenile trout as shown by the electrofishing survey **(Plate 12)**. This reach proceeds west alongside Ballyweeney Road and swings south passing under Lislaban Road after approximately 2 km of river channel, at which point the bed-slope is much reduced and habitat is of lower quality over the subsequent 2½ km **(Plate 13)**. However, in the approach to Kilmandil Bridge the bed-slope improves and there is superior habitat over the following 3½ km **(Plate 14)**. In the final 3 - 3½ km the Killagan follows a low gradient, slow-flowing and deeper course before joining with the River Main near Dunloy.

Plate 13: Killagan Water

Plate 14: Killagan Water

98. The Killagan is surveyed by DAERA as part of an annual programme semi-quantitative electrofishing surveys on each Salmon Index rivers. Salmon fry have not been detected indicating a lack of salmon spawning, but trout are widely distributed in the stream. The River Main is approximately 10 km downstream from the Study Area.

5.7.3 Site Survey: Stream Quality

99. Three sites were surveyed on the three small streams draining the immediate area of the Development infrastructure **(Sites 1-3; Figure 8; Table 12)**. The most northerly stream was surveyed at the Study Area (site 1). A site was surveyed in the middle stream just downstream of the new access track (site 4). On the southern stream, a site was surveyed just downstream of the confluence with a small tributary (site 6).

5.7.3.1 Chemical Water Quality: Basic Parameters

100. The pH in all streams was slightly alkaline (pH 7.9-8.1) and was supported by moderate conductivity readings with satisfactory dissolved oxygen levels also recorded (**Table 13**). Turbidity is a good proxy for suspended sediment concentration at low levels; the very low turbidity readings in all streams is thus consistent with suspended sediment concentrations well below the 25 mg/L upper threshold specified for salmonids in the Water Framework Directive.

101. It should be noted that spot measurements of physico-chemical parameters provide only a snap-shot of stream water quality; consensus on overall quality should consider additional indicators such as those provided by stream macroinvertebrate communities (see below).

Table 13: Stream chemical parameters from baseline surveys conducted in October 2017.

Site no.	Stream	Grid ref		pH	Dissolved Oxygen (mg/L; % sat.)	Cond (µScm-1)	Turb (NTU)
		E	N				
1	Northern Stream	309483	422152	7.9	10.7; 93%	160	2.37
2	Middle Stream	310073	421219	8.15	11.5; 100%	151	0.89
3	Southern Stream	310186	420967	8.06	11.2; 98%	151	0.94

5.7.3.2 Physical Habitat Quality

102. All three small streams draining the Survey Area (width range 0.5-1.6 m) were shallow with moderate flows. The substratum in all streams was coarse comprising mainly cobble and boulder although the Middle and Southern streams had patches of smooth bedrock **(Table 14)**.

Table 14: Stream habitat quality at each site from baseline surveys conducted in October 2017.

Site no	Stream	Sediment cover (%) & type	Mean width	Mean water depth (m)	Mean flow velocity (ms^{-1})	Coarseness index (CI)	Substrate heterogeneity (SD)	Inferred substrate
1	Northern	0.7; sand/silt	1.6	0.15	0.22	4.1	0.57	Nearly homogenous; coarse
2	Middle	1.2; clay	1.3	0.12	0.29	4.25	1.25	Heterogeneous, coarse
3	Southern	14; clay	0.9	0.09	0.17	4.1	1.5	Heterogeneous, coarse

103. Fine sediment cover was negligible in all streams except for the Southern stream but this was due to a base of natural clay in some areas. Nonetheless, the low fine sediment cover was well within the 20% threshold above which stream health can be compromised (Clapcott *et al*. 2011). These low fine sediment levels, coupled with coarseness indices >4.0 are consistent with values in rivers with good salmonid habitat quality reported elsewhere in Northern Ireland (Johnston, 2012).

5.7.3.3 Waterbody status and Aquatic Ecology.

104. Based on the benthic invertebrate indicator element, all three sites were classified as having HIGH WFD-based water body status either for the number of taxa (N-TAXA) or average score per taxon (WHPT-ASPT) **(Table 15)**. All sites had high BMWP and ASPT scores reflecting the natural physical habitat, low sediment cover and low land use intensity in the area. It was interesting to note that the highest ASPT scores, indicative of sensitive and relatively un-impacted invertebrate communities, occurred in the Middle and Southern streams, both more closely connected to drainage from the main core of existing Wind Turbines at the Operational Corkey Windfarm.

Table 15: Waterbody status and benthic invertebrate indices at each site from baseline surveys conducted in October 2017.

Site	Stream/ River	BMWP WHPT score	Number of taxa	N-TAXA WFD-based invert. class	WHPT ASPT	ASPT WFD-based invert. class
1	Northern Stream	105.4	17	**HIGH**	6.2	**HIGH**
2	Middle Stream	130.6	20	**HIGH**	6.5	**HIGH**
3	Southern Stream	120	19	**HIGH**	6.3	**HIGH**

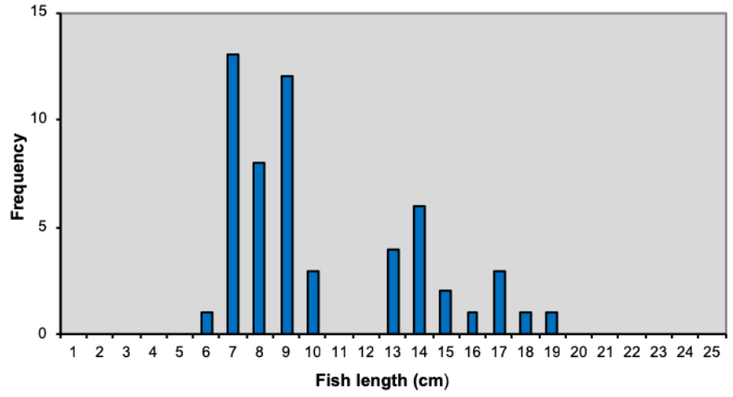
5.7.4 Site Survey: Juvenile Fish Stocks

105. A juvenile fish stock survey of the streams draining the Site and the downstream reach of the Killagan Water was commenced on 26 September 2017 and completed on 6 October 2017 at selected sampling sites **(Figure 8)**.

5.7.4.1 Population Age Structure

106. The age structure of the trout population in the upper Killagan and tributary streams draining the Site was verified by constructing a fish length frequency distribution **(Figure 10)**. The trout population exhibits a clear separation of Age 0 from older age groups (Age 0: 6-10 cm). It is not possible to precisely determine the size ranges of older age classes due to the limited sample size, but it is plausible that Age 1 fish are shown in the range 13-19 cm. The absence of larger fish suggests that mature adults migrate upstream into these streams to spawn, and that the juvenile fish remain until their third year before moving downstream into deeper waters as two-year-olds.

Figure 10: Length frequency distribution of trout caught in the Killagan and tributary streams.



5.7.4.2 Fish Distribution & Abundance

107. The results of the semi-quantitative survey are shown in **Table 15** with the numbers of trout and salmon at each site separated into Ages 0 and 1 based on observed fish length as outlined above. Applying the abundance indices outlined in **Table 4** show trout fry (Age 0) densities ranging from *Absent* to *Excellent*, while salmon were absent from all sites **(Table 16)**.

Table 16: Fish stock survey indicating numbers of juvenile trout and salmon (Age 0 and Age 1) recorded at each site; other species also noted.

Site	River/ stream	Grid Ref		Trout			Salmon	Other species
		East	North	Age 0	Age 1	Abundance Index		
1	Northern	309483	422167	0	0	Absent	0	0
2	Northern	309051	421823	17	2	Good	0	0
3	Middle	310276	421365	0	0	Absent	0	0
4	Middle	310094	421243	3	7	Poor	0	0
5	Middle	309351	421256	2	4	Poor	0	0
6	Southern	310174	420925	1	2	Poor	0	0
7	Southern (branch)	310170	420954	0	0	Absent	0	0
8	Southern	310132	420976	3	0	Poor	0	0
9	Southern	309281	421221	2	1	Poor	0	0
10	Killagan Water	308296	421737	18	2	Excellent	0	0

5.7.4.2.1 Northern Stream

108. Only a short section of the Northern Stream passes through the Site and was found to be devoid of fish, most likely due to a series of waterfall obstacles downstream of the Site. Trout were present at *Good* density in the most downstream section surveyed above Corkey Road and close to the confluence with the Killagan Water.

5.7.4.2.2 Middle Stream

109. Trout were present within the Site in the Middle Stream, but restricted to downstream of an impassable waterfall which is illustrated in **Plate 5**. However, Age 0 fish were only present *Poor* density even though habitat and water quality were apparently satisfactory.

5.7.4.2.3 Southern Stream

110. Trout were present within the Site in the Middle Stream but again with Age 0 fish only present at *Poor* abundance even though habitat and water quality were apparently satisfactory.

5.7.4.2.4 Killagan Water

111. The Killagan Water was found to contain trout at an *Excellent* level of abundance at the site surveyed 600 m downstream of the confluence with the Northern Stream and approximately 1 km from the Site. This is consistent with DAERA abundance indices determined for trout at other suitable locations further downstream on the river.

6 Embedded Mitigation

112. Measures have been taken to eliminate, where possible, and minimise the potential for effects on fish and aquatic ecology through the Design of the Development and the adoption of good practice, and general and site-specific management measures, as set out in **Chapter 4: Site Selection and Design** of the ES, and **Technical Appendix A3.1: Outline Decommissioning and Construction Environment Management Plan** (Outline DCEMP) and **Technical Appendix 7.2.: Water Decommissioning/Construction Environment Management Plan (WCEMP).** The WCEMP will form an appendix to the Outline DCEMP, for the purposes of the ES is shown as **Technical Appendix 7.2** In particular, where possible, ground disturbance has been minimised through re-use of the existing infrastructure, watercourse crossings have been avoided, work within close proximity to watercourses has been avoided, and specific measures are proposed to minimise the effects on watercourses during construction. The result of this is that effects on hydrology (reported in **Chapter 7** of the ES) are assessed as being not significant in terms of the EIA Regulations.

113. For the purposes of this document, however, the Outline DCEMP and WCEMP have been considered as post-hoc mitigation in **Section 7** of this report. Potential effects considered in Section 6, below, are assessed on the basis that no management measures will be in place, a worst-case assessment. Residual effects have then been arrived at, following application of the proposed Outline DCEMP and WCEMP measures, is set out in **Section 7**.

7 Assessment of Potential Effects

114. Potential effects were assessed for the initial decommissioning and construction, and operational phases of the Development. Decommissioning and construction effects cover the discharge of suspended solids, release of other pollutants and interruption of fish passage. Post-construction (operational) effects include habitat loss at watercourse crossings, obstruction of fish passage and surface water run-off.

7.1 Fisheries Significance/ Sensitivity

115. The assessments of Fisheries Significance/ Sensitivity for relevant watercourses draining the land within the Site Boundary as at Scoping stage are indicated in **Table 17**. A watercourse was deemed to have a High/ Very High sensitivity when the WFD class was at least Good and/or Annex II species were present (e.g. salmon, lamprey).

Table 17: Biological Monitoring Data from Killagan Water, 2008-12 (Source: NIEA).

River/Stream	Location/key species	WFD class	Fisheries sensitivity
Northern Stream	Receiving watercourse; located within and downstream of the Site; Annexe II species unlikely; Brown trout present downstream of Site.	Good	Medium
Middle Stream	Receiving watercourse; located within and downstream of the Site; Annexe II species unlikely; Brown trout present within Site.	Good	Medium
Southern Stream	Receiving watercourse; located within and downstream of the Site; Annexe II species unlikely; Brown trout present within Site.	Good	Medium
Killagan Water	Receiving watercourse; located downstream of the Site; Annexe II species: Salmon present in downstream reach adjacent to R Main; Brown trout present.	Good	Medium (High)
River Main	Receiving watercourse; located downstream of the Site; Annexe II species: Salmon present; Brown trout present.	Good	High

116. The sensitivity of the Killagan Water was assessed as Medium due to the presence of Brown trout throughout; however, salmon are present in the lower reach adjacent to the River Main – sensitivity is therefore adjusted to Medium (High).

7.2 Initial Decommissioning and Construction Phases

117. The potential for effects on fisheries and aquatic habitats during the initial decommissioning and construction phases is mainly associated with ground disturbance and the entrainment of sediments in surface water drainage. There is also a potential effect from the accidental spillage of other hazardous substances (oil and fuel) used in the construction process, while construction of stream crossings could obstruct fish movements.

7.2.1 Sediment Run-off

118. The release of fine sediment (grain size <2 mm) is potentially a major cause of environmental effect and is associated with clearly defined negative effects (Newcombe and Jensen, 1996[11]; Turley et al. 2014[12]). Sensitive fish species such as brown trout and Atlantic salmon are highly vulnerable to suspended and deposited sediment in spawning and nursery habitats (Kemp et al. 2011[13]). In spawning gravels, incubating salmonid eggs require good water circulation to provide oxygen and remove waste products. As deposited fine sediment content increases, gravels become embedded, resulting in restricted water circulation and reduced egg and alevin survival (Cowx and Welcome, 1998[14]). After emergence, juvenile salmonids (fry) disperse downstream to suitable nursery rearing habitat generally within 100 m (Kennedy, 1984), often in faster flowing riffles/ runs, where they establish feeding territories and compete for food.

119. Suspended sediment can lower water clarity leading to reduce prey capture efficiency and may affect respiration rates by clogging of gills (Kemp et al. 2011). Deposited sediment can reduce habitat complexity and quality by in-filling of substrate, thus reducing territory size leading to increased aggression and ultimately lower carrying capacity. Deposited fine sediment can also indirectly affect growth and survival of juvenile salmonids by reducing the quality of habitat for preferred invertebrate prey species (Suttle et al., 1994[15]).

120. Although adult salmonids are prone to gill-clogging and visual impairment at high levels of suspended sediment, they are much less reliant on substrate complexity, tending to occupy deeper pools, particularly during the spawning season. Adult salmonids are also more mobile than sessile eggs or juvenile stages, and thus more capable of avoiding adverse local conditions (Kemp et al. 2011).

121. Freshwater benthic macroinvertebrates are also an important component of river ecosystems, acting both as sentinels of general water and habitat quality, and as an important food resource for higher trophic levels such as fish and birds. Pulses of fine sediment can cause behavioural drift, whereas excessive fine sediment can reduce the quality of physical habitat by smothering and blocking of interstitial spaces and water flow (Allan, 1999). As fine sediment infiltration increases, invertebrate abundance and community diversity is reduced, resulting in the replacement of sensitive taxa (mayfly, stonefly and caddis) by more tolerant types (worms, midge larvae, molluscs; Matthaei et al. 2006[16]; Kemp et al. 2011).

122. Sediment release and entrainment can also increase the risk of nutrient addition and alterations in channel morphology and hydrology (Levesque and Dube, 2007[17]; Kelly, 2015[18]). For example, excavated bank material or soils associated with the construction process could increase inputs of sediment bound phosphorus, which could negatively affect aquatic biota by causing excessive algal and macrophyte growth, and depressed oxygen levels.

123. Fine sediment is partly managed by the water quality objectives and standards of the EC Freshwater Fish Directive 2006/44/EC (FWFD), where a mean total suspended solids (TSS) concentration of 25 mg/L is specified for salmonid waters. While Article 6 of the Water Framework Directive has now repealed the FWFD, new standards that provide the same level of protection have been proposed (UKTAG, 2010). However, there is no national environmental standard or guideline for deposited fine sediment in the UK. Fine sediment cover above a threshold of 20% bed cover, based on recommendations in New Zealand by Clapcott et al. (2011), and published research (e.g. O'Connor & Andrew,1998[19]; Kemp et al. 2011), provides a general indication of increasing risk for both invertebrates and salmonids.

- The discharge of suspended solids during initial decommissioning/construction phases of the Development;
- Excavations associated with construction of access tracks and turbine foundations;
- Excavations associated with watercourse crossings;
- Surface peat disturbance and subsequent erosion of the underlying soils;
- Stockpiling of soils and excavated materials;

[11] Newcombe, C.P. and Jensen, J.O.T. (1996). Channel suspended sediment and fisheries: A synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management, 16, 4, 693-727.

[12] Turley, M. D., Bilotta, G. S., Extence, C. A., and Brazier, R. E. (2014). Evaluation of a fine sediment biomonitoring tool across a wide range of temperate rivers and streams. Freshwater Biology, 59, 2268-2277.

[13] Kemp, P, Sear, D., Collins, A, Naden, P., and Jones, I. (2011). The impacts of fine sediment on riverine fish. Hydrological Processes, 25, 11, 1800-1821.

[14] Cowx, I. and Welcomme, R.L. (1998). Rehabilitation of rivers for fish. A study undertaken by the European Inland Fisheries Advisory Commission of FAO. Fishing News Books.

[15] Suttle, K.B., Power, M. E., Levine, J. M., and McNeely, C. (2004). How fine sediment in riverbeds impairs growth and survival of juvenile salmonids. Ecological Applications, 14,4, 969-974.

[16] Matthaei C.D., Weller, F., Kelly, D.W. & Townsend, C.R. (2006) Impacts of fine sediment addition to tussock, pasture, dairy and deer farming streams in New Zealand. Freshwater Biology, 51, 2154-2172.

[17] Levesque, L.M. and Dube, M.G. (2007). Review of the effects of in-stream pipeline crossing construction on aquatic ecosystems and examination of Canadian methodologies for impact assessment. Environmental Monitoring and Assessment, 132, 395-409.

[18] Kelly, D.W. (2015). Water quality in Barkers Creek and its impact on the Waihi River. Environment Canterbury Technical Report No. R14/88.

[18] Kelly, D.W. (2015). Water quality in Barkers Creek and its impact on the Waihi River. Environment Canterbury Technical Report No. R14/88.

[19] O'Connor WCK & Andrew TE (1998) The effects of siltation on Atlantic salmon, Salmo salar L, embryos in the River Bush. Fisheries Management and Ecology 5 (5), 393-401.

- Run-off from access roads; and
- Landslide resulting from slippage of access roads or excavated materials.

124. The proposed site is hydrologically connected to watercourses of significant fisheries interest via on-site and off-site source streams which are potential routes for suspended solids run-off. The River Main is of particular significance due to its stocks of Annexe II listed species, Atlantic salmon.

125. For the purposes of this assessment it has been assumed that the un-mitigated effects from the run-off of suspended solids have the potential to be of ***Moderate Adverse Magnitude*** and of ***Moderate to Large Adverse Significance*** depending on the sensitivity of individual watercourses as noted in **Table 17**.

7.2.2 Release of other pollutants

126. As the Survey Area drains into the Killagan Water and the River Main, there is some potential for spillages or releases of diesel, oil or other polluting substances to reach any of these channels with consequences for resident fish together with invertebrate organisms.

127. During the initial decommissioning/construction phases when there is likely to be a high usage of plant fuel and oil, there will be an increased risk of accidental spillage and discharge to watercourses. Similarly, the application of concrete slurries in construction processes carries some risk of inadvertent discharge with the potential to effect on wild fish stocks.

128. In an extreme situation there is the potential for a ***Moderate Adverse Effect*** arising from a pollution incident, and without mitigation, this would be of ***Moderate to Large Adverse Significance***.

7.2.3 Fish passage: temporary obstruction

129. Improperly managed instream or bank works at watercourse crossing points can result in the obstruction of stream channels during periods of upstream fish migration prior to spawning. The Development has no proposed watercourse crossings located in reaches inhabited by fish. There will therefore be no potential for obstruction of fish passage associated with the Development i.e. ***No Effect***.

7.3 Operational Phase

130. The potential for any effects will be significantly reduced during the operational phase with the initial decommissioning/construction processes complete, site infrastructure in place, and a reduced requirement for any hazardous materials on-site.

7.3.1 Surface Water Run-off

131. Surface water run-off from hard surfaced areas (i.e., access tracks, hardstands, control building area) has the potential to lead to sediment-laden run-off to the receiving watercourses with effects on fish and other forms of aquatic life as outlined above.

132. Wash-out of storage areas of excavated peat/subsoil during or following periods of heavy rainfall also has the potential to result in run-off of sediment to the receiving watercourses with potential increases in sediment load impacting on fish stocks and aquatic habitats.

133. In the case of the Development, un-mitigated effects from surface water run-off has the potential to be of ***Moderate Adverse Magnitude*** and of ***Moderate Adverse to Moderate to Moderate/Large Adverse Significance*** depending of the sensitivity of individual watercourses as noted in **Table A8.4.17**.

7.4 Decommissioning Phase

134. In the event that the Development requires to be decommissioned, the process would likely involve the removal of all above-ground structures. The concrete bases and hardstands are likely to be covered over with soil, reinstated and re-seeded.

135. Given the fewer number of turbines, the effects will be similar to the initial decommissioning and construction phases of the Development. The potential effects on fish stocks and aquatic ecology arising from the final decommissioning phase will be less than the effects arising as a result of the combined initial decommissioning and construction phases described above - these phases combined are therefore considered to represent the worst-case parameters for assessment purposes.

8 Mitigation and Residual Effects

136. Potential effects of the Development on fisheries and aquatic ecology in the primary drainage streams along with the Killagan Water and River Main are assessed in light of proposed mitigation measures, to conclude on residual effects. It is the residual effects of the Development that represent the predicted (rather than potential) effects on fisheries and the aquatic environment during the initial decommissioning and construction, and operational phases.

8.1 Decommissioning and Construction Phase

137. Measures to protect the aquatic environment from disturbance and pollution are set out in the Outline **DCEMP and WCEMP**.

8.1.1 Sediment Run-off

138. Mitigation measures to control sediment run-off are described in detail in the Outline DCEMP and WCEMP. The potential for any significant peat soil instability and mass movement caused as a result of the Development has been determined as being insignificant in the Peat Slide Risk Assessment (**technical appendix A7.1**). Additional mitigation measures detailed in Chapter 7 to reduce the potential for run-off of suspended solids are summarised as follows:

8.1.1.1 Management of Sediment and Surface Waters

139. The potential for pollution of watercourses by silt-laden runoff is addressed in **Chapter 7** with reference to the Outline DCEMP and WCEMP which outlines the incorporation of a surface water management plan / site drainage design using the principles of Sustainable Drainage.

140. The management of sediment and surface water run-off generated during the initial decommissioning/construction phases of the Development is described in the WCEMP **(Technical Appendix A7.2)** which explains that this will be achieved through good practice construction techniques while major works will be minimised during heavy precipitation events.

141. Drainage from the site will include elements of Sustainable Drainage Systems (SuDS) design, where appropriate including:

- Silt traps, silt fencing and silt matting;
- Check dams; and settlement lagoons;
- Outflow monitoring from settlement lagoons; and
- Provision for storm events.

142. SuDS replicate natural drainage patterns and have a number of benefits:

- SuDS will attenuate run-off, thus reducing peak flow and any flooding issues that might arise downstream;
- SuDS will treat run-off, which can reduce sediment and pollutant volumes in run-off before discharging back into natural drainage network; and
- SuDS measures, such as lagoons or retention ponds, correctly implemented will produce suitable environments for wildlife.

8.1.1.2 Water Quality Monitoring

143. A surface water monitoring plan will be implemented as part of the Outline DCEMP. This will facilitate comparison of a range of water quality parameters against baseline water quality analysis of the principal site drainage streams undertaken prior to construction.

8.1.1.3 Timing of Instream Works

144. DCAL (superseded by DAERA) has produced Guidelines for the Protection of Fisheries Habitat during Construction and Development Works at River Sites (DCAL, 2011). This document recommends that instream river works should be avoided during the salmonid spawning season and egg incubation phases, 1 October – 30 April. The proposed watercourse crossings relating to the Development are relatively minor and may therefore proceed without this seasonal restriction.

8.1.2 Release of other pollutants

8.1.2.1 Site Management

145. All precautions will be taken to avoid spillages of diesel, oil or other polluting substances during the initial decomissioning/construction phases. This will be achieved through good site management practices as described in the Good Practice Guidance notes proposed by EA/SEPA/DAERA, including:

- PPG1: Understanding Your Environmental Responsibilities - Good Environmental Practices;
- GPP2: Above ground oil storage tanks;
- PPG3: Use and design of oil separators in surface water drainage systems;
- GPP4: Treatment and disposal of wastewater where there is no connection to the public foul sewer;
- GPP5: Works and maintenance in or near water;
- PPG6: Working at construction and demolition sites;
- PPG7: The safe operation of refuelling facilities;
- GPP8: Safe storage and disposal of used oils;
- GPP13: Vehicle washing and cleaning;
- PPG18: Managing fire water and major spillages;
- GPP21: Pollution incident response planning; and
- GPP26: Safe storage - drums & intermediate bulk containers.

146. The appointed contractor will also be required to include a Pollution Prevention Plan within the Outlinne DCEMP prior to commencement of development. The site drainage system proposed for the Development will also facilitate the interception of diesel, oil or other polluting substances during the construction phase.

8.1.3 Residual Effects

147. Embedded mitigation including avoidance, the implementation of SuDS technology, along with a range of measures to control surface water run-off and the entrainment of sediments will remove the potential for direct damage to fish or siltation of spawning and nursery habitats. These measures will also minimise the risk for release of other construction related polluting substances into the river network.

148. Without mitigation the effects during the initial decommissioning/construction phases were at worst of Moderate Adverse Magnitude and of ***Moderate to Large Adverse Significance***, depending on specific effects and the sensitivity of individual watercourses e.g. sediment run-off to the Killagan Water and River Main. However, with mitigation the effect is reduced to ***Neutral***.

8.2 Operational Phase

8.2.1 Mitigation

149. The SuDS measures set out in the Outline DCEMP and WCEMP and Chapter 7 will provide attenuation of surface water run-off to reduce sediment run-off from the site.

8.3 Decommissioning Phase

8.3.1 Mitigation

150. Mitigation measures during final decommissioning will be the same as during the initial decommissioning/ construction phases with regard to addressing the potential for run-off of sediment and other polluting substances. However, the level of mitigation will be determined by the level of reinstatement required.

8.3.2 Residual Effects

151. Although there will be an increase in the area of hard surface due to the Development, the drainage design will include features to cope with silt run-off will protect receiving watercourses from excessive inputs of suspended solids.

152. Without mitigation the effects during the operational phase were at worst of ***Moderate Adverse Magnitude*** and of ***Moderate Significance***, depending on specific effects and the sensitivity of individual watercourses. However, with mitigation the effect is reduced to ***Neutral***.

9 Cumulative Effect Assessment

153. This section considers other windfarm developments which, in combination with the Development, could give rise to the potential for cumulative effects on fisheries and the aquatic environment in local rivers. In this context, the potential for cumulative effects is only relevant with regard to existing or proposed developments that 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.

154. A total of ten additional windfarm developments have been identified which are wholly or partly located within the River Main catchment and might therefore be considered to have the potential for cumulative effects on the freshwater environment. Outline details on these developments are shown in **Table 18**. None of these developments are located within the same sub-catchment as the Development i.e. the Killagan Water.

Table 18: Additional wind farm developments/proposals within the River Main catchment indicating their location by WFD waterbody within the Braid & Main LMA.

Wind Farm	Planning Reference	WFD waterbody	Number of turbines	Status
Carnalbanagh	LA02/2017/0594/F	Braid River (Aghacully)	7	In Planning
Rathsherry	G/2011/0162/F	Clogh River	9	Operational
Elginny Hill	G/2011/0041/F	Clogh River / Braid River (Rabbit Hilll)	10	Operational
Elliott's Hill	G/1993/0648/F	Kells Water (Moorfields)	10	Operational
Wolf Bog	G/2004/1532/F	Kells Water (Moorfields)	5	Operational
Whappstown	G/2011/0052/F	Kells Water (Moorfields)	4	Approved
Corby Knowe	T/2006/0832/F	Kells Water (Kells)	3	Operational
Glenbuck	D/2005/0628/F D/2012/0042/F D/2006/0599/F D/2015/0011/F	River Main (Dunloy)	4	Operational
Gruig	D/2004/0790/F	Cloghmills Water	10	Operational
Long Mountain	D/2006/0104/F	Dunnstown Burn	12	Operational

155. Whilst there is one documented incident relating to sediment run-off from a windfarm site, at Bin Mountain Wind Farm in Co Tyrone, there are no reports of similar problems have arisen in relation to other sites in Northern Ireland or specifically to the eight sites currently operational in the River Main catchment.

156. 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.

157. The likelihood of significant cumulative effects is increased if two or more windfarms are to be constructed or decommissioned at the same time. Within the Main catchment just one new site (Whappstown) has been approved and may proceed to construction within the next three to five years. Provided that good practice is adopted as outlined in the DCEMP, and that the recommended mitigation measures are fully applied, adding the Development to this baseline (including Whappstown), will not contribute to any significant cumulative effect.

158. The low likelihood of any simultaneous windfarm construction with the Development further reduces the potential for any cumulative effects. Cumulative effects are assessed as being ***Neutral***, therefore.

10 Summary of Effects

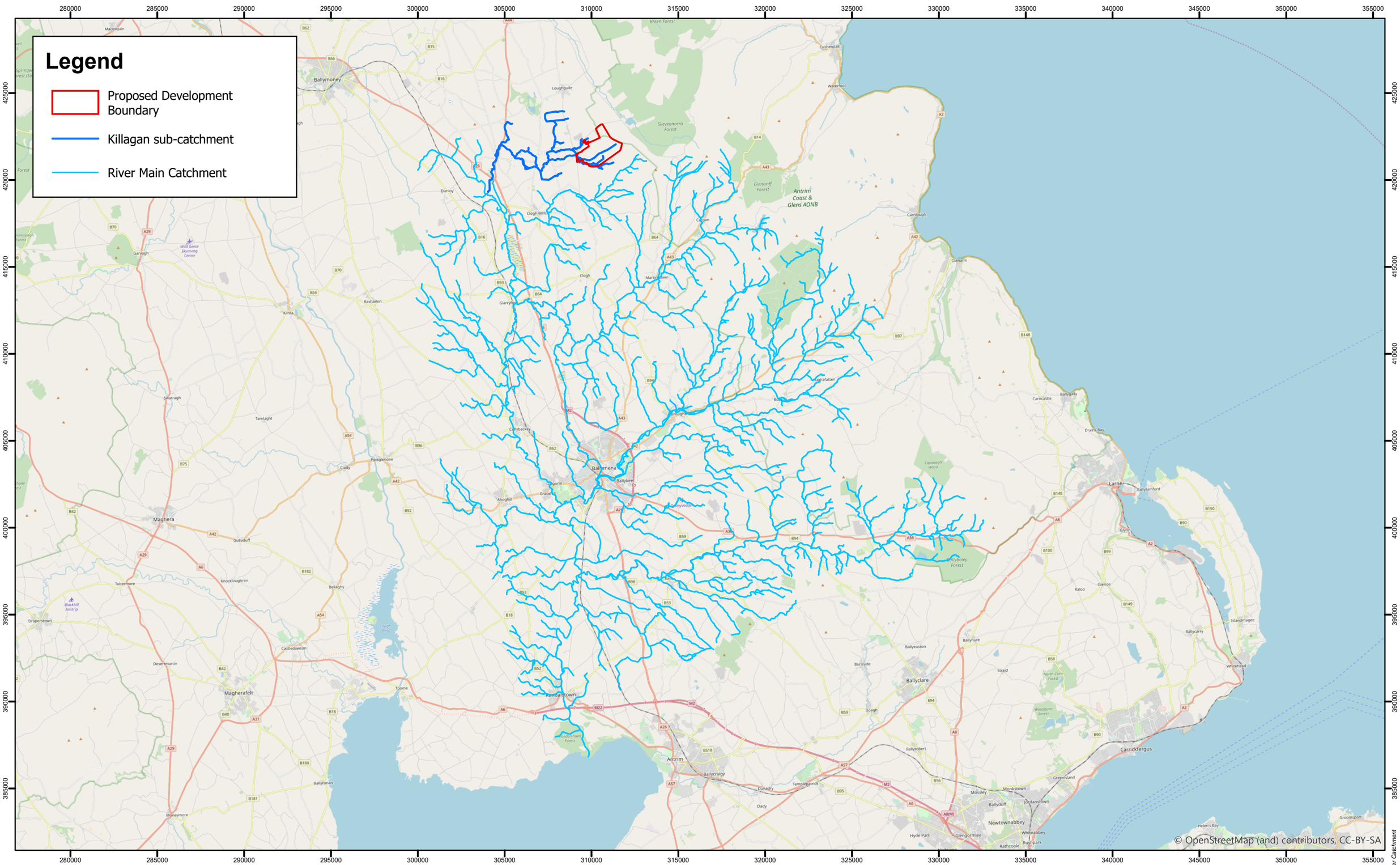
159. **Table 19** provides a summary of the effects detailed within this chapter.

Table 19: Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Decommissioning / Construction Phase				
Northern Stream	Sediment Run-off	Moderate	• Buffer Zones • Site Drainage Management & SuDS • Water Quality Monitoring • Timing of Instream Works	Not Significant
	Release of other pollutants	Moderate	• Site Management as detailed	Not Significant
Middle Stream	Sediment Run-off	Moderate	• Buffer Zones • Site Drainage Management & SuDS • Water Quality Monitoring • Timing of Instream Works	Not Significant
	Release of other pollutants	Moderate	• Site Management as detailed	Not Significant
Southern Stream	Sediment Run-off	Moderate	• Buffer Zones • Site Drainage Management & SuDS • Water Quality Monitoring • Timing of Instream Works	Not Significant
	Release of other pollutants	Moderate	• Site Management as detailed	Not Significant
Killagan Water	Sediment Run-off	Moderate	• Buffer Zones • Site Drainage Management & SuDS • Water Quality Monitoring • Timing of Instream Works	Not Significant
	Release of other pollutants	Moderate	• Site Management as detailed	Not Significant
River Main	Sediment Run-off	Large	• Buffer Zones • Site Drainage Management & SuDS • Water Quality Monitoring • Timing of Instream Works	Not Significant
	Release of other pollutants	Large	• Site Management as detailed	Not Significant
Operational Phase				
Northern Stream	Sediment Water Run-off	Moderate	• SuDS Design	Not Significant
Middle Stream	Sediment Water Run-off	Moderate	• SuDS Design	Not Significant
Southern Stream	Sediment Water Run-off	Moderate	• SuDS Design	Not Significant
Killagan Water	Sediment Water Run-off	Moderate	• SuDS Design	Not Significant
River Main	Sediment Water Run-off	Moderate/ Large	• SuDS Design	Not Significant

11 Statement of Significance

160. This report has assessed the likely significance of effects of the Development on Fisheries and Aquatic Ecology. Without mitigation the effects are predicted to be of ***Moderate to Major Significance***, depending on specific effects and the sensitivity of individual receptors, i.e., watercourses. However, taking into account embedded mitigation in the form of careful design and the application of the Outline DCEMP and WCEMP, the residual effects are predicted to be ***Negligible*** and are ***Not Significant*** in terms of the EIA Regulations and the cumulative assessment has also concluded that effects are ***Not Significant.***



SCOTTISHPOWER RENEWABLES

Rev	Date	By	Comment
A	28/03/2019	SC	First Issue.

0 2.75 5.5 11 km

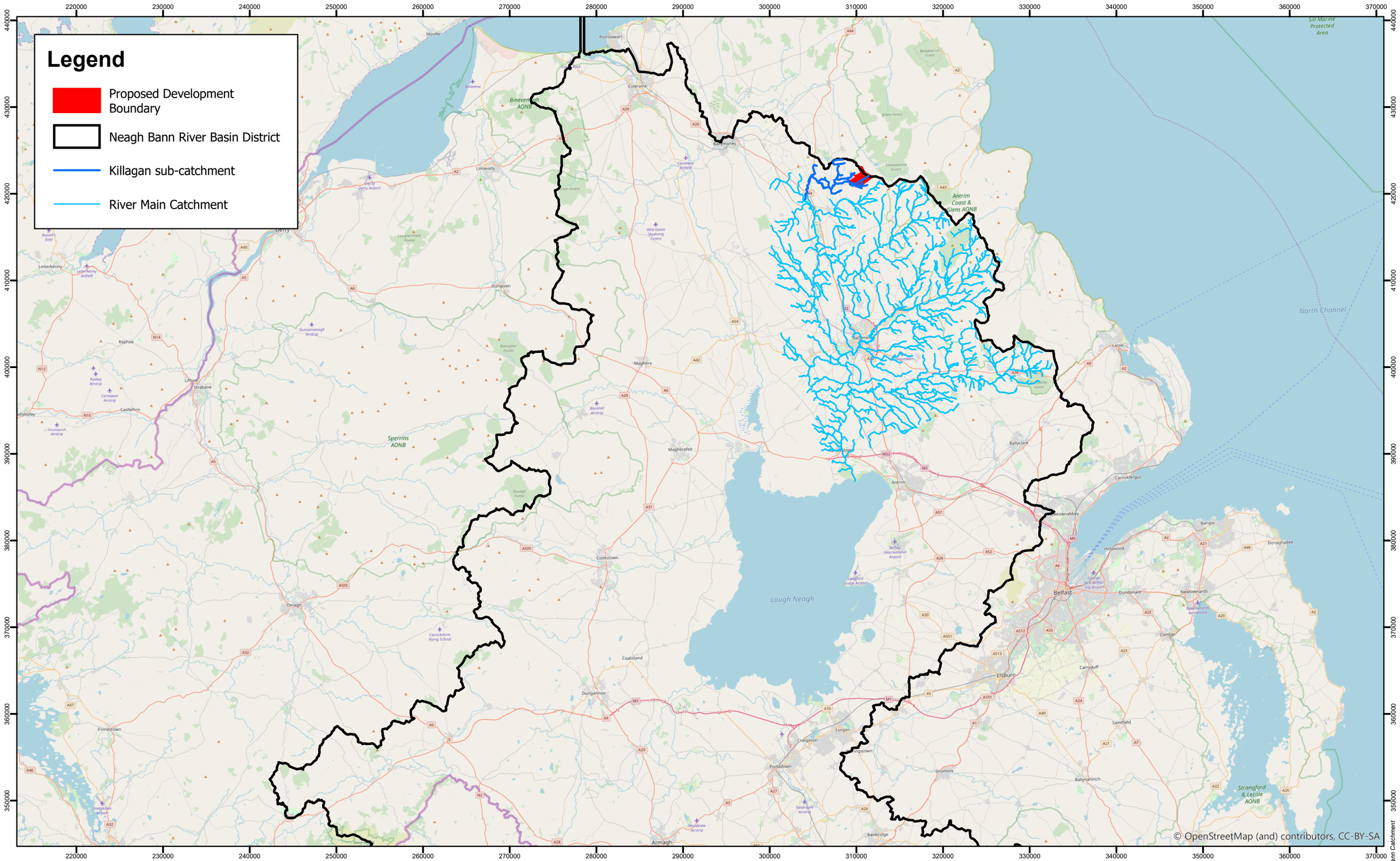
Corkey Windfarm Repowering

Main River Catchment

Figure A8.4.1

Drawing Number:	Datum	Projection
2606-REP-060	TM65	TM
Scale @ A3 1:200,000	Drawing produced by Arcus Consultancy Services	

2606-REP-069 FigA8.4.1 Main River Catchment



SCOTTISHPOWER RENEWABLES

Rev	Date	By	Comment
A	28/03/2019	SC	First Issue.

0 5 10 20 km

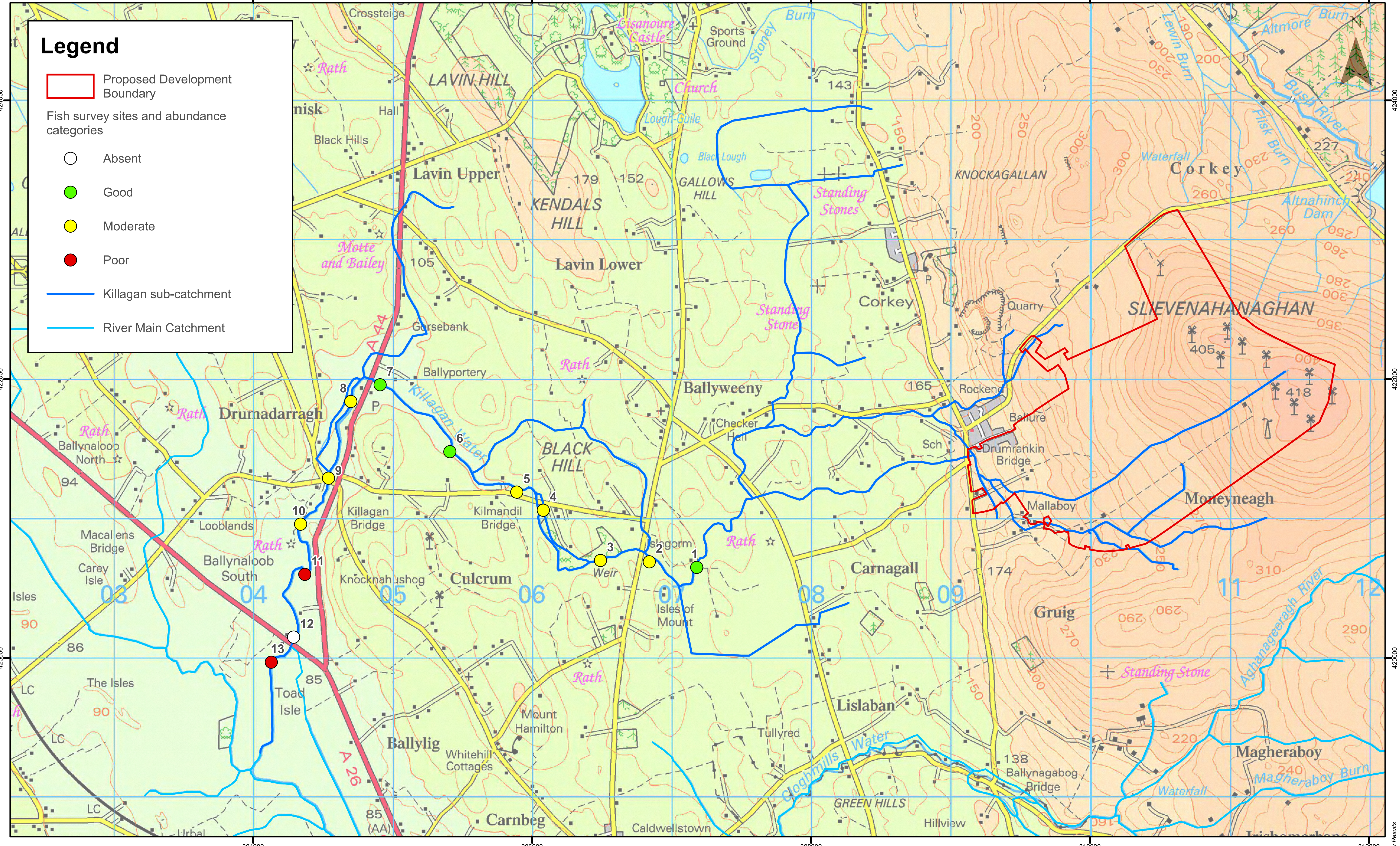
Corkey Windfarm Repowering

Neagh Bann River Basin

Figure A8.4.2

Drawing Number:	Datum	Projection
2606-REP-070	TM65	TM
Scale @ A3 1:400,000	Drawing produced by Arcus Consultancy Services	

2606-REP-070 Fig A8.4.2 Neagh Bann Catchment


Legend
Proposed Development Boundary
Fish survey sites and abundance categories
Absent
Good
Moderate
Poor
Killagan sub-catchment
River Main Catchment
304000
306000
308000
310000
312000
424000
422000
420000
Crosssteige
Rath
LAVIN HILL
Lisanoure Castle
Sports Ground
Stoney Burn
Church
Lough Guile
Black Hills
Lavin Upper
KENDALS HILL
179
152
GALLOWS HILL
Black Lough
Standing Stones
KNOCKAGALLAN
Corkey
Lewin Burn
Altmore Burn
Bush River
Fisk Burn
Altnahinch Dam
Waterfall
Motte and Bailey
105
Lavin Lower
Corkey
Quarry
SLIEVENAHANAGHAN
405
418
Gorsebank
Ballyportery
Standing Stone
Rath
Drumadarragh
Ballynaloob North
Ballyweeny
Rockend
Ballure
Killagan Water
Checker Hall
Sch
Drumrankin Bridge
BLACK HILL
Moneyneagh
Mallaboy
Looblands
Killagan Bridge
Kilmandil Bridge
Macalens Bridge
Ballynaloob South
Carey Isle
Knocknahushog
Culcrum
Weir
Isles of Mount
Carnagall
Gruig
Aghanageeragh River
Isles
The Isles
Toad Isle
A 44
A 26
Mount Hamilton
Standing Stone
Lislaban
Tullyred
Ballylig
Whitehill Cottages
Cloghmills Water
Ballynagabog Bridge
Magheraboy
Magheraboy Burn
Carnbeg
Caldwellstown
GREEN HILLS
Hillview
03
04
05
06
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08
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13
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0.25
0.5
1

A	28/03/2019	SC	First Issue.
Rev	Date	By	Comment

SCOTTISHPOWER RENEWABLES

Corkey Windfarm Repowering

Fish Survey Results

Figure A8.4.3

Drawing Number: 2606-REP-071	Datum TM65	Projection TM
Scale @ A3 1:25,000	Drawing produced by Arcus Consultancy Services	

2606-REP-071 FigA8.4.3 Fish Survey Results

Legend

- Proposed Development Boundary

Trout 0+ class

- Absent
- Excellent
- Good
- Poor
- Killagan sub-catchment
- Stream quality sites

308000 310000 312000

422000

CORKEY MIDDLE
CORKEY SOUTH or LITTLE
Northern Stream
Middle Stream
Southern Stream
DRUMRANKIN
CARNAMENAGH
MONEYNEAGH
CARNAGALL
BALLYWEENY ROAD
CORKEY ROAD
RESERVOIR ROAD
ALTNAHINCH ROAD
CARNAMENAGH ROAD
Altnahinch Reservoir
Killagan Water

1 2 3 4 5 6 7 8 9 10

Rev	Date	By	Comment
A	28/03/2019	SC	First Issue.

0 0.25 0.5 1 km

Corkey Windfarm Repowering

Trout Survey Results

Figure A8.4.4

Drawing Number:	Datum	Projection
2606-REP-072	TM65	TM
Scale @ A3 1:15,000	Drawing produced by Arcus Consultancy Services	

2606-REP-072 FigA8.4.4 Trout Survey Results