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A30 Chiverton to Carland Cross Aquatic Ecology Surveys - 2017

WSP Parsons Brinckerhoff

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Contents

1. Introduction

APEM Ltd. was commissioned by WSP to undertake a range of aquatic ecology surveys in respect of the proposed A30 Chiverton to Carland Cross Improvement Scheme (hereafter referred to as 'the proposed Scheme').

This document provides the results of surveys and associated data interpretations which were completed in 2017, with the exception of the fish population surveys, which have been reported separately (APEM, 2017). The surveys have been undertaken to establish an understanding of the baseline aquatic constraints associated with the proposed Scheme and will ultimately inform an Ecological Impact Assessment (EcIA) forming part of an Environmental Statement (ES) supporting a Development Consent Order (DCO) Application.

The targeted survey approach was specifically designed to provide baseline characterisation of macroinvertebrate populations and still waters (ponds). Data may be used as a reference against which any impacts of the proposed Scheme could be ascertained, but also used to inform future surveys or mitigation measures. The surveys would also advise the presence / absence of conservation species (including otter) and furthermore will provide complementary data on water quality throughout the system.

Data are interpreted and presented in the context of relevant regulatory frameworks, in particular the Water Framework Directive. Where applicable, high-level recommendations regarding mitigation measures designed to protect aquatic ecology and habitats have been made.

2. Methods

2.1 Geographical scope

The watercourses and ponds of interest and the location of aquatic ecology survey locations were selected based on consideration of the proposed Scheme development footprint, as provided by WSP and a walkover conducted in 2016.

During the walkover any watercourse located within 100m of the draft footprint was included within a habitat appraisal walkover survey. The survey mapped habitats for a minimum of 500m distance from the footprint (walkover survey conducted in late 2016) identifying watercourses that could be directly or indirectly 'impacted' by the works

Potential 'directly impacted' reaches are those that would be intersected by the proposed Scheme; there were four such reaches i.e. 2.1, 12.1, 12.2 and 13.4 (see Table 1). Potential direct impacts could include channel intrusion (cutting or realignment), reduction in bank stability and/or generation of sediment to the watercourses (associated with temporary or permanent crossing works).

Potential 'indirectly impacted' reaches and ponds are those that although not directly intersected by the proposed route, are sufficiently near that indirect effects may reasonably be deemed to be possible; indirect impacts could include sediment ingress via site runoff. For the purposes of this study, all watercourses within 100m of the draft footprint were considered to have the potential for indirect impacts. 100m is considered to be a sensible threshold for identification of any potential indirectly impacted reaches, and may be considered to be precautionary given the low topographical gradients in this general area and the legislative compliance assumption of best-practice construction methodologies.

Of the 14 potential 'indirectly impacted' watercourses identified initially, three were deemed (on the basis of walkover observations) very unlikely to be suitable for all fish and macroinvertebrate communities (4.1, 13.2 & 18.1). These streams were likely ephemeral, too shallow and narrow for aquatic ecology to establish, or so denuded to be ineffectual for fish and macroinvertebrates. Site 13.2 was further identified as being on the same watercourse as Site 13.1 and therefore Site 13.2 was scoped out of further survey works. However it was recommended that macroinvertebrate surveys be conducted at sites 4.1 and 18.1 to validate the assumption of ineffectual habitat potential. Watercourse 5.1 was not accessed during the initial walkover survey due to a lack of landowner permission; no follow up monitoring was recommended at this location given the close proximity of site 5.2.

Survey requirements are further discussed in APEM (2016b).

Table 1 Identified direct and indirect survey locations (cross reference Figure 1)

Potential impact	Reach	Fish (incl .lamprey)*	Invertebrates	
		Late summer	Spring	Autumn
Direct	2.1	Y	Y	Y
	12.1	Y	Y	Y
	12.2	Y	Y	Y
	13.4	Y	Y	Y
Indirect	4.1	N	Y	Y
	4.2	Y	Y	Y
	5.1	N	N	N
	5.2	Y	Y	Y
	6.1	Y	Y	Y
	8.1	Y	Y	Y
	10.1	Y	Y	Y
	12.3	Y	Y	Y
	13.1	Y	Y	Y
	13.2	N	N	N
	13.4	Y	Y	Y
	15.1	Y	Y	Y
	16.2	Y	Y	Y
	17.1	Y	Y	Y
	18.1	N	Y	Y

* Fish results are presented in APEM (2017).

The precise survey site within the reach of interest was selected to provide a representative location of the wider stream, where relevant to allow a wide range of species to be sampled and also having regard for survey accessibility. Figure 2–1 presents the watercourse survey locations and Figure 2–2 presents the six pond locations.

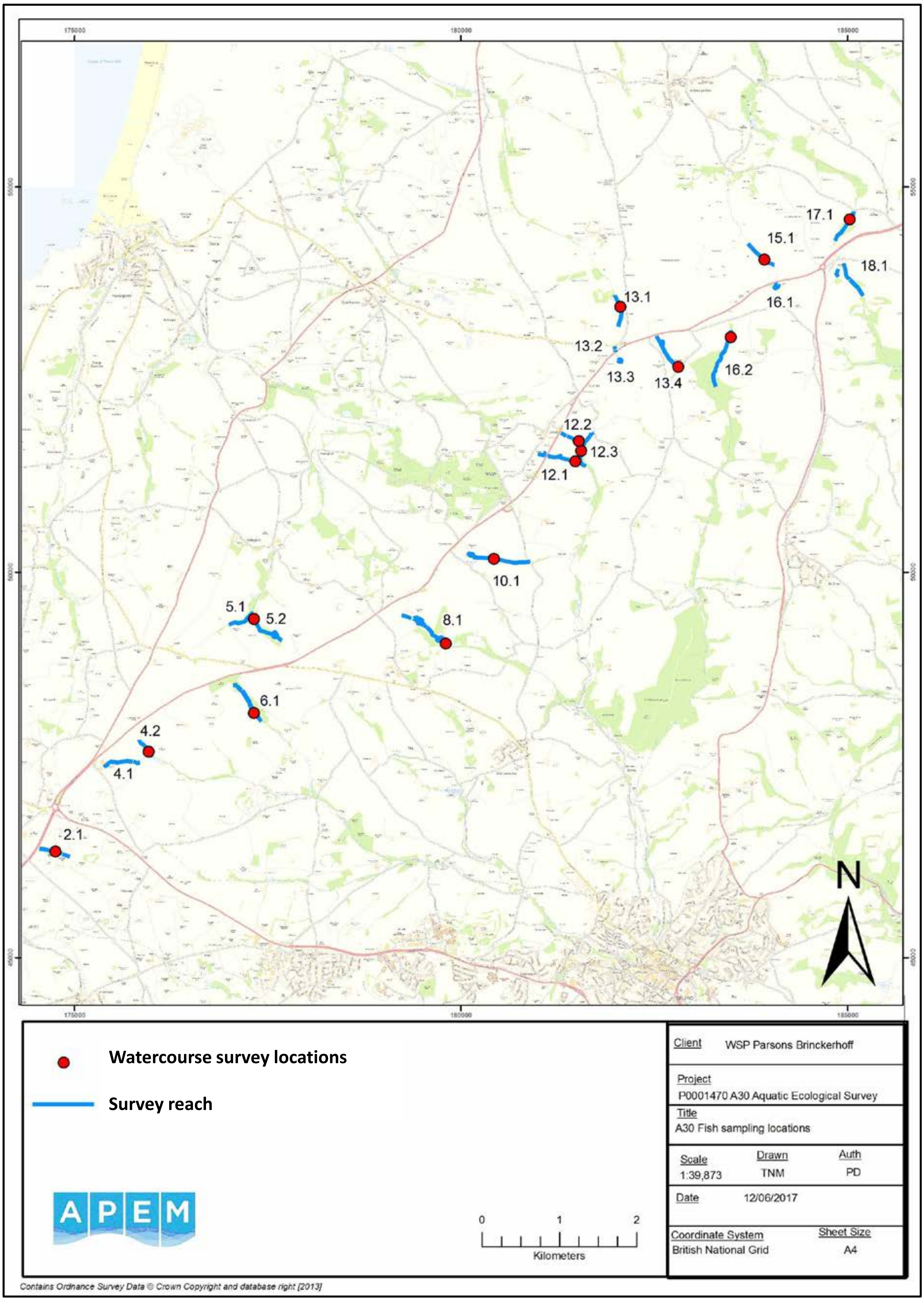

Figure 2–1 **Watercourse survey locations (note 13.3 and 16.1 are ponds).**

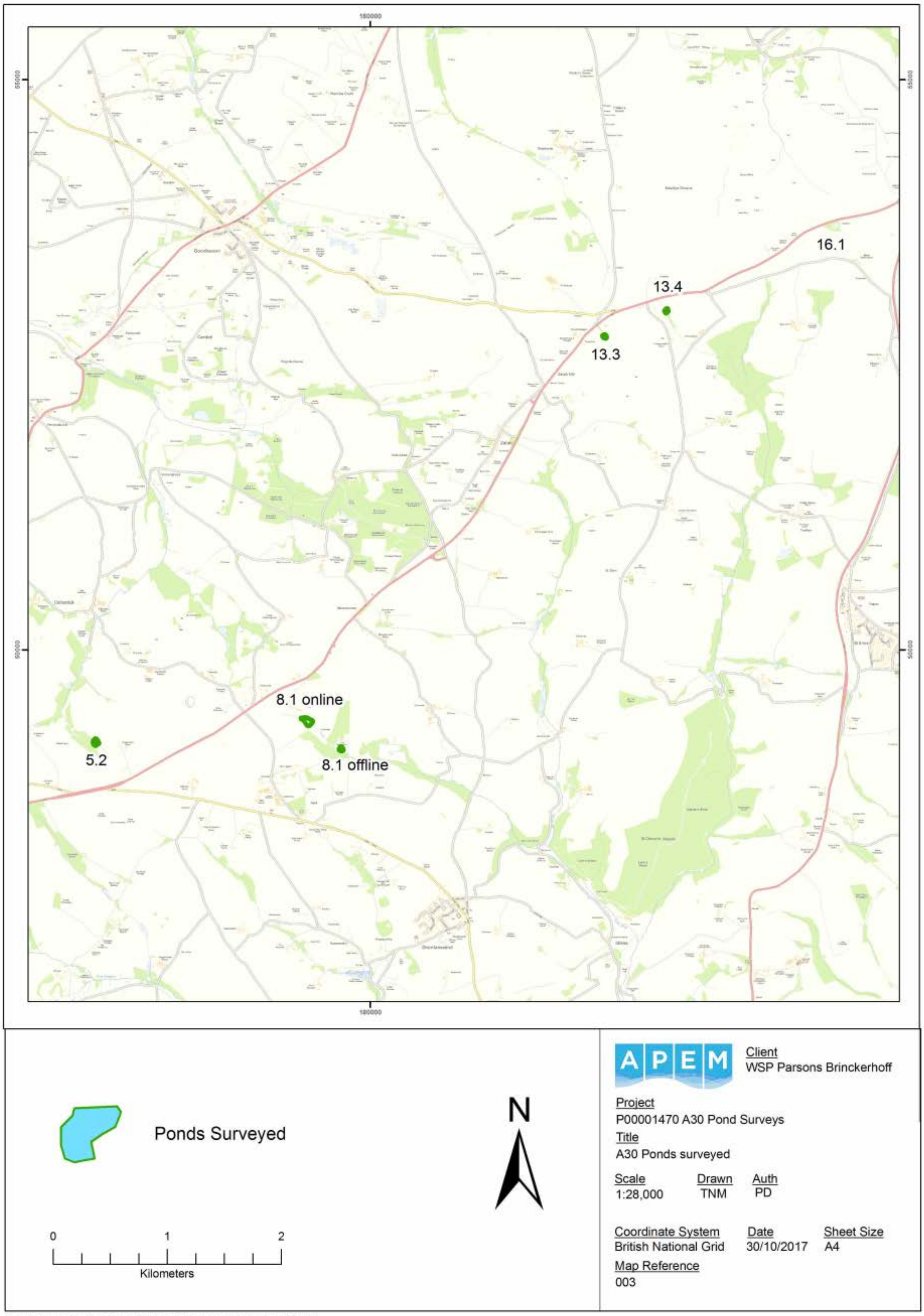

Figure 2–2 **Pond locations.**

Pond 16.1 was a flooded quarry with very steep banks and no access to the waters edge (Figure 2–3). There was no obvious macrophyte cover and due to its inaccessibility is considered unlikely to have been stocked with fish. An extensively overgrown dry ditch leading to the site through dense gorse was observed, which is likely to be an old quarry access track rather than a feeder tributary.

No additional surveys were conducted at pond 16.1 on health and safety grounds.

Figure 2–3 Pond 16.1

2.1.1 *Scheme footprint changes*

Revisions to the proposed Scheme footprint (all of which were minor) were critically reviewed to ensure all sites remained relevant and to identify any new requirements. Only site 2.1 was removed due to footprint revisions as it was no longer considered within potential hydraulic connectivity with the development. No additional watercourses (or ponds) were identified during footprint revisions.

2.2 Survey methods

2.2.1 *Watercourse macroinvertebrate survey*

Two watercourse macroinvertebrate sampling visits were undertaken in 2017; one in Spring (May) and one in Autumn (October), during which each of the fifteen watercourse locations were visited.

Macroinvertebrate samples were collected using a standard three-minute freshwater pond net sampling procedure with a one-minute timed hand search, consistent with the Environment Agency (2009a) guidance. Samples were preserved in 90% industrial methylated spirits solution (IMS) on site and analysed to Mixed Taxon Level 5 in APEM's quality-assured laboratories, to the requirements outlined in Environment Agency (2009b).

The data were aggregated to pressure-specific indices: Biological Monitoring Working Party score (BMWP); Average Score per Taxon (ASPT); Number of Taxa (NTAXA); and Lotic-invertebrate Index for Flow Evaluation (LIFE). In addition, the Proportion of Sediment-sensitive Invertebrates (PSI, Extence at al., 2011) index was calculated to give further insight into potential impacts associated with fine sediment inputs. Species Conservation Score (CS), which is one component of the Community Conservation Index (CCI, Chadd & Extence, 2004) helps to provide a comparative measure of the conservation value of macroinvertebrate communities between sampling locations (having due regard for recent updates).

Whalley Hawkes Paisley Trigg (WHPT) method (UKTAG 2014) is an index of overall biological quality using macroinvertebrates similar to the BMWP index. WHPT ASPT responds to the same environmental pressures as BMWP though unlike BMWP it will respond to pressures that just affect abundance. Therefore, it can detect moderate changes in water quality that would previously have been undetected. WHPT NTAXA also responds to the same environmental pressures as BMWP NTAXA. WHPT ASPT and WHPT NTAXA are the current indices used to determine WFD status during classifications for macroinvertebrates.

Seasonal expected scores were calculated and ratios of Observed and Expected scores (O/E ratios) determined. Expected reference conditions were calculated using the RIVPACS IV model within the River Invertebrate Classification Tool RICT (Davy-Bowker et al, 2008), from which, O/E ratios can then be used within WFD status classification schemes specific to the relevant indices.

Classification schemes using ASPT and NTAXA have historically been formally adopted for the classification of water bodies for the Water Framework Directive (WFD) (Davy-Bowker et al, 2008) by the UK Technical Advisory Group (UKTAG). WHPT metrics have replaced the BMWP metrics (ASPT and NTAXA) for WFD status classifications (UKTAG, 2014). However, there are a number of other factors and rules that are taken into account when classifying overall waterbodies, and therefore the classification scheme is used for indicative comparison here, not definitively.

LIFE O/E ratios have been used to identify sampling locations where flow is a possible pressure acting on the ecological community of a site. This is in line with adopted EA practice (EA, 2012).

The raw data were also analysed for the presence of species with a Conservation Score (CS) of seven (Notable) or above (Chadd & Extence, 2004).

Macroinvertebrate data are summarised in Table 3.1.

2.2.2 *National Pond Survey (NPS)*

Wetland plants were surveyed using the National Pond Survey standard technique described in detail in (Pond Action 1998, Howard, 2002). Wetland plants (species defined as wetland plants on the National Pond Survey field recording sheet list) were surveyed by walking and wading the perimeter and open water areas less than 1 meter deep and noting the species present. The number of uncommon species and the Trophic Rank Score (TRS) were calculated[1]. TRS is a measure of the average trophic rank for each pond. The trophic scores used were based on work undertaken on lakes by Palmer (1989). Plant scores in this system vary between 2.5 (dystrophic i.e. very nutrient poor conditions) and 10 (eutrophic, i.e. nutrient rich conditions) (see Table 5).

Macroinvertebrate samples were collected using a standard three-minute freshwater pond net sampling procedure with a one-minute timed hand search, consistent with the National Pond Survey methodology (Pond Action, 1998). Macroinvertebrate microhabitats were sampled along the pond perimeter with the time sampled at each microhabitat proportional to its area. Samples were preserved in 90% industrial methylated spirits solution (IMS) on site and analysed to Mixed Taxon Level 5 in APEM's quality-assured laboratories, to the requirements outlined in Environment Agency (2009b). The species data were also analysed for the presence of macroinvertebrate species with a Conservation Score (CS) of five (Local conservation status) or above (Chadd & Extence, 2004).

Water quality parameters (dissolved oxygen (%saturation and mg/l), pH, conductivity and temperature) were measured in the field using a YSI Pro multimeter probe. Water quality samples were also collected at each pond for the analysis of alkalinity and calcium in the laboratory. Physical characteristics of the pond were recorded in the field following NPS methods, the pond surface area was calculated by walking the pond perimeter with a Global Positioning System (GPS).

Other Amphibians and fish were noted if they were seen during the Pond Survey.

2.2.3 *Otter presence survey*

Otter are a rare but widespread mammal, found almost throughout the country. The presence or absence of otters was assessed through constant and dynamic survey of the watercourses and ponds for any associated field signs and evidence. All aquatic ecology surveyors maintained vigilance for otter field signs during concurrent fish, macroinvertebrate and pond surveys; as such watercourses have been walked on multiple occasions and multiple seasons. Staff looked for evidence of otters, including:

- Holts;

[1] Number of uncommon species and the TRS calculated using a PSYM (Predictive SYstem for Multimetrics) fieldsheet with the number of uncommon species having a rarity score of 2 and above.

- Spraints (dung);
- Tracks (footprints);
- Feeding remains;
- Otter slides (into water);
- Holts (underground dens);
- Couches (above ground sites where otters rest during the day); or
- Anal jelly.

3. Results

3.1 Watercourse macroinvertebrate survey results

Table 3.1 presents a summary of the macroinvertebrate indices, classifications and EQRs (Ecological Quality Ratios).

For indicative purposes, the data have been compared against the Water Framework Directive (WFD) classification schemes; MINTA (minimum of TAXA and ASPT) that was utilised in WFD Cycle 1 and also the equivalent Cycle 2 classification that is based on the WHPT metrics. Given the limited data set size these classifications should be viewed as indicative only, although spring and autumn data have been collected as per the classification minimum. Figure 3–1 presents the indicative WFD status classifications by location (map exported from SEPA's RICT software).

Table 3.1. – Summary of invertebrate indices and processing results

Site	ASPT	NTAXA	MINTA (Cycle 1)	WHPT ASPT Abund	WHPT NTAXA Abund	Indicative WHPT ASPT WFD status	Indicative WHPT NTAXA WFD status	Indicative Cycle 2 WFD status	PSI O/E Spring	PSI O/E Autumn	LIFE O/E Spring	LIFE O/E Autumn
Site 10.1	H	H	H	6.63	35.5	H	H	H	0.83	0.95	0.94	0.95
Site 12.1	G	H	G	5.82	28	G	H	G	0.70	0.70	**0.91**	**0.92**
Site 12.2	M	G	M	4.49	18	P	H	P	**0.18**	**0.35**	**0.81**	**0.84**
Site 12.3	G	H	G	6.71	28	G	H	G	0.80	0.92	0.94	0.96
Site 13.1	G	H	G	4.98	28	M	H	M	**0.39**	**0.57**	**0.82**	**0.91**
Site 13.4	H	H	H	7.13	39	H	H	H	1.00	1.01	1.01	1.00
Site 15.1	G	G	G	6.78	23.5	G	H	G	0.95	0.71	0.99	**0.89**
Site 16.2	H	H	H	7.03	32	H	H	H	0.94	0.85	0.97	**0.93**
Site 17.1	H	H	H	7.24	26.5	H	H	H	1.04	1.05	1.02	1.01
Site 18.1	H	H	H	6.62	26.5	H	H	H	0.76	0.84	**0.91**	0.98
Site 4.1	G	P	P	5.63	13.5	M	M	M	0.74	**0.55**	0.95	**0.92**
Site 4.2	H	H	H	6.54	20.5	H	H	H	0.85	0.90	0.97	0.96
Site 5.2	H	H	H	6.95	30	H	H	H	0.97	1.05	0.96	1.00
Site 6.1	H	H	H	6.61	29	H	H	H	0.88	0.90	1.00	0.97
Site 8.1	H	H	H	6.96	35.5	H	H	H	0.82	1.03	**0.93**	0.95

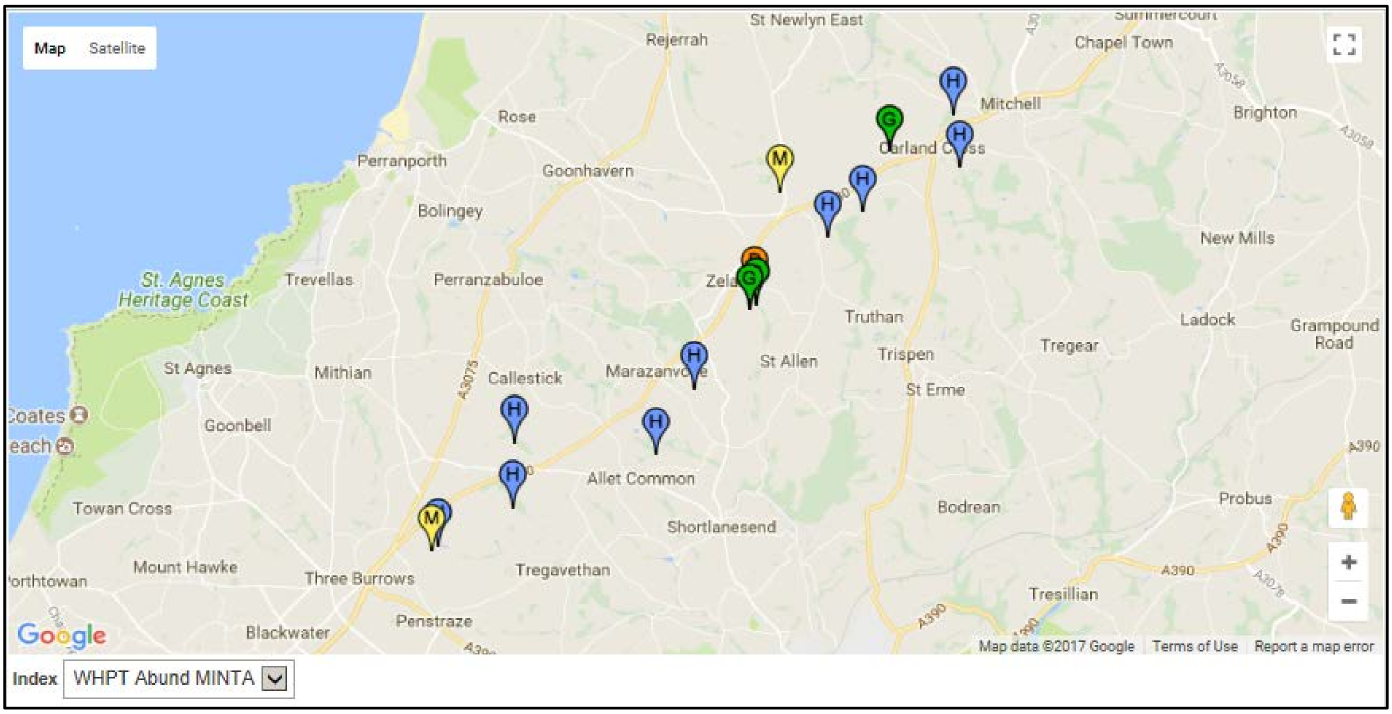

Figure 3–1 Indicative WFD status for invertebrates (applying Cycle 2 methods); figure reproduced from SEPA's RICT website.

With the exception of three sites (Site 12.2, 13.1 and 4.1) all locations had macroinvertebrate populations consistent with at least Good WFD status (applying WFD Cycle 2 classification methods); with nine locations consistent with High status. In general therefore the invertebrate populations are not considered to be adversely impacted, compared to an expected natural population. Sites 13.1 and 4.1 had invertebrate data consistent with moderate status and only site 12.2 had an invertebrate population consistent with poor status. At both Site 12.2 and Site 13.1 the WHPT NTAXA was consistent with high status, indicative of good diversity, however the overall indicative status is depressed on account of the WHPT ASPT. Reduced proportions of sensitive families are indicative of general degradation at these two sites; although the nature of this degradation cannot be confirmed in the absence of further analysis of environmental parameters.

Those sites with a PSI O/E (Observed/Expected) score of less than 0.7 are highlighted within Table 3.1 (in red), which is indicative of potential fine sediment stress (Environment Agency, 2012). Similarly those sites with a LIFE O/E of less than 0.94, which is indicative of potential flow stress are highlighted (Environment Agency, 2012). These thresholds are indicative and do not take account of interactions between different environmental pressures.

Site 12.2 data shows very low PSI O/E and a low LIFE O/E score (as well as data indicative of Poor WFD status). Review of field observations finds that the site character is consistent with these PSI and LIFE results. Site 12.2 is very highly sedimented, with a substrate dominated by pebble and gravel inundated with fine sediment. Field observations also suggest that this watercourse is ephemeral which would explain a depressed LIFE score. Figure 3–2 shows the sediment prevalence at Site 12.2.

Figure 3–2 Sediment prevalence at Site 12.2

Site 13.1 also exhibits low PSI and LIFE metrics. The channel is narrow, heavily overgrown and does not have complete flow connectivity, although there was evidence of intermittent high flows. The substrate was predominantly cobbles and gravels which were partly inundated with fine sediment. Figure 3–3 presents a photograph of the channel at Site 13.1.

Figure 3–3 Site 13.1 photograph

Table 3.2 presents a summary of those species identified with a Conservation Score (CS) of seven or greater. There were only 3 species recorded with a CS of seven or greater, and each had only a single occurrence.

Table 3.2. – Count of all species identified with a Conservation Score (CS) of seven or greater.

		Site Description	
CS	Taxa ID	Site 4.2	Site 18.1
7	*Agabus conspersus*	1	
7	*Ochthebius bicolon*		1
7	*Pomatinus substriatus*		1

Additional species information and distribution maps are provided within Table 3.3. None of the species identified are particularly restricted in their UK distribution, however two of these three species have notable conservation status (Table 3.3).

Table 3.3. – Additional species data, as sourced primarily from the NBN atlas (2017).

Taxa ID	Common name / family	NBN Occurrence records (NBN atlas)	Conservation status
Agabus conspersus	Spattered diver beetle		'Nationally Scarce' i.e. known to occur in 16 to 100 ten-km squares (or hectads); Foster (2010).
Ochthebius bicolon	Moss beetle (water beetle in the family Hydraenidae)		Widespread (more than 100 hectads) and not currently at threat or under decline; Foster (2010).
Pomatinus substriatus	Long-toed water beetle		'Vulnerable' under 2001 IUCN criteria (on basis of its area of occupancy and the fragmentation of the distribution); Foster (2010).

Overall, the invertebrate population is considered to be relatively diverse, albeit with few rare or notable conservation species present. Relative to other locations, Site 12.2 and Site 13.1 exhibit invertebrate populations of lower ecological value potentially on account of fine sediment and flow pressures.

3.2 National Pond Survey results

3.2.1 Water quality parameters

Baseline water quality is shown in Table 4. The ponds are circumneutral with a pH of around 7. Pond 5.2 has the lowest pH across the seasons and is consistently below 7. In the autumn the pH at Pond 13.3 rose to 8.5. Alkalinity at all ponds was low which is to be expected given the local geological conditions. The bedrock geology is Middle Devonian (undifferentiated) - Mudstone, Siltstone and Sandstone which are resistant to weathering and dissolution with low concentrations of dissolved minerals (BGS, 2017).

Visual observations appeared to suggest that nutrient enrichment was an issue at all ponds. There was excessive algal growth in all seasons and evidence of cattle entering ponds 13.3 and 13.4. Pond 5.2 was not open to cattle but the spreading of manure on the surrounding fields, which was evidenced in the spring, would eventually run down to the pond located at the bottom of the valley. There was no evidence of algal growth at pond 8.1 online. It is suspected that nutrients are also present but due to the high turbidity from the carp feeding in the lake this will limit plant growth within the waterbody.

Table 4 Pond survey- water quality results

Impacted pond	Water quality parameter	Concentration		
		Spring	Summer	Autumn
Pond 13.4	Alkalinity (mg/l $CaCO_3$)	34.5	58	33
	Calcium (dissolved, mg/l)	11.8	17	12.4
	pH	6.83	6.8	7.4
	Conductivity (µS/cm)	279	278	263
	Temperature (^oC)	10.7	18.7	12.4
Pond 13.3	Alkalinity (mg/l $CaCO_3$)	17.4	21	29
	Calcium (dissolved, mg/l)	5.21	5.45	6.13
	pH	6.83	6.75	8.5
	Conductivity (µS/cm)	145	152.7	168
	Temperature (^oC)	10.7	20.7	12.7
Pond 8.1 online	Alkalinity (mg/l $CaCO_3$)	26.6	29	32
	Calcium (dissolved, mg/l)	13.2	14.8	15.1
	pH	7.26	6.96	7.27
	Conductivity (µS/cm)	235	209	248
	Temperature (^oC)	12.6	20.5	14.8
Pond 8.1 offline	Alkalinity (mg/l $CaCO_3$)	45	NA	NA
	Calcium (dissolved,	12.5	NA	NA

Impacted pond	Water quality parameter	Concentration		
		Spring	Summer	Autumn
	mg/l)			
	pH	7.04	NA	NA
	Conductivity (µS/cm)	297	NA	NA
	Temperature (^{o}C)	11.6	NA	NA
Pond 5.2	Alkalinity (mg/l $CaCO_3$)	20.2	28	21
	Calcium (dissolved, mg/l)	11.8	10	10.8
	pH	6.2	6.22	6.58
	Conductivity (µS/cm)	250	218	229
	Temperature (^{o}C)	11	17.8	12.5

The baseline water quality is typical of ponds found on this geological typology. The levels of calcium are relatively high reflecting the influence of the Mudstone, Siltstone and sandstone layers in the local geology and a reason for the circumneutral pH (Gregory, 1997). Nutrient concentrations were not measured as part of the water quality analyses, however all ponds showed signs of nutrient enrichment (via visual appraisal and plant species present).

3.2.2 Macrophytes

Plant community species richness, rarity and Trophic Rank Score (TRS) are shown in Table 5. All ponds have a moderately species rich community looking at each season separately (definitions provided in Table 6). The results using the combined seasonal data give a broader picture of the overall species richness, trophic score and rarity of the plant community. The trophic ranking score is similar for all ponds and indicative of a nutrient rich plant community. The number of uncommon species varies across the ponds although no species were recorded with a rarity score greater than two (definitions provided in Table 7).

It is notable that Pond 13.3 supports New Zealand Pigmyweed, *Crassula helmsii*, which is defined as a Schedule 9 invasive[2]). *Crassula helmsii* is an invasive species found throughout much of Southern England. The success of this plant is its ability to colonise almost any static to slow flowing aquatic environment, due to a tolerance for a wide range of environmental conditions, from basic to acidic and oligotrophic to eutrophic (Lansdown, 2015).

[2] Schedule 9 Invasive Non-Native Species (INNS) as listed in the Wildlife and Countryside Act 1981 (as amended by The Wildlife and Countryside Act 1981 (Variation of Schedule 9) (England and Wales) Order 2010).

Table 5 Plant community data for all surveyed ponds. Species richness is given for seasons and combined seasons. All values were calculated using the PSYM calculator (Howard, 2002).

Pond	Spr	Sum	Aut	Sp Richness (Seasons combined)	No of emergent submerged sp.	No. of uncommon sp.	Rare species	Trophic Rank Score	Schedule 9 INNS*
13.4	8	10	12	16	14	2	*Potamogeton berchtoldii Potamogeton pusillus*	8.55	/
13.3	10	17	14	24	20	4	*Potamogeton berchtoldii, Callitiche obtusangula Alisma lanceolatum Rumex palustris*	8.34	*Crassula helmsii*
8.1	14	18	12	25	25	4	*Alisma lanceolatum Rumex palustris Stellaris palustris Myriophyllum spicatum*	8.9	/
5.2	14	22	16	29	24	5	*Alisma lanceolatum Hypericum elodes Rumex palustris Stellaris palustris Potamogeton berchtoldii*	8.36	/

* Schedule 9 Invasive Non-Native Species as listed in the Wildlife and Countryside Act 1981 (as amended by The Wildlife and Countryside Act 1981 (Variation of Schedule 9) (England and Wales) Order 2010).

Table 6 Wetland plants: categories for assessing the conservation value of ponds (Biggs, 2005)

Status	Description
Low	Few wetland plants (less than or equal to 8 species)
Moderate	Below average number of wetland plant species (9-22 species).
High	Above average number of wetland plant species (more than or equal to 23 species). No Nationally Scarce or Red Data Book (RDB).
Very High	Supports one or more Nationally Scarce or RDB species or an exceptionally rich plant assemblage (more than or equal to 40 species).

Table 7 Wetland plants: Uncommon species index (Howard, 2002)

Status	Rarity Score	Definition
Common	1	Recorded from >700 10x10 km grid squares in Britain
Local	2	Recorded from between 101 and 700 grid squares in Britain
Nationally Scarce	4	Nationally Scarce. Recorded from 15-100 grid squares in Britain
At Risk	8	Red Data Book: Category “At risk”
Vulnerable	16	Red Data Book: Category “Vulnerable”
Endangered	32	Red Data Book: Categories “ Endangered” or “Highly Endangered”

Excessive algal growth (except at Pond 8.1 online) was seen in all seasons. The ponds were also choked with plants with *P. natans* covering much of the surface area of each pond. There was evidence of cattle entering ponds 13.3 and 13.4. Pond 5.2 was not open to cattle but the spreading of manure on the surrounding fields was noted in the spring upslope of this pond. At pond 8.1 online no evidence of excessive algal growth was seen. Pond 8.1 online is managed as a carp fishery and the resultant turbidity from the bottom feeding fish will limit plant growth at this location.

3.2.3 Macroinvertebrates

Species richness results are provided in Table 8. All ponds have a moderately species rich macroinvertebrate community looking at each season separately (definitions provided in Table 9). The results using the season data combined give a broader picture of the overall species richness. All ponds have a similar number of species except pond 8.1 where species richness is reduced. The number of uncommon species (i.e. species with a conservation score greater than 4 (Local conservation status – Chadd & Extence, 2004))- Table 10) is reported here; it is appropriate to consider down to a local level of interest for pond communities given the potential for discrete, unique populations. The number of uncommon species varied across the survey area, with four uncommon species collected at ponds 13.3 and 13.4. Notably a red data book species was collected at pond 13.3. At pond 5.2 two uncommon species were collected. No uncommon species were collected at pond 8.1.

One IUCN (vulnerable) species was collected at pond 13.3 (Table 10). The Gravel Water Beetle, *Hydrochus nitidicollis,* is recorded mainly in Devon and Cornwall with records also in Norfolk. It is found in association with the exposed sediments of slack water stream edges and on the edges of ponds amongst gravels (Foster 2010). This species was previously listed as Rare RDB3 but the status has now been replaced and the species is classed as IUCN Vulnerable (Foster 2010), a UKBAP priority species and a NERC S.41 (priority) species.

Table 8 Species richness for each pond surveyed. Seasonal species richness and Combined seasonal species richness is given.

Pond	Spr	Sum	Aut	Species Richness (season combined)
13.4	6	13	20	26
13.3	8	20	20	28
8.1	10	10	9	19
5.2	10	16	16	26

Table 9 Aquatic macroinvertebrates: categories for assessing conservation value based on a single season 3 minute sample (Biggs, 2005).

Status	Description
Low	Few invertebrate species (0-10 species) and no local species.
Moderate	Below average number of invertebrate species (11-32 species)
High	Above average number of invertebrate species (33-49 species). No Nationally Scarce or Red Data Book (RDB).
Very High	Supports one or more Nationally Scarce or RDB species, and/or an exceptionally rich invertebrate assemblage (more than or equal to 50 species).

Table 10 Macroinvertebrate species collected with a conservation score of 5 and above

CS	Species	Pond 13.3			Pond 13.4			Pond 8.1			Pond 5.2		
		Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut
6	*Gyraulus laevis*										19		
6	*Cordulia aenea*		1										
5	*Libellula depressa*												
5	*Notonecta maculata*						3						
5	*Notonecta obliqua*			13			1						
5	*Callicorixa wollastoni*					1							
5	*Cymatia coleoptrata*												19
9	*Hydrochus nitidicollis*		3										
5	*Agraylea sexmaculata*		2	16			20						

3.3 Otter presence survey results

Otter spraint were identified at two sites:

- Site 4.2 – several places on a large rock downstream of road culvert; and
- Site 12.1 – old spraint on boulder.

Example photographs are presented as Figure 3–4 and Figure 3–5 respectively.

No other otter field signs were recorded.

Figure 3–4 Otter spraint on large rock downstream of the road culvert at Site 4.2.

Figure 3–5 Old otter spraint on rock near Site 12.1.

4 Discussion

Table 12 provides a summary of the conservation status of each pond (separated by assessment type).

Table 11 Summary of conservation status (plant, invertebrate) for each pond.

Pond	Conservation status	Criteria
13.4	Plants – Moderate Invertebrates - Moderate	Species richness (all seasons) was below average (Moderate) for both plants and invertebrates (Biggs, 2005)
13.3	Plants – High Invertebrates - Moderate	Species richness (all seasons) was below average (Moderate) for plants and above average (High) for invertebrates (Biggs, 2005)
8.1 online	Plants – High Invertebrates - Moderate	Species richness (all seasons) was below average (Moderate) for plants and above average (High) for invertebrates (Biggs, 2005)
8.1 offline	Plants – Not assessed Invertebrates – Not assessed	Not assessed
5.2	Plants – High Invertebrates - Moderate	Species richness (all seasons) was below average (Moderate) for plants and above average (High) for invertebrates (Biggs, 2005)

A characterisation of the fish populations across the survey area is described in a parallel report (APEM, 2017) which should be read in conjunction with this report.

The plant community of the ponds surveyed had a moderate to high conservation value (combined seasons data). Ponds 13.4.and 13.3 have a plant community with a moderate conservation value. Ponds 8.1 and 5.2 have a plant community with a high conservation value. A number of plant species were identified with a rarity status of 2 (Locally scarce) with no nationally scarce or Red Data Book species recorded. The Trophic Rank Score was relatively high at all ponds with a few species dominating the plant cover. Elevated nutrient conditions will tend to allow species domination (reduced diversity). This can result in rarer species that have a preference for low nutrient conditions being replaced by species more tolerant of nutrient enrichment. Pond 13.3 supports the Schedule 9 non-native species New Zealand Pigmyweed, *Crassula helmsii*, which will require specific consideration within construction management plans for example – to prevent species spread.

The macroinvertebrate community of all ponds is of moderate conservation value with species richness below average. The reason for the “nationally scarce” designation of the water beetle, *Hydrochus nitidicollis*, is that the factors that caused the original decline are still operating and it is a species vulnerable to habitat modification due to its affinity for a specific habitat type (exposed substratum). The UKBAP for the appropriate management of *Hydrochus Nitidicollis* habitat (i.e. exposed riverine pond substratum features) is to conserve habitat where possible. It is acknowledged that additional data would benefit the understanding of the current status of this species at existing sites.

Overall the invertebrate population within the watercourses was found to be relatively diverse, albeit with very few rare or notable conservation species present. With the exception of three sites, all locations had macroinvertebrate populations consistent with at least Good WFD status. Some degree of variation in population character and indicative status classification is to be expected on small headwater watercourses of this type. A low number of notable species were recorded. Some fine sediment and flow related pressure is evident in the macroinvertebrate results (particularly at sites 12.2 and 13.1). It is recommended that all in-stream works are avoided as per best-practice construction methodologies, which is likely to be achievable given the modest width of most watercourses. Where instream works are unavoidable then consultation with the appropriate conservation bodies should be ensured.

The presence of otter within the survey area has been confirmed, via identification of spraints. Although spraints were recorded within different catchments (Site 4.2-Kenwyn) and 12.1-Zelah Brook) it is reasonable to assume that all watercourses within the study area will be utilised by otter, given an otter’s large range and the proximity of small stream catchments in this area. Appropriate mitigation measures that may be considered to avoid unnecessary adverse impact to otters include maintenance of buffer zones along watercourses, avoidance of night works and appropriate design of culverts and crossing points.

It is recommended that if work is unavoidable on ponds 8.1 and 5.2 (high wetland plant conservation value) or pond 13.3 (notable species recorded as well as a INNS) then consultation with the appropriate conservation bodies should be undertaken in order to minimize any impacts. The excess nutrients evident could be better managed with consultation with local landowners to limit cattle entering the ponds through appropriate fencing.

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6 Appendices

6.1 Pond macrophyte species

Plants identified during each seasonal pond survey. Where a species was recorded this is marked as present (P). The percentage cover of filamentous algae is marked as the total percentage cover recorded during the survey.

Plant	13.4			13.3			8.1			5.2		
	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut
Submerged Plants												
Callitriche Sp				P	P	P				P		
Callitriche obtusangula				P								
Callitriche stagnalis	P	P	P	P							P	P
Myriophyllum alterniflorum					P	P						
Myriophyllum spicatum							P	P	P			
Potamogeton berchtoldii		P			P						P	
Potamogeton Pusillus	P											
Floating Leaved Plants												
Lemna minor				P							P	P
Lemna minuta			P		P	P						
Lemna trisulca											P	P
Potamogeton natans	P	P	P	P	P	P				P	P	P
Emergent Plants												
Alisma lanceolatum				P			P			P		
Angelica sylvestris		P			P			P		P	P	P
Bidens tripartita											P	
Cardamine pratensis										P		
Crassula helmsii				P	P	P						
Eleocharis palustris					P	P						P
Epilobium hirsutum								P	P		P	
Equisetum sp								P				
Eupatorium cannabinum											P	
Filipendula ulmaria								P				
Galium palustre		P			P			P		P	P	
Hypericum elodes											P	P
Hypericum perforatum								P			P	
Iris Pseudacorus							P	P	P	P		P
Juncus effusus	P		P		P	P	P	P	P	P	P	P
Juncus inflexus							P	P	P			
Lotus penduncuIatus								P			P	P
Lychnis flos-cuculi											P	
Lycopus europaeus					P	P						
Lythrum salicaria											P	P
Mentha aquatica	P	P	P		P	P	P	P	P	P	P	P
Myosotis scorpioides	P		P		P	P	P	P	P	P	P	P

Plant	13.4			13.3			8.1			5.2		
	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut
Oenanthe crocata			P		P	P	P	P	P			
Pulicaris dysenterica								P			P	
Persicaria hydropiper							P					
Phalais arundinacea			P			P			P			
Ranunculus flammula		P	P		P	P		P	P	P	P	P
Rorippa palustris				P								
Rumex sp.											P	
Rumex palustris				P			P			P		
Scrophularia auriculata	P	P	P				P					
Solanum dulcamara		P	P		P	P		P	P			
Sparganium erectum							P			P		P
Stellaria palustris							P					
Typha latifolia							P	P	P	P	P	P
Veronica beccabunga	P	P	P	P	P							
Trees and Shrubs												
Alnus glutinosa	P		P	P			P					
Salix sp.				P					P	P		P
Algae												
Filamentous	15%	20%	30%	10%	10%	15%	2%	0%	2%	25%	46%	40%

6.2 Pond macroinvertebrate species

Macroinvertebrate identified during each seasonal pond survey. Where a species was recorded the abundance is given. The Conservation Score (CS) is also given for each species collected.

CS	Species	13.3			13.4			8.1			5.2		
		Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut
1	*Polycelis nigra/tenuis*	1		8			3						
2	*Dugesia lugubris/polychroa*	2	8	17		1							
3	*Dugesia tigrina*		8	58	4	2	63			18	1	17	31
1	*Potamopyrgus antipodarum*				6	7					42	133	23
1	*Physa fontinalis*					36							
1	*Lymnaeidae*										1	2	11
1	*Lymnaea stagnalis*											1	
1	*Radix balthica*										17	34	181
1	*Gyraulus albus*				1	1	15		4			27	
2	*Gyraulus crista*						1		1			1	
6	*Gyraulus laevis*										19		
3	*Hippeutis complanatus*												
2	*Ferrisia clessiniana*	79	16	47					1	5			
3	*Musculium lacustre*		5	1									
1	*Glossiphonia complanata*		1										

2	*Theromyzon tessulatum*			1			3						
1	*Helobdella stagnalis*				24	4	7					1	3
4	*Alboglossiphonia heteroclita*											1	5
5	*Erpobdella testacea*												
4	*Hydracarina*		2	1	3		2	1		15			2
1	*Asellus aquaticus*	22	40	60				9					
3	*Proasellus meridianus*					7	1	2	2	1			
1	*Crangonyx pseudogracilis*	190	73	494							26	94	555
1	*Gammarus pulex*									1			
1	*Cloeon dipterum*	15	54	57		1	3	1					
1	*Caenis horaria*							1		1			
1	*Caenis luctuosa/macrura*							1	6	1			
4	*Cordulegaster boltonii*									1			
1	*Ischnura elegans*							1					
6	*Cordulia aenea*		1										
2	*Hydrometra stagnorum*											1	
4	*Ranatra linearis*		1	1									
3	*Ilyocoris cimicoides*		1			1						3	1
5	*Libellula depressa*												
1	*Notonecta glauca*		1	1			4						
5	*Notonecta maculata*						3						
5	*Notonecta obliqua*			13			1						
3	*Notonecta viridis*			6									
4	*Plea minutissima*			1									1
5	*Callicorixa wollastoni*					1							
5	*Cymatia coleoptrata*												19
1	*Corixa punctata*					1	2						1
4	*Hesperocorixa linnaei*											1	1
3	*Sigara distincta*		1										
4	*Sigara fossarum*		1										
2	*Sigara lateralis*					1		1					
2	*Sigara nigrolineata*										1		
1	*Haliplus ruficollis*												6
4	*Hygrobia hermanni*	3	2									1	1
2	*Noterus clavicornis*	1	1	2			19				1		6
2	*Laccophilus minutus*			1			1						
2	*Hygrotus inaequalis*					1	1						
9	*Hydrochus nitidicollis*		3										
1	*Helophorus brevipalpis*				1		1					2	
1	*Anacaena limbata*											1	
3	*Anacaena lutescens*						1						
1	*Sialis lutaria*		3										
5	*Agraylea sexmaculata*		2	16			20						
1	*Tinodes waeneri*								2				

3	*Cyrnus trimaculatus*							1	7				
1	*Limnephilus lunatus*								1		1		
3	*Limnephilus marmoratus*								8		1		
2	*Mystacides azurea*							2	19	5			
3	*Oecetis lacustris*												
4	*Oecetis testacea*												
4	*Dixa nebulosa*			1									
4	*Dixella aestivalis*			50			6						

6.3 Watercourse macroinvertebrate species

Macroinvertebrates identified during each seasonal watercourse survey. Where a species was recorded the abundance is given. The Conservation Score (CS) is also given for each species collected.

		Spring survey														
CS	Taxa ID	Site 4.2	Site 12.3	Site 13.1	Site 4.1	Site 17.1	Site 12.2	Site 16.2	Site 5.2	Site 13.4	Site 6.1	Site 10.1	Site 18.1	Site 8.1	Site 15.1	Site 12.1
	Microturbellaria			5												
	Tricladida		2			1	1		2	2		1				
	Planariidae		1				1									
	Polycelis sp.	3		1			2	1	2							
3	Polycelis felina	30	36	3	79	1	97	11	33	31	18	8		1	5	1
	Polycelis nigra/tenuis	1		2					2						1	1
	Nemertea						1									
	Nematoda			17					2	1	1	4				
	Gastropoda			14					2	1				1		
1	Potamopyrgus antipodarum		2188	102		25	1279	91	31	590	215	559	22	46	8	319
	Physidae			108								3		1		1
1	Physa fontinalis						4									
	Physella acuta group			62			3					1		1		
3	Galba truncatula		1						1							
1	Radix balthica		1	5										1		
1	Ancylus fluviatilis	8	43	1				7	10	35		29			22	3
	Ancylus group (incl. Ancylus, Ferissia & Acroloxus)		5									4				
	Sphaeriidae		1				2				7					
	Pisidium sp.	3	5	39		1	1471	3	7	19	53	15	1	9		1
	Oligochaeta	62	117	812	193	82	1861	34	135	119	42	108	102	55	23	272
	Glossiphoniidae			1						10						
1	Glossiphonia complanata									3						1
1	Helobdella stagnalis			85			26									
	Erpobdellidae						23									
1	Erpobdella octoculata						4									
5	Erpobdella testacea						1									
	Hydracarina	3	6	7	1				1	7		20		10	1	
	Oribatei	4	1	2	5		1	1	1	1	1	2		2		4
	Cladocera														1	
	Ostracoda	5							13	2		6		2	1	
	Asellidae			2								1				
1	Asellus aquaticus			238								22		2		35
3	Proasellus meridianus													2		
5	Orchestia cavimana											1				
1	Crangonyx pseudogracilis			4								6		4		8
	Gammaridae group													1		
1	Gammarus pulex										176					
	Collembola	1	3		2			1				1	3	1		
	Baetidae				2	2				1	1				1	
	Baetis sp.	16	5						2			35				
1	Baetis rhodani	2	54	8		10		27	3	19	7	6	9	9		7
4	Baetis scambus/fuscatus	9		2	1				57	16		10	11		1	
	Baetis vernus		7		2				1	4			1			
2	Alainites muticus		3			59		12	49	208	2	21	69	43	15	
	Heptageniidae										1					
	Rhithrogena sp.			1		7		11		108	2	2	1	3		
	Leptophlebiidae															1
	Paraleptophlebia sp.								4	1						
2	Habrophlebia fusca											10		1		
1	Ephemera danica		1					1		8			8	1		
1	Serratella ignita		6						1	3		9	3	17		25
3	Brachyptera risi					1							1			
	Nemouridae										1	2				1
6	Protonemura meyeri				1											
	Amphinemura sp.				11											
2	Amphinemura sulcicollis	17			13	5		7	7	8		7	13	4	4	
2	Nemurella picteti			1								1	16		6	4
	Nemoura sp.													1		1

CS	Taxa ID	Spring survey														
		Site 4.2	Site 12.3	Site 13.1	Site 4.1	Site 17.1	Site 12.2	Site 16.2	Site 5.2	Site 13.4	Site 6.1	Site 10.1	Site 18.1	Site 8.1	Site 15.1	Site 12.1
4	Nemoura avicularis			1					2					1		
	Leuctra sp.	2			5	5		7	3	5	1	65	5	50	5	
1	Leuctra fusca													1		
4	Leuctra geniculata													1		3
3	Leuctra hippopus	7								1						
1	Leuctra inermis				1							3	3	1		
4	Leuctra nigra	4				22		13	30	17	4	2	5	27	36	
	Perlodidae					1										
2	Isoperla grammatica		1			2		1	2	13	1	6	6	26		
	Chloroperlidae	2														
1	Siphonoperla torrentium	66			2	27	1	51	44	150		60	1		15	
5	Calopteryx virgo													2		
	Anisoptera										1					
4	Cordulegaster boltonii		2			9		2	8	4	14	3	3	9	2	2
	Velia sp.	14	1		9		1		2	2	1	6	5		3	2
2	Velia caprai										1					
1	Hydroporus palustris			3												
2	Hydroporus tessellatus						1						2			1
	Agabus sp.	2		2	3							2				
7	Agabus conspersus	1														
5	Agabus guttatus				3								2			
	Ilybius sp.			1												
	Gyrinus sp.											2		2		
3	Orectochilus villosus							1				8		3		
1	Helophorus brevipalpis	1														
	Helophorus flavipes/obscurus	1														
3	Helophorus obscurus												4			
	Hydrobius sp.						2									
1	Anacaena globulus				1					1						
	Cercyon sp.				1											
7	Ochthebius bicolon												1			
1	Hydraena gracilis							1						1		
	Hydraena riparia/rufipes/britteni		1									1				
1	Limnebius truncatellus											1	4			
	Scirtidae							1	1		1			1		
	Elodes sp.		1			8		7	3	5	12	3			2	
	Cyphon sp.											2				
	Odeles sp.							4								
	Odeles marginata					2			3		2			1	9	
7	Pomatinus substriatus												1			
1	Elmis aenea	23	27	3		14		12	23	108	2	26	1	37	22	47
2	Limnius volckmari		150							2				10		
	Curculionidae		1			2	1		1	1	2	1		1	1	
	Trichoptera			1		2		2	2	7	1			2		
	Rhyacophila sp.		1							1				4	1	2
1	Rhyacophila dorsalis					1				1		1		1		1
	Glossosomatidae		3					1	3	4						
	Agapetus sp.					1				1		1				
1	Agapetus fuscipes		8			18		4	21	50	17	43	1		3	3
	Ithytrichia sp.		1													
	Philopotamidae									4						
2	Philopotamus montanus							5	2	25	1				10	
	Wormaldia sp.	2				3			1	1	1	1			3	
2	Wormaldia occipitalis					7		38	19	12	3	4			14	
	Psychomyiidae										1					
	Lype sp.					1				1				1		
	Polycentropodidae				1	2										
	Plectrocnemia sp.	2														
2	Plectrocnemia conspersa				1			7	10	6	2	2				3
3	Plectrocnemia geniculata	8												1	4	
	Polycentropus sp.											1				
	Hydropsychidae									2						
	Hydropsyche sp.			1								1				
1	Hydropsyche siltalai		6					3	17	129		5		10		

CS	Taxa ID	Spring survey														
		Site 4.2	Site 12.3	Site 13.1	Site 4.1	Site 17.1	Site 12.2	Site 16.2	Site 5.2	Site 13.4	Site 6.1	Site 10.1	Site 18.1	Site 8.1	Site 15.1	Site 12.1
4	Diplectrona felix	1		1		34				2	133		1		19	
	Lepidostomatidae													1		
	Crunoecia sp.									26						
3	Crunoecia irrorata	3	1					1			2	6		3		3
2	Lepidostoma hirtum		10											7		
	Limnephilidae					1		1	4		6	8		14		1
3	Halesus digitatus					2			3	2	1	2				
2	Halesus radiatus		1			1				3	1	3				
2	Potamophylax cingulatus		2					1	2	3	2					1
3	Chaetopteryx villosa								1			2		1		
	Chaetopteryx villosa / Halesus sp.											1		10		
1	Limnephilus lunatus				1							2				8
	Goeridae								1	1						
2	Silo pallipes					1				7		2				1
3	Beraea maurus	2	1			3		1	2	3		3				2
4	Beraea pullata						7	2	2							1
	Sericostomatidae									2						1
1	Sericostoma personatum	3				1		5	3	109	2	7		23	3	1
3	Odontocerum albicorne					2					1			1		
	Athripsodes albifrons gp (incl. bilineatus & commutatus)		1									1				1
5	Oecetis furva								1							
4	Oecetis testacea		2											3		
	Lepidoptera				1				1							
	Diptera			1	2				1		1	2		1		
	Tipula sp.				20		1			2		3		1		
	Limoniidae						1			1				1		
	Austrolimnophila sp.				1											
	Pseudolimnophila sp.															1
	Eloeophila sp.	2	3			1		5	5	6	4			8	1	5
	Neolimnomyia sp.		1			1					3					
	Pilaria sp.		1		1	2			5	1	3	1		2		
	Molophilus sp.				9											
	Pedicia sp.		1		3			5		2	1			1		
	Dicranota sp.	6	6	1				2	2	7	1	13	2	8	2	15
	Psychodidae	1		61	33		1	2	1	1	3	10	5		1	6
	Ptychoptera sp.	2											1			3
	Ptychoptera lacustris									1	56	4		1		
	Dixidae											1				
	Dixa maculata group			2		1		2		2	2	3	6		2	2
5	Dixa dilatata											1				
4	Dixa nebulosa								1			2	1			
5	Dixa puberula	3	1			1			3	1	1	7			2	1
4	Dixa submaculata									1		2		2		
	Ceratopogonidae	1	13	18	1	3	8	2	9	19	2	25		22		34
	Simuliidae	22	275	201		9		20	7	9	13	13		17	25	75
	Chironomidae	193	235	1597	476	36	406	31	136	128	95	158	109	262	24	789
	Chrysops sp.															2
	Empididae		1													
	Clinocerinae			1	2											
	Hemerodrominae		43											4		
	Chelifera sp.									2						
	Dolichopodidae													1		

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CS	Taxa ID	Site 4.1	Site 8.1	Site 6.1	Site 4.2	Site 12.2	Site 13.4	Site 5.2	Site 12.3	Site 18.1	Site 15.1	Site 12.1	Site 17.1	Site 13.1	Site 16.2	Site 10.1
	Tricladida						1			1		1		2		
6	Planaria torva	1														
	Polycelis sp.			1		2			1					1	1	
3	Polycelis felina	31	4	2	4	3	9	13	6	41			1		13	9
1	Polycelis nigra/tenuis													5		
2	Dugesia lugubris/polychroa													1		
	Nematoda			3		1	1						1			
	Gastropoda	1														
1	Potamopyrgus antipodarum		307	1041		708	142	283	662	1003	13	656	39	240	443	859
	Physidae					6	1							62		1
	Physella acuta						1									
	Physella acuta group					3						1		469		4
	Lymnaeidae	1								1				1		
	Planorbis sp.						1									
2	Gyraulus crista															1
1	Ancylus fluviatilis			13	72		27	20	15		2	1		44	12	8
	Ancylus group (incl. Ancylus, Ferissia & Acroloxus)															1
	Sphaeriidae		2	3	4	10	1	2	4	1	2		2	10	1	
	Pisidium sp.		9	20	3	23		6	12	77	7	2	1	37	2	36
	Oligochaeta	582	34	62	3	117	51	72	53	72	37	146	29	2109	35	157
	Hirudinea													5		
	Glossiphonia group (Glossiphonia complanata & Alboglossiphonia heteroclita)						1									
1	Glossiphonia complanata					4	2		3			3		4	2	
1	Helobdella stagnalis				1	83			1					217		
	Erpobdellidae					4										
	Erpobdella sp.					2										
1	Erpobdella octoculata					4										
	Hydracarina	1				1				1				24		1
	Oribatei	2		2	1	1					4			3	1	
	Ostracoda							1		2	1					1
1	Asellus aquaticus											31		1156	1	13
1	Crangonyx pseudogracilis					2						10		3	1	2
1	Gammarus pulex			148												
	Collembola			1												
	Baetidae															2
	Baetis sp.			1												
	Baetis group (incl. Baetis, Alainites, Labiobaetis & Nigrobaetis)														1	
1	Baetis rhodani		3	12			29	20	9			3	10	71	1	11
4	Baetis scambus/fuscatus															1
2	Alainites muticus		2				13	7	2	1			1			
	Nigrobaetis sp.		1													
	Heptageniidae		1				1									
	Rhithrogena sp.		1				42						3		5	3
	Ecdyonurus sp.						1									
	Leptophlebiidae						1									
	Paraleptophlebia sp.		1				5									
1	Ephemera danica						1									
	Nemurella/Nemoura					1		2		5	8			7	6	
	Protonemura sp.									1						
5	Protonemura meyeri							1								

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2	Amphinemura sulcicollis	5			6		2			4				1	3	
2	Nemurella picteti			5						7	1			2	11	
	Nemoura sp.													1		
	Nemoura cambrica/erratica	1														
3	Nemoura avicularis		2		2						1					
	Leuctra sp.	5	1	22	40		11	25	2	15	14		6	2	14	2
1	Leuctra fusca		30	1	2		12	28	1		3		1		9	3
4	Leuctra nigra		1	1	2		2	3	1	2					1	
2	Isoperla grammatica								1							1
1	Siphonoperla torrentium		1		3		5		1				4		1	5
	Coenagrionidae													1		
4	Cordulegaster boltonii			9					1	2	3			1	1	
	Velia sp.					1	1									
	Haliplus sp.														1	
2	Orectochilus villosus		8				1	7	1						2	
1	Helophorus brevipalpis										1					
1	Hydraena riparia		1													
	Hydraena riparia/rufipes/britteni							2				2			1	
1	Limnebius truncatellus							2			3					
	Elodes sp.		8			29			3	4		3				1
	Cyphon sp.										2					
	Odeles marginata		33	13		1	8	15	9	17	6		9		9	
1	Elmis aenea	1	19	10	51		25	26	24		1	88	4	31	6	7
1	Limnius volckmari		4				1		77							
5	Osmylus fulvicephalus							1								
	Trichoptera										2			1		
	Rhyacophila sp.												1			
1	Rhyacophila dorsalis		2				1	1	2					2		
	Glossosomatidae			5											1	
	Agapetus sp.			5			9	4	5	2	4				4	3
1	Agapetus fuscipes			3			18								1	
	Ithytrichia sp.		10													
2	Philopotamus montanus						27	1		1			1			
	Wormaldia sp.									4					3	4
2	Wormaldia occipitalis		2				23	8	1	10			18	3	19	9
	Lype sp.			2									1			
5	Tinodes assimilis													1		
	Polycentropodidae		2													
	Plectrocnemia sp.				6			1								1
2	Plectrocnemia conspersa	3		5							3		2	6	1	
3	Plectrocnemia geniculata				14			2							1	
	Polycentropus sp.		2													
2	Polycentropus flavomaculatus		5													
	Hydropsychidae						1	5					3			
	Hydropsyche sp.		1													1
1	Hydropsyche siltalai		43				21	10	46					4	3	15
4	Diplectrona felix		1	128			4	11		104	4		34	6	8	
	Lepidostomatidae		2		1											
3	Crunoecia irrorata		1	4				2		25	5	4	2	5	2	2
	Lasiocephala/Lepidostoma group								8							
1	Lepidostoma hirtum								3							1
	Limnephilidae		23	72		1	5	19	23	10	1	5	13		30	3

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	Micropterna/Stenophylax											2				
	Micropterna sp.			4										1		
2	Micropterna lateralis										1					
1	Micropterna sequax													6		
2	Potamophylax cingulatus			4			1									
	Potamophylax latipennis/cingulatus		1	4			3									1
2	Potamophylax latipennis			2												
3	Chaetopteryx villosa			3												
	Silo sp.						1									
1	Silo pallipes						34	3	6			1	3		2	1
	Beraea sp.					2										
3	Beraea maurus			1				4		1	7		2	3	1	2
4	Beraea pullata					7										1
1	Sericostoma personatum		61	2	3		37	5	2	63	12	2		10	6	4
3	Odontocerum albicorne		6										1			
	Athripsodes albifrons gp (incl. bilineatus & commutatus)								1							
	Adicella sp.									1						
3	Adicella reducta	1		2						3						
	Oecetis sp.		1													
4	Oecetis testacea		5													
	Diptera												1			1
	Tipula sp.		4				3	5	1	2	1	3	2		1	3
	Limoniidae														1	
	Eloeophila sp.				1				2	2	7				3	1
	Neolimnomyia sp.			2		2						1				
	Pilaria sp.							1						3		
	Erioptera sp.										1					
	Pediciidae						1									
	Pedicia sp.	1	1		1			3		1	2	1			1	
	Dicranota sp.	9	2				1	1	2	19		13		8		14
	Psychodidae		3	1	1	17	2	1		27				3	1	
	Ptychoptera sp.			8						3						
	Dixa sp.															2
	Dixa maculata group							1		4						
5	Dixa dilatata							2		1						
4	Dixa nebulosa					1			1			1				
5	Dixa puberula		2					2								
	Ceratopogonidae		2	2		17		7		1	9	2		6		2
	Simuliidae		12	149	1	58	91	92	8	16	5	44	43	574	23	47
	Chironomidae	44	54	50	40	84	139	28	41	57	49	59	18	432	6	15
	Stratiomyidae						1									
	Beris sp.	1								1						
	Clinocerinae					4				1				3		
	Chelifera sp.			2		2				1	2			1	1	
	Chrysogaster sp.										1					
	Limnophora sp.													1		

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