Tywi and Claerwen Invertebrate Survey

1. Introduction

1.1 Background

Infinis propose to develop run-of-river hydropower schemes on the Afon Tywi in Carmarthenshire, South West Wales and on the River Claerwen in the Elan Valley, Powys. Infinis, assisted by AMEC Environment & Infrastructure UK Ltd (AMEC), are preparing the planning applications and supporting documents, including an Environmental Statement (ES). As part of this work AMEC completed aquatic macroinvertebrate surveys of the reaches of the Tywi and Claerwen that could potentially be affected by the schemes, as well as surveys of 'Control' sites on tributaries of these rivers. These surveys were carried out in 2011.

1.2 Proposed Hydropower Scheme Locations

The River Claerwen flows from Claerwen Reservoir into the Dolymynach/Caban Coch Reservoir, over a length of approximately 4km. The proposed hydropower scheme would be located on the Claerwen between the two Reservoirs. A number of smaller tributaries join the Claerwen. This includes the Rhiwnant, the confluence with which is situated at the downstream end of the Claerwen, immediately upstream Dolymynach Reservoir. The confluence of the Afon Arban with the Claerwen is at the upstream end of the Claerwen, immediately downstream of Claerwen Reservoir.

The River Tywi (Towy) flows from Lyn Brianne Reservoir, north of Ystradffin. The location of the proposed hydropower scheme is at approximate National Grid Reference (NGR) SN785 476, near Ystradffin, within the upper Tywi catchment, a short distance downstream of Llyn Brianne Reservoir. The Doethie is a tributary of the Towy which it joins from the north-west about two kilometres downstream of the reservoir.

2. Methods

2.1 Physical & Chemical Parameters of Survey Sites

The survey site locations are summarised in Appendix A. Sites were selected that fall within the reaches of the watercourses that lie between the proposed intake and outfall locations and hence within what would be referred to as the 'depleted reach'. Two control sites close to the depleted reaches were also surveyed, these are on tributaries of the Claerwen (The Rhiwnant) and Tywi (Doethie).

Data was collected on various physical and chemical parameters at the sample sites, including pH, conductivity, water temperature and total suspended solids. These were measured using a

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hand-held Hannah HI98129 pH/conductivity meter. Dissolved oxygen was measured using a Hannah HI9142 Dissolved Oxygen meter. Wetted width was measured using a Bushnell Medalist laser range finder or with a metre rule on narrow (<3m) watercourse reaches. Flow velocity was measured with a Geopacks Flometer 1. Substrate composition was estimated by eye and conforms roughly to the Wentworth scale but with the term 'pebble' encompassing the coarse gravel, medium gravel and fine gravel of the Wentworth scale.

2.2 Invertebrate Sampling and Identification

The survey was carried out by an experienced Entomologist. Each site was surveyed by kick-sampling for 3-minutes in riffles and throughout the survey reach in accordance with standard Environment Agency survey method. An additional minute was spent manually searching the substrate. The samples were collected with a standard hand net (supplied by EFE Field Equipment, Totnes). Each sample was sieved using a coarse (1cm) sieve and 500-micron sieve to remove twigs, leaves, seeds and large stones. The coarse material retained by the 1cm sieve was examined for large invertebrates before being returned to the river. The fine fraction (<1cm) was placed into a sample container and preserved in the field using 10% formalin.

The preserved fractions were later examined in the laboratory by placing small amounts of material into gridded petri-dishes and adding water. These petri-dishes were then examined carefully under a stereomicroscope. Each light fraction typically required 40-50 petri-dishes. Aquatic invertebrates were removed from the fractions into a vial for identification and counted at the same time. For particularly abundant taxa, sub-sampling was used to estimate the total number of specimens i.e. individuals were counted from 20-25% of the dishes and multiplied up. All macroinvertebrates have been identified to species level with the exception of particularly difficult taxa, such as oligochaetes, chironomids and some other Diptera larvae. Immature specimens, as well as females that could not be identified to species-level, where identified to the appropriate level.

2.3 Biotic Indices – Biological Water Quality

Biological Monitoring Working Party (BMWP) scores and Average Score per Taxon (ASPT) were calculated for each of the invertebrate samples. BMWP is a biotic index that uses aquatic macroinvertebrates to determine water quality of running waters in relation to organic pollution. It works on the principle that macroinvertebrates vary in their sensitivity to water quality with the most pollution - sensitive scoring highly (up to 10) and the most pollution - tolerant scoring low scores (zero, in the worst case). Most organisms fall somewhere on a scale between the two extremes. The values for each taxon are added together to give an overall BMWP score for the sample site. The total scores are banded into five categories reflecting poor, moderate, good, very good and excellent water quality (Table 1).

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Table 1 Biological Water Quality Banding according to BMWP Score

Water Quality Band	BMWP Range
Poor	<25
Moderate	26 - 50
Good	51 - 100
Very Good	101 - 150
Exceptional	>150

BMWP score alone can be insufficient as a measure of biological water quality due to the variability of the scores in relation to habitat diversity. Therefore the Average Score per Taxon is derived by dividing the BMWP score by the number of taxa used to obtain that score. This reduces the influence of habitat diversity. Armitage et al (1983) recommended the use of ASPT since its value is less sensitive to sampling effort and seasonal change than BMWP score.

2.4 Biotic Indices - Flow

Lotic-invertebrate Index for Flow Evaluation (LIFE) scores were also calculated for families and species for all samples. LIFE is a method for linking benthic invertebrate data to prevailing flow regimes, recognising that species/taxa are often associated with particular flow ranges. It is an index designed for British waters and is described by Extence et al (1999). Some taxa for which it is impossible to classify their flow preferences or where taxonomic difficulties make them unreliable do not score. LIFE scores were calculated using Species Diversity and Richness software developed by Pisces Conservation Ltd.

2.5 Species Rarity

The rarity of the species recorded has been checked against the Red Data Book and Nationally Scarce statuses given to invertebrates by the Joint Nature Conservation Committee (JNCC). The JNCC statuses are taken from the latest national reviews of different insect orders and these are also given on the computer database software RECORDER. Red Data Book species are confined to between 1 and 15 10km squares in Britain, whilst Nationally Scarce species are those confined to between 16 and 100 10km squares. Since 1995 the International Union for Conservation of Nature and Natural Resources (IUCN) categories has been adopted by the JNCC as the new standard for Red Lists in Britain. JNCC aims to work towards assessing the status of all native species against standard criteria based on the internationally accepted guidelines developed by the IUCN (see IUCN 2001, 2003). Only a small number of taxonomic groups have been given IUCN codes but these include the water beetles (Foster 2010).

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3. Results and Conclusions

3.1 Notable Species and Species Diversity

The aquatic macro-invertebrates recorded are on the Tywi and Claerwen are summarised in Appendix B and details of the sample sites are provided in Appendix C. No legally protected, UK or Local Biodiversity Action Plan or Red Data Book invertebrate species were recorded.

A total of 61 aquatic macro-invertebrate species were recorded. The average number of species per sample as well as species diversity has not been calculated but these are clearly low to very low.

One Nationally Scarce riffle beetle (*Oulimnius troglodytes*) was recorded from the Rhiwnant and the Tywi. This species is afforded Nationally Scarce (neither Red List nor Near Threatened) status by Foster (2010) in the most recent version of the national review of water beetles. The aquatic snipe-fly (*Ibisia marginata*) which was recorded as larvae in the samples is a local species.

The only aquatic mollusc recorded was the river limpet (*Ancylus fluviatilis*) and it was recorded at only one sample site. Several Mollusc species would be expected in rivers and streams similar to those surveyed and, for example Jenkin's spire snail (*Potamopyrgus antipodarum*), the common pond snail (*Radix balthica*), orb mussels (Sphaerium spp) and pea mussels (Pisidium spp). Similarly no Crustacea were recorded and the presence of the freshwater shrimp (*Gammarus pulex*) in particular would be expected in unpolluted, well-oxygenated upland rivers. With the exception of river limpet being recorded at one sample site the absence of these two groups in particular may be related to acid waters since both rely heavily on calcium carbonate for their shells and exoskeletons.

Diversity of Ephemeroptera, Plecoptera and Trichoptera was also low in almost all the samples and these are groups that would be expected to be diverse and species-rich in unpolluted, well-oxygenated upland rivers and streams. Other groups such as Odonata which have few representatives in running-water, were absent whilst all water beetle families with the exception of the riffle beetles (Elmididae) were poorly represented. The only frequent beetle with the exception of the riffle beetles was the dytiscid (*Oreodytes sanmarki*) which is adapted to living in fast-flowing conditions. Chironomid (non-biting midge) and simulid (blackfly) larval abundance appeared to be low to very low which is unusual of rivers of this type. Abundance of almost all taxa was substantially lower than would be expected on similar watercourses.

3.2 Biotic Indices

3.2.1 Claerwen and Rhiwnant

The BMWP scores recorded ranged from 27 to 53 with a trend of improving scores from upstream to downstream (Appendix B). All the Claerwen samples exhibited moderate biological water quality and the Rhiwnant (R1a) has good biological water quality. The same pattern was evident with respect to the number of scoring taxa with only five scoring (BMWP) taxa at the most upstream sample site on the Claerwen (C1a) increasing to 9 taxa at the most downstream Claerwen site (C6a) and on the tributary the Rhiwnant (R1a). ASPT exhibited a different pattern but still with the highest score on the Rhiwnant (R1a). The LIFE Scores are summarised in Table 2 and are similar across survey sites.

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Table 2 Claerwen LIFE Scores

Site	LIFE	No Scoring taxa
C1a	8.333	3
C2a	8.333	3
C3a	8.333	3
C6a	8.5	4
R1a	8.444	9

3.2.2 River Tywi and Doethie

The total BMWP scores varied from 18 at the second sample site (T2a) to 103 (T6a) on the Tywi (Appendix B). Biological water quality on the Tywi varies from poor (T2a) to very good (on T6a) with that on the Doethie (D1a), being good. The number of scoring taxa was very low (4 taxa) on the second sample (T2a) and highest on the third (T6a) and fourth (T7a) samples on the Towy. The ASPT scores mirrored the BMWP scores. The LIFE Scores are summarised in Table 3 and are comparable across sites.

Table 3 Tywi LIFE Scores

Site	LIFE	No Scoring taxa
T1a	7	4
T2a	8	1
T6a	8.286	14
T7a	8.333	15
D1a	8.333	12

3.2.3 Assessment

The relatively short list of species recorded from the sample sites, the low abundance of taxa, low species richness and diversity indicate a potential water quality constraint on the invertebrate assemblages. The relatively low BMWP scores and number of scoring taxa also indicate water quality problems.

Previous studies (for example, Stoner 1984, Anon 2007) report acidification in the upper catchment of the River Tywi. Various factors such as nitrogen pollution, acid rain, habitat degradation, afforestation and base-poor geology have been considered as contributory factors. Liming is undertaken to address the acidification however the results of the survey appear to indicate that there continues to be constraints on the invertebrate ecology of both the Claerwen and Towy.

The results may also be partly influenced by strong to very strong flows, boulder-strewn nature of the channel and slippery algae-covered rocks, which made kick-sampling and moving around

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the channel difficult. Therefore sampling was restricted to the first third of the channel. Water levels also appeared to be elevated presumably due to heavy rainfall preceding the survey. The results may also be influenced by negative impacts of river regulation on invertebrate communities of both the Claerwen and Tywi – some relevant but out-of-date data on this issue is available for the River Elan, of which the Claerwen is a tributary, below Caban Coch Reservoir (see UWIST 1979).

3.3 Conclusions

A total of 61 aquatic macro-invertebrate species were recorded from the Rivers Claerwen and Tywi and their tributaries. One Nationally Scarce riffle beetle (*Oulimnius troglodytes*) was recorded. Overall, species richness, diversity and abundance were low and indicate a potentially substantial water quality problem. The BMWP analysis corroborates this conclusion with relatively low BMWP scores and low numbers of scoring taxa. The absence of groups such as freshwater Crustacea, including the typically ubiquitous freshwater shrimp (*Gammarus pulex*), and Odonata and near absence of freshwater Mollusca also supports this conclusion. None of the reaches sampled can currently be considered to be of notable nature conservation value with respect to their aquatic invertebrate fauna.

4. References

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APPENDIX A

SURVEY SITES

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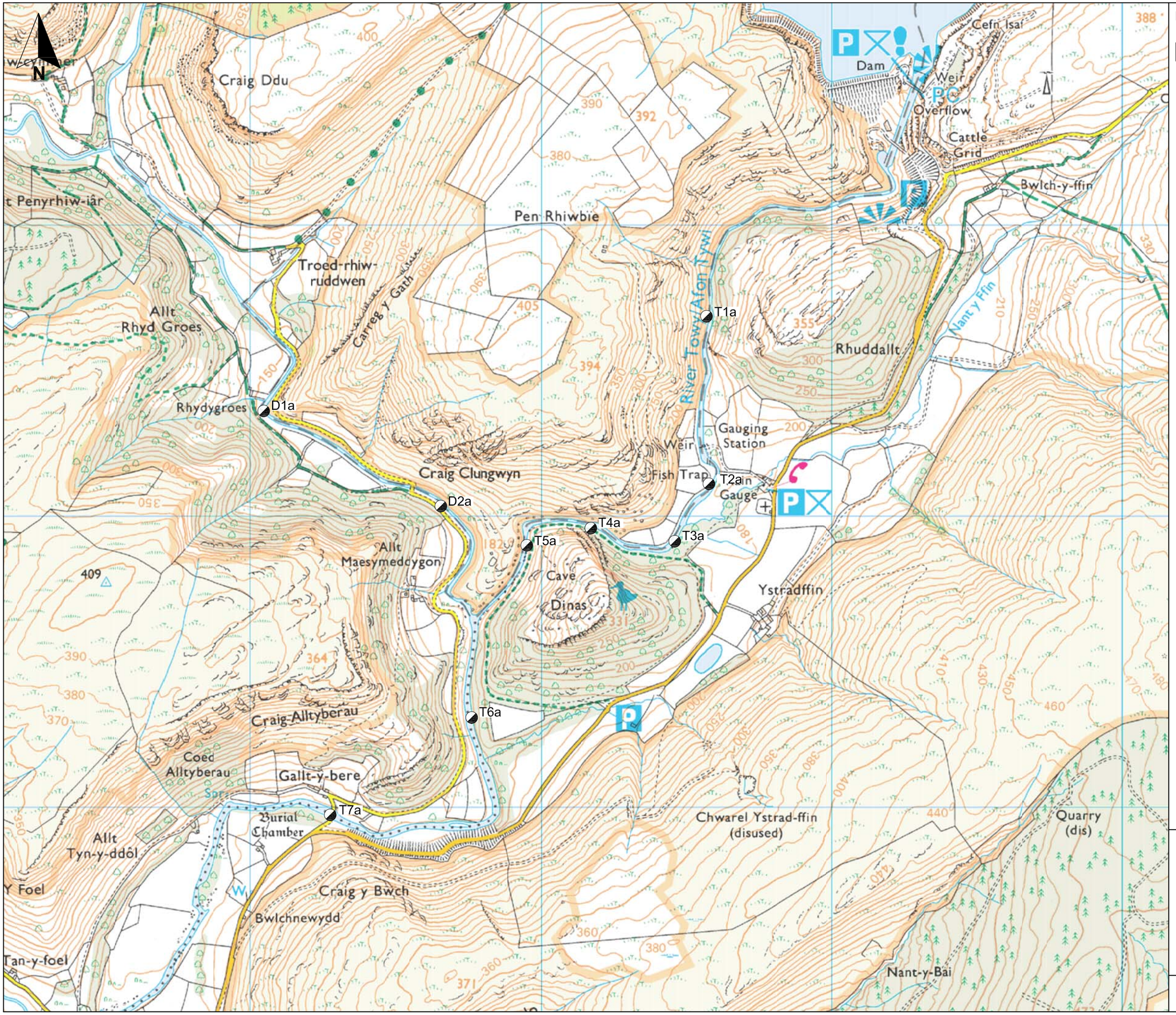

Key

Survey site

Site	Survey
T1a	Fish; Invertebrates; Possible Bryophyte cross section
T2a	Fish; Invertebrates; hydrology;
T3a	Hydrology only
T4a	Hydrology Possible Bryophyte cross section
T5a	Hydrology Possible Bryophyte cross section
T6a	Fish; Invertebrates; hydrology;
T7a	Fish; Invertebrates; Possible Bryophyte cross section
D1a	Fish; Invertebrates
D2a	Fish;

0 m 500 m

Scale 1:12,500 @ A3

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River Towy

Location of Survey Sites

July 2011
29639-W06.dwg parkj

amec

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Key

Survey site

Site	Survey
C1a	Fish; Invertebrates; Bryophytes
C2a	Fish; Invertebrates; Bryophytes; Hydrology;
C3a	Fish; Invertebrates; Bryophytes; Hydrology;
C4a	Hydrology
C5a	Hydrology
C6a	Fish; Invertebrates; Bryophytes;
R1a	Fish; Invertebrates;

0 m 500 m

Scale 1:10,000 @ A3

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River Claerwen

Location of Survey Sites

July 2011
30124-W06.dwg parkj

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APPENDIX B

AQUATIC INVERTEBRATES (AND BIOTIC INDICES) RECORDED FROM RIVERS CLAERWEN AND TOWY AND TRIBUTARIES: JULY 2011

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APPENDIX B: AQUATIC INVERTEBRATES (AND BIOTIC INDICES) RECORDED FROM RIVERS CLAERWEN AND TOWY AND TRIBUTARIES: JULY 2011

SITE CODE		C1a	C2a	C3a	C6a	R1a	T1a	T2a	T6a	T7a	D1a
RIVER		Claerwen	Claerwen	Claerwen	Claerwen	Rhiwnant	Towy	Towy	Towy	Towy	Doethie
Taxa	Stage										
Nematoda	Adult									1	
Lumbricidae	Adult				1						
Oligochaeta	Adults	2	6	42	6		27	110	11	11	10
Erpobdella sp	Juvenile			1							
Ancylus fluviatilis	Adult										1
Atractides sp	Adults					4				1	
Lebertia sp	Adults				1						
Sperchonopsis verrucosa	Adults									1	
Baetis rhodani	Nymphs	1	2	1	6	300	2		76	308	39
Baetis scambus	Nymphs									1	
Ecdyonurus insignis	Nymphs								3		
Serratella ignita	Nymphs				2	20			60	98	8
Heptageniidae	Early instar										1
Amphineura sulcicollis	Nymphs									1	
Isoperla grammatica	Nymphs	1	1			2			1	2	1
Leuctra fusca	Nymphs	3	5	4	25		1		4	10	15
Leuctra nigra	Nymphs							3	2	3	1
Nemouridae	Early instar								1		
Nemurella picteti	Nymphs						3				
Brachycentrus subnubilus	Nymphs									1	1
Chaetopteryx villosa	Nymphs									2	
Limnephilidae	Early instar									2	
Odontocerum albicorne	Nymphs								1		
Polycentropus kingi	Nymphs								1	3	
Rhyacophila dorsalis	Nymphs			1	2	10			1	5	3
Sericostoma personatum	Nymphs								4		2
Oreodytes sanmarki	Adults					1			8	2	3
Oreodytes sp	Larvae									1	
Dytiscini	Larvae						1				
Helophorus brevipalpis	Adult						1				
Elmis aenea	Larvae					2			6	11	4
Elmis aenea	Adults					3				1	
Esolus parallelopipedus	Adults								1		
Esolus/Oulimnius sp	Larvae			1							
Limnius volckmari	Larvae			1		1			4	1	18
Limnius volckmari	Adults					1					1
Oulimnius troglodytes	Adults					2			1	1	
Oulimnius sp	Larvae				1				3		
Dryops luridus	Adult									1	
Tipula vittata	Larvae						1				
Tipula sp	Larvae				1			3			
Dicranota sp	Larvae					2		1			
Brillia modesta	Larvae								2		2
Metriocnemus sp	Larvae						2				
Orthocladiinae	Larvae	2	7	31	6		23	7	11	8	5
Tanypodinae	Larvae	1	1		1	2	1		1	2	
Tanytarsini	Larvae		3	11	2	1	25	7	12	4	3
Conchapelopia melanops	Pupae				1						
Zavrelimyia nubila	Pupae						1				
Simulium argyreatum/variegatum	Larvae					6			3	12	2
Simulium cryophilum	Larvae									1	
Simulium equinum group	Larvae						3				
Simulium variegatum	Pupae					1					
Simulium vernum	Larvae					1					
Simulium sp	Larvae								1		
Psychodidae	Larvae		1				1				
Ibisia marginata	Larvae								2		6
Ibisia marginata	Pupae								1		
Chelifera sp	Larvae			3			1				
Wiedemannia sp	Larvae				2					1	
Hemerodrominae	Pupae			5	2				1	1	1
BMWP SCORE		27	32	37	44	53	44	18	103	95	84
NUMBER SCORING TAXA		5	6	8	9	9	9	4	15	15	13
ASPT		5.4	5.3	4.6	4.8	5.8	4.8	4.5	6.8	6.3	6.4
FISH RECORDED IN SAMPLES											
Cottus gobio	Juvenile									1	
ADULT INSECTS RECORDED IN SAMPLES											
Wiedemannia insularis	Adults		1			1					

APPENDIX C

AQUATIC INVERTEBRATE SAMPLE SITES ON RIVERS CLAERWEN AND TOWY AND TRIBUTARIES: JULY 2011

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APPENDIX C: AQUATIC INVERTEBRATE SAMPLE SITES ON RIVERS CLAERWEN AND TOWY AND TRIBUTARIES: JULY 2011

AMEC SITE	C1a	C2a	C3a	C6a	R1a	T1a	T2a	T6a	T7a	D1a
WATERCOURSE	Claerwen	Claerwen	Claerwen	Claerwen	Rhiwnant	Towy	Towy	Towy	Towy	Doethie
Grid Reference (SN)	8767962937	8849362540	8874162265	8985861711	8967461672	7855747638	7852147024	7775846312	7719346015	7704147370
Wetted width (M)	14	18	18	14	6	17	17	20	23	13
River depth (cm)(Max.)	50	52	85	63	37	76	48	64	56	34
Velocity (M/sec)	0.25	0.3	0.15	0.57	0.25	0.33	0.42	0.06	0.43	0.25
pH	6.75	6.35	6.02	5.95	5.95	6.35	6.35	6.36	6.26	6.21
Conductivity	20	18	19	18	17	35	34	34	32	27
Dissolved oxygen	3.2	3.8	3.1	2.9	3.6	4.8	4.2	2.9	4.4	3.5
Macrophyte cover (%)	0	0	2	0	0	0	0	0	1	0
Boulders (%)	50	80	50	50	40	80	20	30	25	33
Cobbles (%)	40	15	30	30	30	15	10	40	50	33
Pebbles (%)	5	5	20	15	15	5	40	20	25	33
Gravel (%)	5	0	0	5	15	0	0	0	0	0
Adjacent land-use(s)	USP	USP	USP	USP	USP	SNW	R, USP	SNW	SNW	BCH,USP
Water temp. (°C)	11.4	12.2	11.9	12	11.9	13.7	13.8	14.2	13.7	14.4
Total dissolved solids (ppm)	10	9	9	9	8	17	17	16	16	12
RIPARIAN VEGETATION										
Acer pseudoplatanus	0	0	1	0	0	0	0	0	0	0
Alnus glutinosa	0	0	0	1	0	0	0	1	0	1
Betula pendula	0	0	1	0	1	0	0	0	0	0
Cirsium sp	1	1	1	1	0	0	1	0	1	0
Corylus avellana	0	0	0	0	1	0	0	0	0	0
Digitalis purpurea	0	0	1	0	0	0	0	0	1	1
Endymion non-scriptus	0	0	0	0	0	0	0	1	0	0
Epilobium sp	0	0	0	0	0	1	0	0	0	0
Filipendula ulmaria	0	0	0	0	0	1	0	0	0	0
Fraxinus excelsior	0	0	0	1	0	0	0	0	0	0
Galium sp	0	1	0	0	0	0	0	0	0	0
Geranium robertianum	0	0	0	0	0	1	0	0	0	0
Grasses	1	1	1	1	1	0	1	1	1	1
Juncus effusus	1	1	1	1	0	1	1	0	0	1
Lotus sp	0	0	0	0	0	1	1	0	1	0
Oenanthe sp	0	0	0	0	0	0	0	0	1	0
Oxalis acetosella	0	0	0	0	0	1	0	0	0	0
Potentilla erecta	0	1	0	0	0	0	0	0	0	0
Pteridium aquilinum	0	1	1	0	0	1	1	1	1	1
Quercus petraea	0	0	0	0	1	1	0	0	0	0
Ranunculus ficaria	0	0	0	0	0	1	0	1	0	0
Ranunculus sp	0	0	0	0	0	0	1	1	0	0
Reynoutria japonica	0	0	0	0	0	1	0	1	0	0
Rubus fruticosus agg.	0	0	0	0	0	1	0	0	0	0
Rumex acetosa	0	0	0	0	0	0	1	0	1	0
Salix caprea	0	1	1	1	1	1	1	0	0	1
Sorbus aucuparia	0	0	0	0	1	0	0	0	0	0
Ulex sp	0	0	0	0	0	0	1	0	0	0
Vaccinium myrtillus	0	0	0	0	0	1	0	0	0	0

River depth: C6a, T1a, T2a & T6a measured at 1/4 depth due to strong current. Rest measured mid-point.

Land-use: BCH = Bracken covered hillside, R = Riparian vegetation, USP = Upland sheep pasture, SNW = Semi-natural woodland