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In association with Freshwater Biological Association

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The Verderers of the New Forest

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1 SUMMARY

Utilising a project team composed of experts from Bournemouth University Global Environmental Solutions (BUG) and the Freshwater Biological Association (FBA), this document reports the findings of a pre-restoration biodiversity audit of New Forest Streams carried out in April 2015.

The survey was commissioned to provide a pre-restoration baseline of ecological quality against which to assess the success of future planned stream restoration work.

The survey was also tasked with highlighting any rare species afforded conservation protection under the following designations:

- Schedule 5 Wildlife and Countryside Act (1981) Species
- Red Data Book Species
- UK BAP Priority Species
- Nationally and Regionally Scarce Species

This document reports the findings of the 2015 pre-restoration surveys:

- With the exception of some temporarily reduced biotic index results possibly due to recent tree felling, the three groups of freshwater stream sites surveyed were in generally good biological condition.
- A wide range of freshwater macroinvertebrate species have been recorded with each group of sites having its own distinctive community.
- The survey has recorded two fish and one invertebrate species with conservation designations.
- This survey has compiled important baseline information on the spring 2015 pre-restoration physical stream type of each watercourse, their macroinvertebrate communities, and their biological condition compared to reference condition predictions.
- These baseline data will enable an informed assessment to be made of the success of planned restoration work to a) preserve the ecological quality and b) enhance the biodiversity of the SAC features (e.g. mire communities) associated with these New Forest streams.
- This work exemplifies best-practice on the part of the Forestry Commission in commissioning pre-restoration surveys to properly understand the ecological outcomes associated with its work.

Further post restoration surveys are planned for in April/May 2016 to assess the ecological outcome of the restoration work after 12 months.

2 INTRODUCTION

Geo- and hydromorphological restoration of flowing water bodies are widely regarded as being of positive environmental benefit, however, this can be difficult to justify to local land owners, interest groups and other organisations without sound supporting evidence. This project has been designed to focus specifically on freshwater macroinvertebrate communities as an indicator of ecological quality and to detect whether any temporal changes in community structure (positive or negative) can be attributed to the physical re-engineering of stream profiles.

During an initial scoping exercise a total of five New Forest sites were assessed for their suitability to acquire pre-restoration baseline data. Due to the ephemeral nature of one site at Amberslade, the stream bed was found to be dry and thus this site was dropped from the survey. Of the remaining four sites, surveys were conducted in accordance with the RIVPACS 3-minute kick-sampling protocol. To elucidate treatment effects from ambient conditions a further two control sites were also included within the survey design.

Utilising a project team composed of experts from Bournemouth University Global Environmental Solutions (BUG) and the Freshwater Biological Association (FBA), this document reports the findings of the 2015 pre-restoration surveys, with further post restoration surveys planned for completion in April/May 2016.

2.1 Aims and Objectives

The specific aims and objectives of this project are as follows:

- Provide a pre-restoration biodiversity audit of New Forest Streams to highlight any rare species afforded conservation protection under the following designations:
    - Schedule 5 Wildlife and Countryside Act (1981) Species
    - Red Data Book Species
    - UK BAP Priority Species
    - Nationally and Regionally Scarce Species

- Provide a pre-restoration baseline of ecological quality in line with Water Framework Directive (WFD) best practice methodology

- Undertake repeat post-restoration surveys (April/May 2016) to determine ecological gains/losses attributable to the in stream restoration works.

Note: This work is delivered under call off 10 under the Specialist Ecological Surveys Framework (Ref. No. 304/NF/13/751).

3 METHODOLOGY

3.1 Walkover Survey and Site Selection

A walkover survey was used to assess the suitability of the streams for subsequent macroinvertebrate kick sampling, specifically the accessibility of each potential watercourse, their approximate size and water depth, their permanence, and current presence of water in the channel. In addition, and to facilitate easy return to the selected sampling locations, GPS readings and site photographs were also taken. The walkover survey was carried out by Adrian Pinder (BUG) and Nick Wardlaw (FC) on 22 April 2015. The spatial distribution of the four sites assessed is provided in Figure 1.

Figure 1. Location of restoration sites visited on 22 April 2015

With the exception of Amberslade, an ephemeral stream which had already run dry (Figure 2), suitable survey sites were identified at Cowley's Heath, Pondhead and Harvestlade. With Amberslade omitted from the survey, BUG and FC agreed the spatial survey design summarised in Table 1. Maps depicting the exact location of sampling sites are provided in Appendix I.

Table 1. Summary of selected sampling sites and NGR's

Locality	Site code	NGR	(T)reatment or (C)ontrol
Cowley's Heath	East 1	SU41998, 02523	T
	West 1	SU41410, 02443	T
	Control 1	SU42395, 02523	C
Pondhead	U/S 1	SU32392, 66901	T
	D/S2	SU32446,06955	T
	Control 1	SU31980, 06897	C
Harvestlade	H1	SU20697, 05553	T

Figure 2. The dry stream bed of Amberslade on 22 April 2015

3.2 Macroinvertebrate Survey

The macroinvertebrate the survey was carried out by Adrian Pinder (BUG) and John Davy-Bowker (FBA) on the 27th April 2015. Macroinvertebrate samples were collected in accordance with the standard Environment Agency (EA) three-minute kick sampling procedure using a 1mm mesh long-handled pond net (set out in '*Procedures For Collecting and Analysing Macroinvertebrate Samples"*. BT001 3.0, Third Issue; 1991) and by the procedure for collecting and analysing macroinvertebrate samples for RIVPACS (Murray-Bligh *et al.,* 1992). This ensured that a representative range of mesohabitats were sampled in proportion to their occurrence to facilitate spatial and temporal comparisons.

At each sampling site, a basic suite of physicochemical parameters (pH, temperature, Conductivity, dissolved Oxygen) and general habitat characteristics (water velocity category, width, depth and substratum composition) were recorded on a standard RIVPACS/RICT '*Sample Area Form'* (Appendix III). These variables are useful both for describing the general sampling site characteristics, and also as predictor variables for running the RIVPACS (River Invertebrate and Prediction and Classification System) model (see *Data Analysis and Assessment*).

All samples were accompanied with a confirmatory site photograph (Appendix II), GPS reading, and sampling site sketch map to facilitate subsequent return to the same location for re-survey work. In addition, the presence of aquatic macrophytes and other species observed incidentally during the macroinvertebrate sampling (e.g. fish) were also recorded.

All sampling equipment, chemical analysis probes and personal protective equipment had been thoroughly dried prior to visiting the New Forest and all equipment was checked for foreign species as recommended by the GB Non-Native Species Secretariat '*Check, Clean, Dry*' campaign (GB NNSS, 2015). As an additional precaution, all equipment that might come into contact with the sampling sites was sprayed with '*Virkon® S'* (DuPont™) a powerful broad-spectrum virucidal, bactericidal and fungicidal disinfectant prior to visiting the sampling sites to prevent the transfer of crayfish plague or other pathogens.

Macroinvertebrate samples were fixed at the riverbank using 4% formaldehyde. The use of formaldehyde is considered superior to 70% Industrial Methylated Spirits due to its more rapid and thorough fixation of organic matter and the greatly enhanced shelf life of the samples and the invertebrate specimens they contain. Sample pots were clearly labelled both internally, using pencil and waterproof paper labels, and externally using a waterproof bullet marker. Samples were returned to the laboratory for processing (bankside analysis being considered inappropriate for species level analysis).

Laboratory Sample Processing

Macroinvertebrate samples were sorted, identified and enumerated following the procedures set out in '*Procedures For Collecting and Analysing Macroinvertebrate Samples"*. BT001 3.0, Third Issue; 1991) and by the procedure for collecting and analysing macroinvertebrate samples for RIVPACS (Murray-Bligh *et al.,* 1992). Samples were processed to species-level, specifically RIVPACS Taxonomic Level '*TL5'* (Davy-Bowker *et al.,* 2010), and numerical abundances of all taxa were estimated and recorded on laboratory sample data sheets.

Examination of picked invertebrates was made using a binocular/compound microscope as required. Appropriate taxonomic keys were used for identification, making reference to FBA reference collections where necessary. All samples were reconstituted (put back into their original sample pots and re-preserved) and retained for subsequent quality assurance purposes. Where any specimens were retained for addition to FBA reference collections, this was clearly marked on the laboratory sample analysis sheets. All sample analyses were carried out by the Freshwater Biological Association (J. Davy-Bowker, FBA River Laboratory; M. Fletcher and S. Pawley, FBA Windermere).

Data Entry and Validation

Macroinvertebrate data from sample analysis laboratory datasheets was entered into an FBA designed Microsoft® Access data entry database. Following data entry, sample validation reports (lists of entered species names and abundances) were printed out and manual data validation checks were performed to ensure that no errors arose due to data entry. Any data entry errors were corrected and the validation process was repeated until the data were error-free. Following validation, data was then exported for the calculation of biotic indices and the assignment of conservation designations (see below).

Calculation of Biotic Indices

Data was imported into an FBA designed Microsoft® Access database containing queries for the automatic calculation of a wide range of freshwater macroinvertebrate biotic indices at family and/or species levels.

Further information on the biotic indices is provided below (commonly used index abbreviations, the full name of each index, sources/references and typical types of environmental stress described by each index):

- **BMWP, NTAXA, ASPT**
  Name: Biological Monitoring Work Party
  Reference(s): Armitage *et al.,* 1983; Hawkes 1997
  Stressor described: General degradation

- **WHPT, NTAXA, ASPT**
  Name: Whalley, Hawkes, Paisley, Trigg
  Reference(s): UKTAG, 2014
  Stressor described: General degradation

- **AWIC(sp) Murphy**
  Name: Acid Water Indicator Community
  Reference(s): Murphy *et al.,* 2013
  Stressor describe: Acidity/acidification stress

- **WFD AWIC(sp) McFarland**
  Name: *WFD Acid Water Indicator Community*
  Reference(s): McFarland 2010; UKTAG, 2014

Stressor described: Acidity/acidification stress

- **LIFE(sp)**
  Name: Lotic-invertebrate Index for Flow Evaluation
  Reference(s): *Extence et al., 1999*
  Stressor described: Flow stress

- **PSI(sp)**
  Name: Proportion of Sediment-sensitive Invertebrates
  Reference(s): *Extence et al., 2013*
  Stressor described: Sedimentation stress

- **SPEAR(sp)%**
  Name: Species At Risk
  Reference(s): Beketov *et al., 2008*
  Stressor described: Pesticide stress

- **CCI**
  Name: Community Conservation Index
  Reference(s): Chadd and Extence, 2004
  Stressor described: Conservation value

RIVPACS Assessments

In addition to the calculation of observed biotic indices for the macroinvertebrate samples (described above) it was useful to also be able to compare these observed indices to a benchmark or reference value for that type of stream. This type of comparison in running waters is commonly achieved in the United Kingdom by using RIVPACS predictive models.

RIVPACS (River Invertebrate Prediction and Classification System) is a predictive model that uses environmental variables such as stream width and depth, distance from source and altitude etc to predict the reference (undisturbed) values of a range of biotic indices (Wright *et al.,* 1997; Clarke *et al.,* 2003). RIVPACS is based on a dataset of 685 GB reference sites that are grouped into similar 'end groups' whose environmental variables are similar to each other. Predicted biotic indices for test samples (the New Forest samples) are obtained by gathering the same environmental variables (environmental predictor variables) and running these through the model. Each test sample is assigned a probability of RIVPACS end group membership based on its environmental variables. The biotic index values of the reference sites in the various end groups then contribute to the predicted index values for the test sample. Rather than drawing the prediction solely from one end group of reference sites, the predictions of reference condition biotic indices are derived by the model as a weighted average depending upon probability of end group membership (Clarke *et al.,* 2011).

The RIVPACS model used was the current RIVPACS IV model (Davy-Bowker *et al*., 2008) within the RICT (River Invertebrate Classification Tool) software – a web based tool containing the RIVPACS models:

www.sepa.org.uk/environment/water/classification/river-invertebrates-classification-tool/

RIVPACS IV is the current RIVPACS model used by the Environment Agency and others to perform Water Framework Directive (Council of the European Communities, 2000) quality assessments and is regarded as the industry standard for assessing the biological condition of running waters.

The observed values of the biotic indices from the New Forest samples were then compared to the RIVPACS predicted expected values of the indices by the calculation of observed/expected ratios. For example, and observed biotic index value of 75 would be divided by an expected value of the same index, of say 85, to give and observed/expected (O/E) ratio of 0.882. An O/E ratio of around 1.0 indicates that a test sample has exceeded its predicted biotic index value (it is better than similar reference condition sites in the model); an O/E ratio of slightly below 1.0 (e.g. 0.882) indicates that a test sample is close to its predicted index value and is therefore only minimally impacted; an O/E ratio close to zero indicates that a test sample falls along way short of its predicted biotic index value and it therefore heavily stressed or degraded.

Assignment of Conservation Designations

In addition to describing the overall community-level conservation status of the samples by calculating the CCI index (see biotic indices section above), species present in the macroinvertebrate samples were also individually assessed for their conservation value by assigning rarity and threat conservation designations. Current designations were obtained from the Joint Nature Conservation Committee (JNCC) website (http://jncc.defra.gov.uk/page-3408; file: Taxon_designations_20140822.zip; last updated on the 1st August 2014). This included conservation designations for any species that have been assigned some form of rarity, threat or legal status in Great Britain or the UK, specifically:

- **Bern Convention** (Appendices 1, 2 and 3)
- **Biodiversity Action Plan (BAP) UK priority species list**
- **EC CITES** (Annexes A, B, C and D)
- **Global Red list status**
- **Nationally Rare/Scarce** (Not based on IUCN criteria)
- **Nationally Scarce and Nationally Rare Species** (Also with an IUCN status)
- **National Red Lists** (This includes red listings based on pre-1994, 1994 and 2001 IUCN guidelines)
- **Species of principal importance in England, Scotland, Wales and North Ireland** (NERC section 41 and 42 lists, Scottish Biodiversity
- **The Wildlife and Countryside Act 1981** (Schedule 1, 5 and 8)

4 RESULTS AND DISCUSSION

4.1 Physicochemical Variables

The physicochemical variables for the seven New Forest macroinvertebrate sampling sites on the 27th of April 2015 are shown in Table 2.

Table 2. Physicochemical variables for the April 2015 RIVPACS samples. Origin of variables: [1]measured *in situ* and recorded on RIVPACS sample area form; [2]recorded *in situ* from handheld GPS; [3]derived from 1:50,000 Ordnance Survey map; [4]derived from discharge category map; [5]measured *in situ* with YSI hand-held meter).

SITE	Cowleys Heath Control C1	Cowleys Heath East 1	Cowleys Heath West 1	Pondhead C1	Pondhead U/S 1	Pondhead D/S 2	Harvestlade 1
[1]Year	1	1	1	1	1	1	1
[1]Sample date	27/4/15	27/4/15	27/4/15	27/4/15	27/4/15	27/4/15	27/4/15
[1]Sample time of day	10:30	11:20	12:15	14:00	14:40	15:10	16:45
[1]Method	K/S	K/S	K/S	K/S	K/S	K/S	K/S
[1]Duration	3min	3min	3min	3min	3min	3min	3min
[1]Kick Sampler	JDB	JDB	JDB	JDB	JDB	JDB	JDB
[1]Recorder	AP	AP	AP	AP	AP	AP	AP
[2]NGR	SU	SU	SU	SU	SU	SU	SU
[2]Easting	42392	42006	41418	31990	32392	32446	20697
[2]Northing	02534	02508	02443	06909	06903	06961	05556
[2]Altitude (m)	24	20	21	23	23	24	61
[3]Slope (m km^{-1})	5	25	11	4	5	5	7
[4]Discharge (category)	1	1	1	1	1	1	1
[1]Velocity (category)	2	1	1	2	1	1	2
[3]Distance from source (km)	2.3	0.2	0.5	3.5	2.5	2.6	1.1
[1]Mean width (m)	2.7	0.5	1.2	2.2	2.3	2.8	0.9
[1]Depth at ¼ width (cm)	7	3	4	4	11	15	5
[1]Depth at ½ width (cm)	9	17	27	6	13	12	7
[1]Depth at ¾ width (cm)	9	5	11	10	14	3	9
[1]Mean depth (cm)	8.3	8.3	14	6.7	12.7	10	7
[1]Boulders and cobbles (%)	0	0	0	0	0	0	5
[1]Pebbles and gravel (%)	83	40	60	89	85	85	85
[1]Sand (%)	15	25	20	10	5	10	5
[1]Silt and clay (%)	2	35	20	1	10	5	5
[5]pH	6.5	6.8	6.8	6.7	6.7	6.7	7.0
[5]Temperature (°C)	9.4	16.6	11.8	10.6	11.4	11.4	13.0
[5]Conductivity (µs)	234.0	217.6	170.3	281.0	273.0	273.0	109.0
[5]Dissolved Oxygen (%)	122.4	90.0	122.0	111.2	122.5	122.5	119.0
[5]Dissolved Oxygen (mg l^{-1})	13.95	8.93	12.27	12.34	13.38	13.38	12.60
[1]Water clarity	Clear	Clear	Clear	Clear	Clear	Clear	Clear
[1]Water colour	Faint	Faint	Faint	Faint	Colour	Colour	Faint
[1]Macrophytes	Table 5	Table 5	Table 5	Table 5	Table 5	Table 5	Table 5
[1]Extra species	Table 5	Table 5	Table 5	Table 5	Table 5	Table 5	Table 5
[1]Algae cover (%)	0	0	0	0	0	0	2
[1]Moss cover (%)	0	0	0	0	0	0	0
[1]Higher plant cover (%)	0	<1	0	0	<1	<1	<1
[1]Total cover (%)	0	<1	0	0	<1	<1	2
[1]Detritus	Present	Present	Present	Present	Present	Present	Present
[1]Other information	Public access	Deep cut Clear fell	Clear fell	-	-	-	-

The physicochemical variables recorded at the invertebrate sampling sites were broadly representative of the general physicochemical characteristics of the streams sampled and as such the variables represent chosen describe the general characteristics of these streams.
All of the sites were at low altitudes (20-61m above sea level) and had relatively low slopes (4 – 25m altitude change per km of river). All of the sites had low discharge category (≤0.31 cubic metres per second); low velocity category (≤25 cm s^{-1}); and low distances to source (≤3.5 km). River widths were narrow (≤2.7m) and mean water depths were shallow (≤14cm). These stream dimensions are typical of New Forest streams where all river systems are less than 30km from source to mouth and have sources at altitudes less than 125m (Langford *et al.,* 2010).
The stream substratum at all sites was dominated by pebbles and gravel (40-89%), although two of the sites (Cowleys Heath East 1 and West 1) had appreciable percentage cover of sand, silt and clay (20-35%). Substratum composition is a powerful driver of macroinvertebrate community composition (Murphy & Davy-Bowker, 2005) and is also likely to be a factor that may change as a result of subsequent restoration work. These baseline data therefore provide a useful benchmark against which to assess such changes.
The sampling sites had circum-neutral pH ranging between 6.5 and 7.0 and were thus not acidic. Dissolved oxygen was good, ranging between 90.0 and 122.5 mg l^{-1} (8.93 – 13.95 mg l^{-1}), and water clarity was generally clear, although most sites had a faint brown water colouration.

4.2 Macroinvertebrate Species and Conservation Designations

The species found in the seven New Forest macroinvertebrate samples taken on the 27th of April 2015 are shown in Table 3.

Table 3. Macroinvertebrate species and abundances (April 2015 RIVPACS samples).

Species	Cowleys Heath Control C1	Cowleys Heath East 1	Cowleys Heath West 1	Pondhead C1	Pondhead U/S 1	Pondhead D/S 2	Harvestlade 1
Polycelis felina (Dalyell, 1814)				44			
Dendrocoelum lacteum (O.F.Müller, 1774)				1			
Potamopyrgus antipodarum (J.E.Gray, 1843)	388	4	8				
Radix balthica (Linnaeus, 1758)		2	4	4	2		
Planorbis (Planorbis) carinatus (O.F. Müller, 1774)				1			
Ancylus fluviatilis O.F. Müller, 1774	20			28	28	12	
Sphaeriidae sp.					4		
Pisidium sp.	8		4	228	56	36	
Oligochaeta sp.	202	100	124	264	212	388	24
Piscicola geometra (Linnaeus, 1761)						1	
Theromyzon tessulatum (O.F.Müller, 1774)						1	
Glossiphonia complanata (Linnaeus, 1758)	2				8	6	
Erpobdella sp.						1	
Erpobdella octoculata (Linnaeus, 1758)				6	12	4	
Hydracarina sp.	10			1	4	3	8
Asellus aquaticus (Linnaeus, 1758)		2		24	4	16	
Gammarus sp.			80			80	
Gammarus pulex (Linnaeus, 1758)	124	9	36	1092	40	16	
Niphargus aquilex Schiodte, 1855							1
Baetidae sp.	2						

Table 3. (continued). Macroinvertebrate species and abundances (April 2015 RIVPACS samples).

Species	Cowleys Heath Control C1	Cowleys Heath East 1	Cowleys Heath West 1	Pondhead C1	Pondhead U/S 1	Pondhead D/S 2	Harvestlade 1
Baetis rhodani (Pictet, 1843-1845)	54		2	20		16	
Procloeon pennulatum (Eaton, 1870)		2					
Habrophlebia fusca (Curtis, 1834)		20	5	60	632	544	
Ephemera danica Müller, 1764				8	232	16	
Amphinemura standfussi Ris, 1902	1				4	2	
Amphinemura sulcicollis (Stephens, 1836)		1		5		8	
Nemoura cinerea (Retzius, 1783)		20	8			4	1
Leuctra sp.	2	64	388	16	8	8	84
Leuctra nigra (Olivier, 1811)			1				
Capnia bifrons (Newman, 1839)						1	
Isoperla grammatica (Poda, 1761)						3	
Siphonoperla torrentium (Pictet, 1841)	24	12	76		4	12	32
Calopteryx sp.	2		2				
Calopteryx virgo (Linnaeus, 1758)					1	2	
Anisoptera sp.		10					
Cordulegaster boltonii (Donovan, 1807)		2	3				5
Veliidae sp.						1	
Velia sp.	2						
Gerris lacustris (Linnaeus, 1758)		1					
Dytiscidae sp.		1					
Orectochilus villosus (O.F. Müller, 1776)	2			1	4	3	
Helophorus (Trichohelophorus) alternans Gené, 1836		1					
Helophorus (Rhopalohelophorus) brevipalpis Bedel, 1881							1
Anacaena globulus (Paykull, 1829)	1	1					
Anacaena lutescens (Stephens, 1829)		2		1			
Hydraena nigrita Germar, 1824		1					
Elodes sp.				1		2	
Dryops sp.		2					
Elmis aenea (Müller, 1806)				24	12	3	
Limnius volckmari (Panzer, 1793)	52			76	80	88	4
Oulimnius sp.	6		1	16		28	
Oulimnius tuberculatus (Müller, 1806)	18			24	120	8	
Sialis lutaria (Linnaeus, 1758)						1	
Agapetus sp.	36		10	196	40	68	
Oxyethira sp.		64	8				
Lype sp.						1	
Polycentropodidae sp.							1
Cyrnus trimaculatus (Curtis, 1834)					1	1	
Plectrocnemia conspersa (Curtis, 1834)		9	4			4	
Polycentropus irroratus (Curtis, 1835)	1				4	4	
Hydropsyche sp.			2				
Hydropsyche angustipennis (Curtis, 1834)				7			
Hydropsyche siltalai Döhler, 1963	20		8	3	4	20	
Lepidostoma hirtum (Fabricius, 1775)	46		4	2	72	64	1
Limnephilidae sp.		2					
Halesus sp.	3				2	8	1
Micropterna group				1			
Potamophylax group	11		12	18	54	73	2
Limnephilus lunatus Curtis, 1834			4				
Limnephilus rhombicus (Linnaeus, 1758)					1	1	

Table 3. (continued). Macroinvertebrate species and abundances (April 2015 RIVPACS samples).

Species	Cowleys Heath Control C1	Cowleys Heath East 1	Cowleys Heath West 1	Pondhead C1	Pondhead U/S 1	Pondhead D/S 2	Harvestlade 1
Goera pilosa (Fabricius, 1775)					2	1	
Silo pallipes (Fabricius, 1781)	4			20	1		
Sericostoma personatum (Spence in Kirby & Spence, 1826)	36		28	68	172	140	3
Athripsodes sp.							8
Athripsodes bilineatus (Linnaeus, 1758)	26		16	56	40	44	
Mystacides azurea (Linnaeus, 1761)					4	8	
Adicella reducta (McLachlan, 1865)				4			
Oecetis testacea (Curtis, 1834)					1	4	
Tipulidae				2		1	1
Limoniidae	2		4			1	
Pediciidae	1			140	8		
Psychodidae	1						
Ceratopogonidae	2	6	4	3	44	8	4
Simuliidae	38	164	212	512		8	40
Chironomidae	46	148	224	212	128	164	60
Tabanidae	3	32	1	8	64	16	
Athericidae							12

The seven New Forest samples yielded a rich fauna of macroinvertebrate species with good species richness overall and in particular across several macroinvertebrate orders, most especially the aquatic Coleoptera (Water Beetles), Plecoptera (Stoneflies), and Trichoptera (Caddis Flies).

The three groups of sites (Cowleys Heath, Pondhead and Harvestlade) each had their own characteristic community with differing proportions of species from different invertebrate orders being present.

The three Cowleys Heath sites had an average species richness (excluding those taxa that could not be identified to species) of 16.0 species (min. 15; max. 17) and were characterised by high species richness of aquatic Coleoptera (7 species recorded across all three sites).

The three Pondhead sites had average species richness of 27.7 species (min. 24; max. 33) and had high species richness of Plecoptera and Trichoptera (6 and 14 species recorded respectively).

The single Harvestlade site was the least species rich of all the sites sampled with only 8 species recorded in total compared to the average species richness across the other six sites of 21.8.

These macroinvertebrate data, collected in April 2015 immediately prior to planned river restoration work, provide an excellent baseline against which to assess future change.

One species found in the April macroinvertebrate 2015 samples had a JNCC recognised conservation status. The Water Beetle *Helophorus (Trichohelophorus) alternans* Gené, 1836 is designated as Nationally Scare (Table 4) occurring in only 16-100 hectads in Great Britain (Foster, 2010). Due to its rarity this species merits particular consideration in judging the future success of the restoration work. Plant and fish species with conservation designations (section 4.3) are also summarised in Table 4.

Table 4. Species found in the spring 2015 RIVPACS samples with one or more current conservation designations

Species	Designation	Source
Helophorus (Trichohelophorus) alternans Gené, 1836 Water beetle	Nationally scarce – NS Occurring in 16-100 hectads* in Great Britain *10km x 10km squares	Foster, G.N. 2010. A review of the scarce and threatened Coleoptera of Great Britain Part (3) - Water beetles of Great Britain. Species Status 1. Joint Nature Conservation Committee, Peterborough.
Salmo trutta Linnaeus, 1758 Brown Trout	England NERC S.41	Species "of principal importance for the purpose of conserving biodiversity" covered under section 41 (England) of the NERC Act (2006) and therefore need to be taken into consideration by a public body when performing any of its functions with a view to conserving biodiversity.
Salmo trutta Linnaeus, 1758 Brown Trout	Biodiversity Action Plan UK list of priority species BAP-2007, Priority Species	The UK List of Priority Species and Habitats contains 1150 species and 65 habitats that have been listed as priorities for conservation action under the UK Biodiversity Action Plan (UK BAP).
Cottus gobio Linnaeus, 1758 Bullhead	Habitats Directive Annex 2 - non-priority species	Animal and plant species of Community interest (i.e. endangered, vulnerable, rare or endemic in the European Community) whose conservation requires the designation of special areas of conservation. Note that the contents of this annex have been updated in April 2003 following the Treaty of Accession.

4.3 Other Species Recorded

As part of the macroinvertebrate sampling protocol records were also made of the macrophytes recorded within the invertebrate sampling sites (Table 5). In addition, incidental observations of fish species are also presented. Whilst neither macrophyte nor fish species were the primary target of the macroinvertebrate sampling, these species are presented below as a potentially useful additional baseline against which to assess future change. It is also noteworthy that despite the small size of these headwater streams, Brown Trout – *Salmo trutta* Linnaeus, 1758 appear to have spawned at two of the three Cowleys Heath sites and Bullhead – *Cottus gobio* Linnaeus, 1758 were found at about half of the sites. Both are also species with conservation designations (Table 4).

Table 5. Macrophytes (surveyed) and fish species (incidentally observed) in the sampling area of the April 2015 RIVPACS samples.

SITE	Cowleys Heath Control C1	Cowleys Heath East 1	Cowleys Heath West 1	Pondhead C1	Pondhead U/S 1	Pondhead D/S 2	Harvestlade 1
Macrophytes:							
Potamogeton sp.		<1%	<1%				
Eleogiton fluitans		<1%					
Sparganium sp					<1%		
Oenanthe sp.						<1%	
Ranunculus flammula							<1%
Fish:							
Brown Trout (newly emerged fry)	2		1				
Bullhead	1				5	3	1
Minnow					1		
3-Spine Stickleback						1	

4.4 Biotic Indices and Comparison with Reference Conditions

A subset of the recorded physicochemical variables was used to build the set of environmental predictor variables (Table 6) to run RIVPACS predictions of expected reference condition (un-polluted) biotic indices for the New Forest samples.

Table 6. RIVPACS environmental predictor variables for the April 2015 RIVPACS samples (input values for RIVPACS). Origin of variables: [1]measured *in situ* and recorded on RIVPACS sample area form; [2]recorded *in situ* from handheld GPS; [3]derived from 1:50,000 Ordnance Survey map; [4]derived from discharge category map; [5]measured *in situ* with YSI hand-held meter).

SITE	Cowleys Heath Control C1	Cowleys Heath East 1	Cowleys Heath West 1	Pondhead C1	Pondhead U/S 1	Pondhead D/S 2	Harvestlade 1
Year[1]	1	1	1	1	1	1	1
NGR[2]	SU	SU	SU	SU	SU	SU	SU
Easting[2]	42392	42006	41418	31990	32392	32446	20697
Northing[2]	02534	02508	02443	06909	06903	06961	05556
Altitude[2]	24	20	21	23	23	24	61
Slope[3]	5	25	11	4	5	5	7
Discharge category[4]	1	1	1	1	1	1	1
Velocity category[1]	2	1	1	2	1	1	2
Distance from source[3]	2.3	0.2	0.5	3.5	2.5	2.6	1.1
Mean width[1]	2.7	0.5	1.2	2.2	2.3	2.8	0.9
Mean depth[1]	8.3	8.3	14	6.7	12.7	10	7
Boulders and cobbles[1]	0	0	0	0	0	0	5
Pebbles and gravel[1]	83	40	60	89	85	85	85
Sand[1]	15	25	20	10	5	10	5
Silt and clay[1]	2	35	20	1	10	5	5
Alkalinity[n/a]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hardness[n/a]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Calcium[n/a]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Conductivity[5]	234	218	170	281	273	273	109

RIVPACS predictive models work by assigning test sites to existing RIVPACS model end groups by a weighted averaging approach based on their physicochemical predictor variables. These probabilities of end group membership essentially define RIVPACS 'stream types' for the test sites.

Stream types for the New Forest samples are shown in Table 7. Most of the New Forest samples were associated with RIVPACS stream types 27, 30 and 40. As is the norm for RIVPACS predictions, most of the New Forest samples were associated with a variety of RIVPACS stream types. End groups with high probabilities of end group membership contribute more information to the prediction of expected biotic indices and those with lower probabilities contribute less.

The probabilities of end group membership provide a useful baseline against which to assess future change as a result of restoration work. For example, the site Cowleys Heath East 1 was 100% associated with RIVPACS end group (stream type) 30. Because end group associations are derived solely by physicochemical variables, any restoration work that alters those variables, e.g. alters substratum composition, stream width, stream depth etc, will therefore alter the end group associations in future RIVPACS assessments. This in turn will alter the predicted reference condition values of the biotic indices.

This concept, that altering the physicochemical characteristics of the sampling sites through restoration work will also change the end group associations and hence the predicted reference condition biotic indices, is important and leads to two possible future outcomes.

One possibility is that the restoration work may not appreciably alter the end group associations. In this case the restoration may produce in better examples of the same types of stream. A second possibility is that the restoration work will produce physicochemically different types of stream. In this case, the reference condition predictions of the biotic indices will also shift compared to these baseline April 2015 predictions. Presentation here (Table 7) of the RIVPACS model end-group associations for the baseline samples will permit future understanding and interpretation of these potential changes.

Table 7. Stream type (environmental end-group associations) for the April 2015 RIVPACS samples (output values from RIVPACS).

End Group	Cowleys Heath Control C1	Cowleys Heath East 1	Cowleys Heath West 1	Pondhead C1	Pondhead U/S 1	Pondhead D/S 2	Harvestlade 1
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
21	0.0001	0	0	0.0018	0.0001	0.0002	0.0001
22	0	0	0	0	0	0	0
23	0	0	0	0.0001	0	0	0
24	0.003	0	0	0.0099	0.0008	0.0019	0
25	0.0003	0	0	0.0006	0.0002	0.0004	0.0004
26	0.0054	0	0	0.0104	0.0043	0.0069	0.0032
27	0.7196	0	0.4644	0.5671	0.5582	0.6143	0.97
28	0.0032	0	0	0.025	0.0024	0.0045	0.0067
29	0.0026	0	0.0002	0.0009	0.0004	0.0005	0.0024
30	0.0001	1	0.5229	0	0	0	0.0156
31	0.0002	0	0	0.0028	0.0003	0.0006	0.0001
32	0	0	0	0.0004	0	0.0001	0
33	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0
35	0.0035	0	0	0.0399	0.0044	0.0086	0
36	0.0001	0	0	0.0005	0.0002	0.0002	0
37	0.0024	0	0	0.0046	0.0032	0.003	0
38	0.0142	0	0.0001	0.0361	0.0127	0.0153	0
39	0.0139	0	0.0032	0.0234	0.0366	0.026	0.0002
40	0.2314	0	0.0092	0.2764	0.3761	0.3175	0.0012
41	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0
Probability of model fit	> 5%	< 1 %	< 1 %	> 5%	> 5%	> 5%	> 5%
Suitability Code	1	4	4	1	1	1	1

Note: due to the small size of these New Forest headwater streams, overall RIVPACS model fit was weak for some sites (see 'probability of model fit' in Table 7). A Water Framework Directive status Classification for these samples has not been undertaken.

Table 8 presents the biotic index values for the seven April 2015 New Forest baseline samples. Table 8 contains 3 panels:

- Observed biotic index values – calculated directly from the macroinvertebrate communities (Table 3)
- RIVPACS expected biotic index values – reference condition values of the biotic indices predicted by RIVPACS
- Observed/Expected ratios – observed biotic index values divided by RIVPACS expected biotic index values (O/E ratios)

The biotic indices provide a useful integration of the complex macroinvertebrate species lists in Table 2 into simple summary metrics that describe the condition of each of the samples in various different ways. In particular, the observed/expected ratios standardise the observed biotic index values from each site against the expected reference condition values along a common scale around 1, where values less than one indicate that an index has a lower value than expected, and values above one indicate that an index has a higher than expected value. The lower panel of Table 8 is colour coded to indicate a 'normal' range of O/E ratios for the biotic indices.

Cowleys Heath Sites

The three sites from Cowleys Heath sites had BMWP, NTAXA and ASPT scores that were either close to or exceeded those predicted by RIVPACS (BMWP 1.04 – 1.25; NTAXA 1.05 – 1.25; ASPT 0.99 – 1.05). The same was true for the WHPT indices (Score 1.07 – 1.14; NTAXA 1.08 – 1.15; ASPT 0.97 – 0.99). These indices measure general degradation and (in the case of ASPT) organic pollution stress, of which there appears to be none.

The situation was more complicated with the other biological indices. The two AWIC acidity indices ranged from 0.94 – 1.11 for the C1 Control site and the West 1 site; however there were slightly reduced O/E ratios for the East 1 site (0.76 and 0.87). The PSI index, a measure of sedimentation stress, was also notably reduced at East 1, with an O/E 0.41 compared to 1.06 and 0.92 for the other two sites. The CCI index (a measure of conservation value) was also reduced at East 1 compared to the other two sites.

Table 8. Observed, Expected (reference condition), and observed/expected (O/E) ratios for biotic index values for the April 2015 RIVPACS samples (RIVPACS input and output values).

INDEX_NAME	Cowleys Heath Control C1	Cowleys Heath East 1	Cowleys Heath West 1	Pondhead C1	Pondhead U/S 1	Pondhead D/S 2	Harvestlade 1
OBSERVED BIOTIC INDEX VALUES							
TL1 BMWP	154	112	152	170	166	213	108
TL1 NTAXA	25	20	24	29	26	33	16
TL1 ASPT	6.160	5.600	6.333	5.862	6.385	6.455	6.750
TL2 WHPT Score (AbW,DistFam)	186.8	141.5	168.0	187.6	179.5	237.5	128.3
TL2 WHPT NTAXA (AbW,DistFam)	29	23	26	31	28	36	18
TL2 WHPT ASPT (AbW,DistFam)	6.441	6.152	6.462	6.052	6.411	6.597	7.128
TL5 AWIC(Sp) Murphy	7.250	5.500	6.455	7.000	6.909	6.000	5.333
TL5 WFD AWIC(Sp) Mcfarland	10.083	7.000	8.545	9.750	9.455	8.400	6.667
TL5 LIFE(Sp)	8.300	7.118	8.000	7.923	7.714	7.784	7.889
TL5 PSI(Sp)	75.556	30.769	68.750	62.712	60.000	65.217	57.143
TL5 SPEAR(Sp) %	41.000	36.578	49.507	37.039	48.951	56.995	43.662
TL5 CCI	10.588	17.500	9.333	8.958	11.538	11.515	11.250
RIVPACS EXPECTED BIOTIC INDEX VALUES							
TL1 BMWP	147.693	102.786	121.485	147.849	151.289	149.797	141.003
TL1 NTAXA	23.872	17.571	19.949	24.211	24.73	24.393	22.37
TL1 ASPT	6.206	5.835	6.059	6.118	6.136	6.16	6.309
TL2 WHPT Score (AbW,DistFam)	174.302	127.329	147.602	173.478	176.963	175.798	168.956
TL2 WHPT NTAXA (AbW,DistFam)	26.742	20.071	22.573	27.073	27.678	27.306	25.109
TL2 WHPT ASPT (AbW,DistFam)	6.546	6.336	6.518	6.429	6.422	6.467	6.734
TL5 AWIC(Sp) Murphy	6.596	6.696	6.6	6.669	6.659	6.639	6.49
TL5 WFD AWIC(Sp) Mcfarland	9.116	9.17	9.055	9.244	9.241	9.198	8.915
TL5 LIFE(Sp)	8.171	8.226	8.269	8.096	8.066	8.106	8.334
TL5 PSI(Sp)	71.069	74.164	74.859	68.797	67.731	69.013	76.195
TL5 SPEAR(Sp) %	51.581	44.776	49.406	49.193	49.59	50.271	54.559
TL5 CCI	11.272	16.224	13.731	11.317	11.459	11.379	11.064
OBSERVED/EXPECTED RATIOS							
TL1 BMWP	1.04	1.09	1.25	1.15	1.10	1.42	0.77
TL1 NTAXA	1.05	1.14	1.20	1.20	1.05	1.35	0.72
TL1 ASPT	0.99	0.96	1.05	0.96	1.04	1.05	1.07
TL2 WHPT Score (AbW,DistFam)	1.07	1.11	1.14	1.08	1.01	1.35	0.76
TL2 WHPT NTAXA (AbW,DistFam)	1.08	1.15	1.15	1.15	1.01	1.32	0.72
TL2 WHPT ASPT (AbW,DistFam)	0.98	0.97	0.99	0.94	1.00	1.02	1.06
TL5 AWIC(Sp) Murphy	1.10	0.82	0.98	1.05	1.04	0.90	0.82
TL5 WFD AWIC(Sp) Mcfarland	1.11	0.76	0.94	1.05	1.02	0.91	0.75
TL5 LIFE(Sp)	1.02	0.87	0.97	0.98	0.96	0.96	0.95
TL5 PSI(Sp)	1.06	0.41	0.92	0.91	0.89	0.94	0.75
TL5 SPEAR(Sp) %	0.79	0.82	1.00	0.75	0.99	1.13	0.80
TL5 CCI	0.94	1.08	0.68	0.79	1.01	1.01	1.02

Key to Observed/Expected ratios:

>1.3
0.7-1.3
0.5-0.7
<0.5

The Cowleys Heath site East 1 had been subject to recent tree felling work (see Appendix II photograph) and the percentage cover of silt and clay (35%) was the highest of the sites sampled (Table 2). It seems likely that sediment release has temporarily affected the stream.

Pondhead Sites

The three Pondhead sites had BMWP, NTAXA and ASPT scores that generally exceeded or in the case of the site Pondhead D/S 2, markedly exceeded those predicted by RIVPACS. (BMWP O/E 1.42, NTAXA O/E 1.35). Similar results were obtained with the WHPT index (WHPT Score O/E 1.35, NTAXA O/E 1.32). All three sites are in good condition with respect to general degradation stress and organic pollution.

Most of the other indices were also close to or exceeded their RIVPACS predictions for the Pondhead sites. The two AWIC acidity indices (O/E values 0.91 – 1.05), the LIFE index (0.96 – 0.98) and the PSI index (0.89 – 0.94) were within normal ranges indicating no acidity, flow or sedimentation stress. SPEAR and CCI were slightly lower at the Pondhead Control C1 site, but not appreciably so, and all three sites appear to be in overall good biological condition.

Harvestlade Site

The single Harvestlade site had reduced BMWP and NTAXA scores compared to those predicted by RIVPACS (O/E 0.77 and 0.72) but O/E ASPT was normal at 1.07. Similar results were obtained with the WHPT indices (Score 0.76, NTAXA 0.72 and ASPT 1.06). Most of the other index O/E ratios were within normal ranges, however one of the AWIC indices was quite low (0.75) and O/E PSI was also at the lower end of a normal range (0.75). These scores indicate that the Harvestlade site, whilst not affected by general degradation or organic pollution stress, may have been subject to recent physical disturbance associated with tree felling.

Overall Assessment

- A wide range of freshwater macroinvertebrate species have been recorded, and each group of sites has its own distinctive community.
- The survey has also recorded two fish and one invertebrate species with conservation designations.
- This survey has compiled important baseline information on the spring 2015 pre-restoration physical stream type of each watercourse, their macroinvertebrate communities, and their biological condition compared to reference condition predictions.
- These baseline data will enable an informed assessment to be made of the success of planned restoration work to a) preserve the ecological quality and b) enhance the biodiversity of the SAC features (e.g. mire communities) associated with these New Forest streams.
- This work exemplifies best-practice on the part of the Forestry Commission in commissioning a pre-restoration survey to properly understand the ecological outcomes associated with its work.

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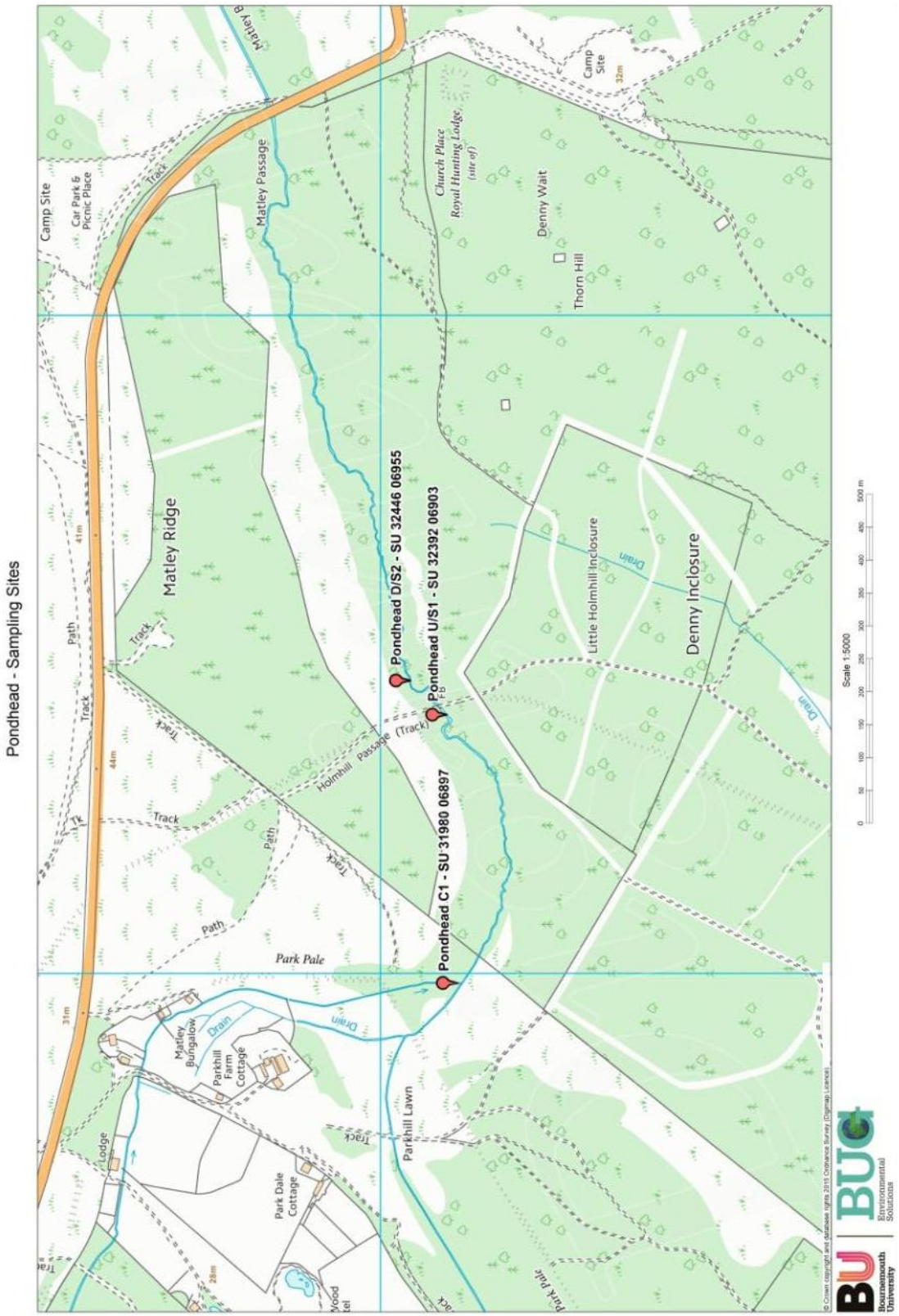
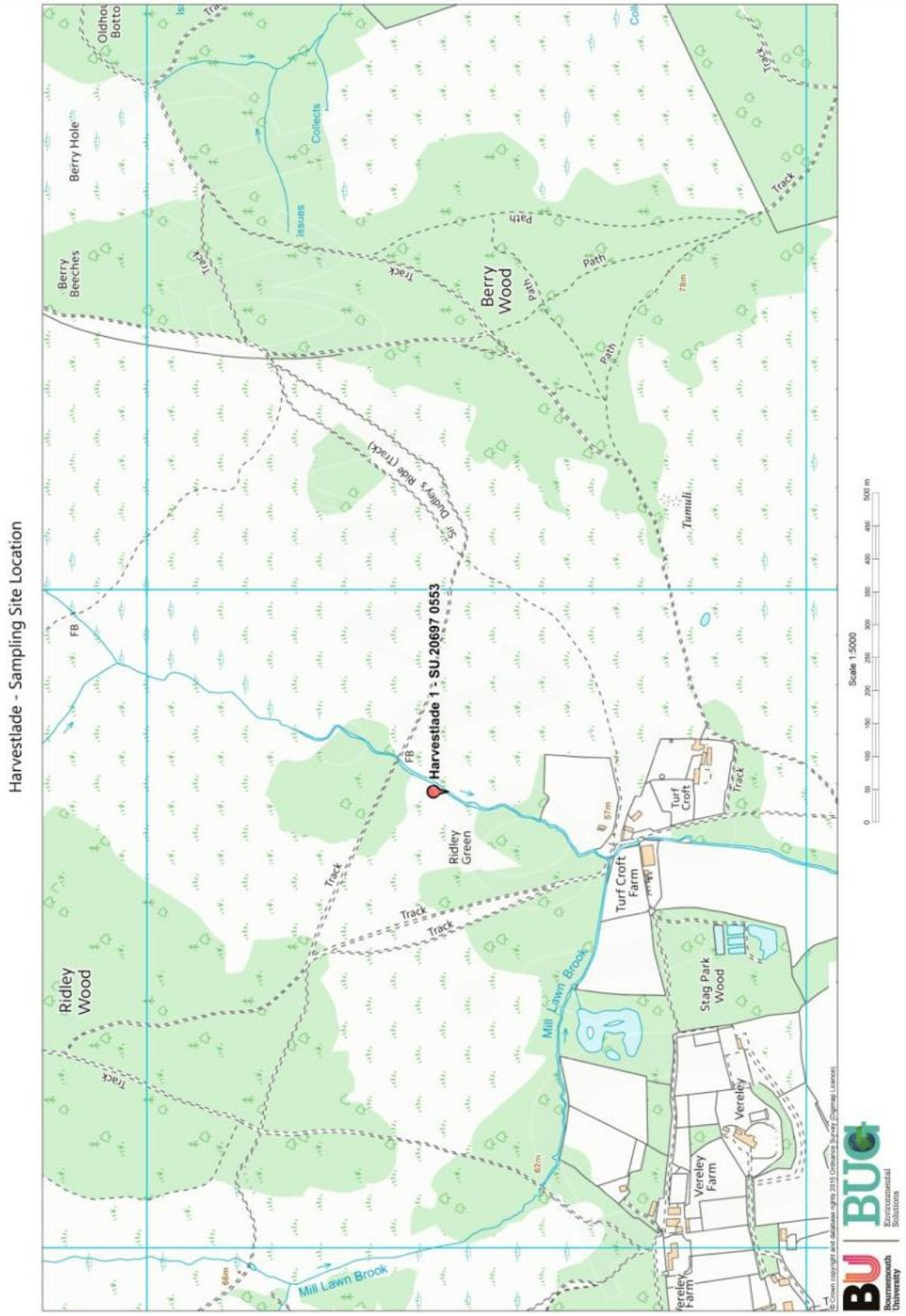
6 APPENDIX I: SITE MAPS

Cowleys Heath


Pondhead - Sampling Sites
Pondhead D/S2 - SU 32446 06955
Pondhead U/S1 - SU 32392 06903
Pondhead C1 - SU 31980 06897
Matley Ridge
Matley Passage
Holmhill Passage (Track)
Little Holmhill Inclosure
Denny Inclosure
Denny Wait
Thorn Hill
Church Place
Royal Hunting Lodge
(site of)
Camp Site
Car Park & Picnic Place
Park Pale
Parkhill Lawn
Matley Bungalow
Parkhill Farm Cottage
Park Dale Cottage
Lodge
Drain
Track
Path
Scale 1:5000
Bournemouth University
BUG
Environmental Solutions

Pondhead



Harvestlade

7 APPENDIX II: INVERTEBRATE SAMPLE SITE PHOTOGRAPHS

Cowleys Heath Control C1, 27 April 2015

Cowleys Heath East 1, 27 April 2015

Cowleys Heath West 1, 27 April 2015

Pondhead C1, 27 April 2015

Pondhead US 1, 27 April 2015

Pondhead DS 2, 27 April 2015

Harvestlade 1, 27 April 2015

8 APPENDIX III: INVERTEBRATE SAMPLE FIELD DATA SHEETS

RIVPACS/RICT Sample Area Form (Page 1 of 2)

Photo ✓

Print double sided on waterproof paper and fill in using a sharpened pencil

Organisation	Forestry Commission
Region/Area	New Forest
River	Cowleys Heath
Site	Carbot Cl
Grid Reference (6 figure)	SU 42392 02534, Elevation 24m
Sampler Name (in full)	John Davy-Bowker
Recorder Name (in full)	John Davy-Bowker & Adrian Pinder
Date (in full)	27 April 2015, 10:30am
Sample Time (minutes)	3 minutes
Sampling Method	3MK + Search

e.g. '3MK' = (RIVPACS 3-minute Kick/Sweep, plus 1 minute Search)
'LHPN' = (RIVPACS 3-minute Long Handled Pond Net from the bank , plus 1 minute margin Search)
'Airlift' = (RIVPACS 3-minute Airlift from a boat, plus 1 minute margin Search)

Sample No.

pH 6.5
Temp 9.4°C
Conduct: 234µS
DO: 122.4%
13.95mg/l
YSI
(Professional Plus Meter, BU).

Water Width in Sample Area (m)	2.7 (metres)

Depth in Sample Area (cm) at widths:

¼ Width 7 (cm) ½ Width 9 (cm) ¾ Width 9 (cm)

Estimated Surface Velocity in Main Flow Channel cm sec $^{-1}$ (tick ✓one category only):

Category 1	Category 2	Category 3	Category 4	Category 5
<10	>10-25 ✓	>25-50	>50-100	>100

Summary

Width	
Mean Depth	
Velocity Category	

Substratum in Sample Area

Estimate the percentage cover of the four categories listed below for the full width of the river at the sample area. Note that a Tennis Ball is approximately 6.4 cm in diameter and therefore approximates to the threshold between the 'Pebbles and Gravel' and the 'Boulders and Cobbles' categories. Include substratum under macrophytes in estimates of percentage cover. Exclude rock pavement from estimates of percentage cover. Percentage cover estimates should be whole numbers (no decimals); not include < or > values; and should total 100%.

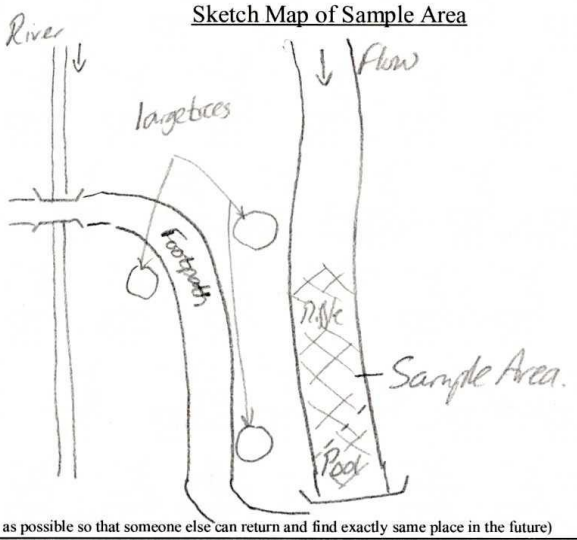
		Percentage Cover (%)
Boulders & Cobbles	>6.4 cm along longest axis	0
Pebbles & Gravel	>2mm to 6.4cm	83
Sand	>0.0625mm to 2mm	15
Silt & Clay	< 0.0625mm	2

Summary

Boulders Cobbles	
Pebbles Gravel	
Sand	
Silt Clay	
Total	100

RIVPACS/RICT Sample Area Form (Page 2 of 2)

Sketch Map of Sample Area



(Please provide as much detail as possible so that someone else can return and find exactly same place in the future)

Water Clarity (tick)	Clear and Bright	✓	Cloudy		Turbid	
Water Colour (describe)	Very faint brown coloration					

Macrophytes

Record macrophytes found in the invertebrate sampling area (including mosses and algae). Identify to species where possible. Tick species sampled as part of the macroinvertebrate sample (including the search).

Macrophytes in sample area	Extra species in wider survey area
None	2x Brown Trout Newly Emerged Fry 1x Bullhead

Cover %	Algae	0	Moss	0	Higher plants	0	Total	0
Detritus (rotting vegetable matter, leaves)					Present	✓	Absent	

Additional Information	
Record any additional information (including changes in the sample area since the last visit). Note any signs of pollution including discharges or sewage fungus; any hydro-morphological degradation (e.g. evidence of dredging, over-widening, sheet piling or rip-rap); or any other factors present that might lead you to think the site is stressed in any way.	Quite high public access with dogs & people entering the river at numerous locations.

RIVPACS/RICT Sample Area Form (Page 1 of 2)

Photo ✓

Print double sided on waterproof paper and fill in using a sharpened pencil

Organisation	Forestry Commission
Region/Area	New Forest
River	Cowleys Heath East
Site	East 1
Grid Reference (6 figure)	SU 42006 02508, Elevation 20m
Sampler Name (in full)	John Davy-Bowker
Recorder Name (in full)	John Davy-Bowker & Adrian Pinder
Date (in full)	27 Apr 2015, 11:20
Sample Time (minutes)	3 minutes
Sampling Method	3MK + Search

e.g. '3MK' = (RIVPACS 3-minute Kick/Sweep, plus 1 minute Search)
'LHPN' = (RIVPACS 3-minute Long Handled Pond Net from the bank , plus 1 minute margin Search)
'Airlift' = (RIVPACS 3-minute Airlift from a boat, plus 1 minute margin Search)

Sample No.

ph: 6·8
Temp: 16·6°C
Cond: 217·6µS
DO: 90·0%
8·93mgl^{-1}
(YSI)

Water Width in Sample Area (m): 0·5 (metres)

Depth in Sample Area (cm) at widths:

¼ Width (discard) 3 (cm) ½ Width middle 17 (cm) ¾ Width (left bank) 5 (cm)

Estimated Surface Velocity in Main Flow Channel cm sec^{-1} (tick ✓one category only):

Category 1		Category 2		Category 3		Category 4		Category 5	
<10	✓	>10-25		>25-50		>50-100		>100	

Summary

Width	
Mean Depth	
Velocity Category	

Substratum in Sample Area

Estimate the percentage cover of the four categories listed below for the full width of the river at the sample area. Note that a Tennis Ball is approximately 6.4 cm in diameter and therefore approximates to the threshold between the 'Pebbles and Gravel' and the 'Boulders and Cobbles' categories. Include substratum under macrophytes in estimates of percentage cover. Exclude rock pavement from estimates of percentage cover. Percentage cover estimates should be whole numbers (no decimals); not include < or > values; and should total 100%.

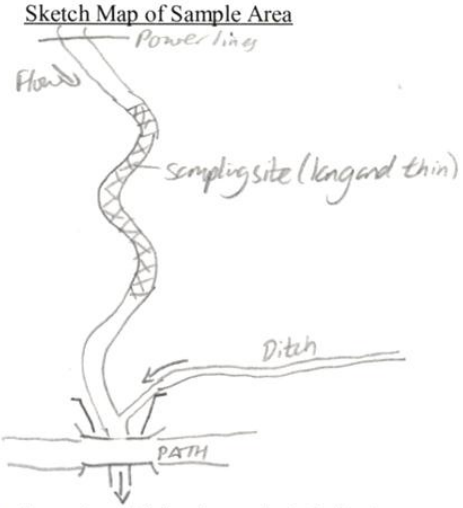
		Percentage Cover (%)
Boulders & Cobbles	>6.4 cm along longest axis	0
Pebbles & Gravel	>2mm to 6.4cm	40
Sand	>0.0625mm to 2mm	25
Silt & Clay	< 0.0625mm	35

Summary

Boulders Cobbles	
Pebbles Gravel	
Sand	
Silt Clay	
Total	100

RIVPACS/RICT Sample Area Form (Page 2 of 2)

Sketch Map of Sample Area



(Please provide as much detail as possible so that someone else can return and find exactly same place in the future)

Water Clarity (tick)	Clear and Bright	✓	Cloudy		Turbid	
Water Colour (describe)	Very faint brown coloration					

Macrophytes

Record macrophytes found in the invertebrate sampling area (including mosses and algae). Identify to species where possible. Tick species sampled as part of the macroinvertebrate sample (including the search).

Macrophytes in sample area	Extra species in wider survey area
Potamogeton <1% Submerged Fine leaved (later confirmed as a mixture of Elodea canadensis (<1% cover).	

Cover %	Algae	0	Moss	0	Higher plants	<1%	Total	<1%
Detritus (rotting vegetable matter, leaves)					Present	✓	Absent	

Additional Information	
Record any additional information (including changes in the sample area since the last visit). Note any signs of pollution including discharges or sewage fungus; any hydro-morphological degradation (e.g. evidence of dredging, over-widening, sheet piling or rip-rap); or any other factors present that might lead you to think the site is stressed in any way.	Deeply cut channel with recent clear felling on both banks.

RIVPACS/RICT Sample Area Form (Page 1 of 2)

Photo ✓

Print double sided on waterproof paper and fill in using a sharpened pencil

Organisation	Forestry Commission
Region/Area	New Forest
River	Cowleys Heath West
Site	West1
Grid Reference (6 figure)	SU 41418 02443, Elevation 21m
Sampler Name (in full)	John Davy-Bowker
Recorder Name (in full)	John Davy-Bowker & Adrian Pinder
Date (in full)	27 Apr 2015 12:15
Sample Time (minutes)	3 minutes
Sampling Method	3MK + Seach

Sample No.

ph: 6·8
Temp: 11·8°C
Cond: 170·3 µS
DO: 122% ?
12·27 mg(-1)
(YSI)

e.g. '3MK' = (RIVPACS 3-minute Kick/Sweep, plus 1 minute Search)
'LHPN' = (RIVPACS 3-minute Long Handled Pond Net from the bank , plus 1 minute margin Search)
'Airlift' = (RIVPACS 3-minute Airlift from a boat, plus 1 minute margin Search)

Water Width in Sample Area (m)	1·2 (metres)

Depth in Sample Area (cm) at widths:

¼ Width 4 (u/s) (cm) ½ Width 27 (mid) (cm) ¾ Width 11 (c/s end) (cm)

Estimated Surface Velocity in Main Flow Channel cm sec $^{-1}$ (tick ✓ one category only):

Category 1	Category 2	Category 3	Category 4	Category 5
<10 ✓	>10-25	>25-50	>50-100	>100

Summary

Width	
Mean Depth	
Velocity Category	

Substratum in Sample Area

Estimate the percentage cover of the four categories listed below for the full width of the river at the sample area. Note that a Tennis Ball is approximately 6.4 cm in diameter and therefore approximates to the threshold between the 'Pebbles and Gravel' and the 'Boulders and Cobbles' categories. Include substratum under macrophytes in estimates of percentage cover. Exclude rock pavement from estimates of percentage cover. Percentage cover estimates should be whole numbers (no decimals); not include < or > values; and should total 100%.

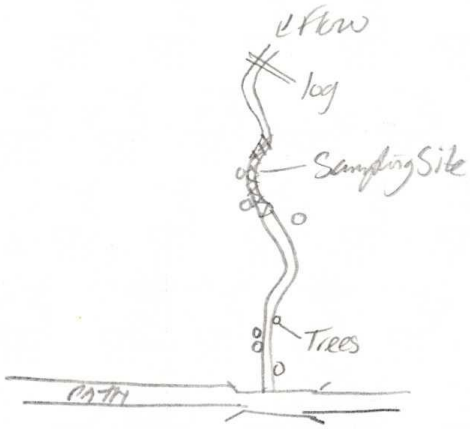
		Percentage Cover (%)
Boulders & Cobbles	>6.4 cm along longest axis	0
Pebbles & Gravel	>2mm to 6.4cm	60
Sand	>0.0625mm to 2mm	20
Silt & Clay	< 0.0625mm	20

Summary

Boulders Cobbles	
Pebbles Gravel	
Sand	
Silt Clay	
Total	100

RIVPACS/RICT Sample Area Form (Page 2 of 2)

Sketch Map of Sample Area



(Please provide as much detail as possible so that someone else can return and find exactly same place in the future)

Water Clarity (tick)	Clear and Bright	✓	Cloudy		Turbid	
Water Colour (describe)	Very faint brown coloration					

Macrophytes

Record macrophytes found in the invertebrate sampling area (including mosses and algae). Identify to species where possible. Tick species sampled as part of the macroinvertebrate sample (including the search).

Macrophytes in sample area	Extra species in wider survey area
None	1x Newly emerged trout fry returned to River. Potamogeton

Cover %	Algae	0	Moss	0	Higher plants	0	Total	0
Detritus (rotting vegetable matter, leaves)					Present	✓	Absent	

Additional Information	
Record any additional information (including changes in the sample area since the last visit). Note any signs of pollution including discharges or sewage fungus; any hydro-morphological degradation (e.g. evidence of dredging, over-widening, sheet piling or rip-rap); or any other factors present that might lead you to think the site is stressed in any way.	Clear felling on both sides of river.

RIVPACS/RICT Sample Area Form (Page 1 of 2)

Photo ✓

Print double sided on waterproof paper and fill in using a sharpened pencil

Organisation	Forestry Commission
Region/Area	New Forest
River	Pondhead C1
Site	C1
Grid Reference (6 figure)	SU 31990 06909, Elevation 23m
Sampler Name (in full)	John Davy-Bowker
Recorder Name (in full)	John Davy-Bowker & Adrian Pinder
Date (in full)	27 Apr 2015 14:00
Sample Time (minutes)	3 Minutes
Sampling Method	3MK + Search

e.g. '3MK' = (RIVPACS 3-minute Kick/Sweep, plus 1 minute Search)
'LHPN' = (RIVPACS 3-minute Long Handled Pond Net from the bank , plus 1 minute margin Search)
'Airlift' = (RIVPACS 3-minute Airlift from a boat, plus 1 minute margin Search)

Sample No.

ph: 6.7
Temp: 10.6°C
Cond: 281 µS
DO: 111.2%
12.34 mg l^{-1}
(YSI)

Water Width in Sample Area (m)	2.2 (metres)

Depth in Sample Area (cm) at widths:

¼ Width 4 (cm) ½ Width 6 (cm) ¾ Width 10 (cm)

Estimated Surface Velocity in Main Flow Channel cm sec^{-1} (tick ✓ one category only):

Category 1	Category 2	Category 3	Category 4	Category 5
<10	>10-25 ✓	>25-50	>50-100	>100

Summary	
Width	
Mean Depth	
Velocity Category	

Substratum in Sample Area

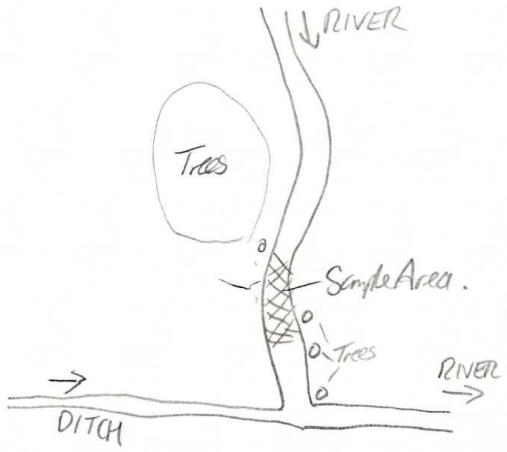
Estimate the percentage cover of the four categories listed below for the full width of the river at the sample area. Note that a Tennis Ball is approximately 6.4 cm in diameter and therefore approximates to the threshold between the 'Pebbles and Gravel' and the 'Boulders and Cobbles' categories. Include substratum under macrophytes in estimates of percentage cover. Exclude rock pavement from estimates of percentage cover. Percentage cover estimates should be whole numbers (no decimals); not include < or > values; and should total 100%.

		Percentage Cover (%)
Boulders & Cobbles	>6.4 cm along longest axis	0
Pebbles & Gravel	>2mm to 6.4cm	89
Sand	>0.0625mm to 2mm	10
Silt & Clay	< 0.0625mm	1

Summary	
Boulders Cobbles	
Pebbles Gravel	
Sand	
Silt Clay	
Total	100

RIVPACS/RICT Sample Area Form (Page 2 of 2)

Sketch Map of Sample Area



(Please provide as much detail as possible so that someone else can return and find exactly same place in the future)

Water Clarity (tick)	Clear and Bright	✓	Cloudy		Turbid	
Water Colour (describe)	Very faint brown colouration					

Macrophytes

Record macrophytes found in the invertebrate sampling area (including mosses and algae). Identify to species where possible. Tick species sampled as part of the macroinvertebrate sample (including the search).

Macrophytes in sample area	Extra species in wider survey area
None	Adrain confident that Trout are present, and in the other nearby channel.

Cover %	Algae	0	Moss	0	Higher plants	0	Total	0
Detritus (rotting vegetable matter, leaves)					Present	✓	Absent	

Additional Information

Record any additional information (including changes in the sample area since the last visit). Note any signs of pollution including discharges or sewage fungus; any hydro-morphological degradation (e.g. evidence of dredging, over-widening, sheet piling or rip-rap); or any other factors present that might lead you to think the site is stressed in any way.

RIVPACS/RICT Sample Area Form (Page 1 of 2)

Print double sided on waterproof paper and fill in using a sharpened pencil

Photo ✓

Organisation	Forestry Commission
Region/Area	New Forest
River	Pondhead u/s 1
Site	u/s 1
Grid Reference (6 figure)	SU 32392 06903, Elevation 23m
Sampler Name (in full)	John Davy-Bowker
Recorder Name (in full)	John Davy-Bowker & Adrian Pinder
Date (in full)	27 Apr 2015, 14:40
Sample Time (minutes)	3 Minutes
Sampling Method	3MK + Seach.

Sample No.
—

ph: 6.7
Temp: 11.4°C
Cond: 273 µS
DO 122.5%
13.38 mg/l
(YSI)

e.g. '3MK' = (RIVPACS 3-minute Kick/Sweep, plus 1 minute Search)
'LHPN' = (RIVPACS 3-minute Long Handled Pond Net from the bank , plus 1 minute margin Search)
'Airlift' = (RIVPACS 3-minute Airlift from a boat, plus 1 minute margin Search)

Water Width in Sample Area (m)	2.3 (metres)

Depth in Sample Area (cm) at widths:

¼ Width	½ Width	¾ Width
11 (cm)	13 (cm)	14 (cm)

Estimated Surface Velocity in Main Flow Channel cm sec $^{-1}$ (tick ✓ one category only):

Category 1	Category 2	Category 3	Category 4	Category 5
<10 ✓	>10-25	>25-50	>50-100	>100

Summary

Width	
Mean Depth	
Velocity Category	

Substratum in Sample Area

Estimate the percentage cover of the four categories listed below for the full width of the river at the sample area. Note that a Tennis Ball is approximately 6.4 cm in diameter and therefore approximates to the threshold between the 'Pebbles and Gravel' and the 'Boulders and Cobbles' categories. Include substratum under macrophytes in estimates of percentage cover. Exclude rock pavement from estimates of percentage cover. Percentage cover estimates should be whole numbers (no decimals); not include < or > values; and should total 100%.

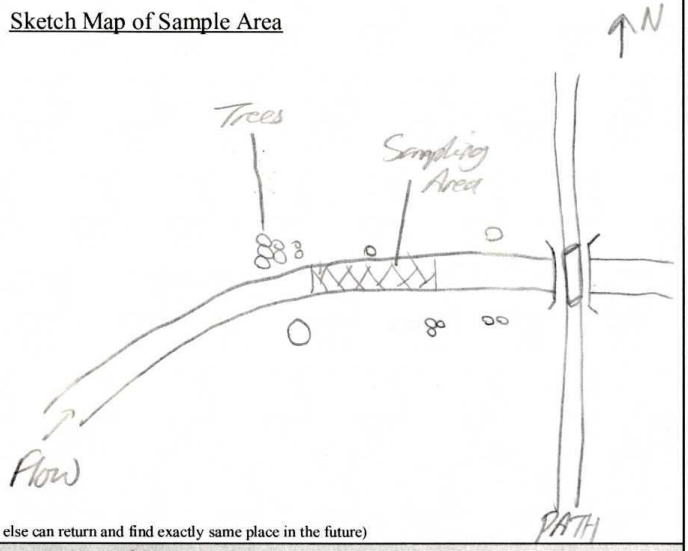
		Percentage Cover (%)
Boulders & Cobbles	>6.4 cm along longest axis	0
Pebbles & Gravel	>2mm to 6.4cm	85
Sand	>0.0625mm to 2mm	5
Silt & Clay	< 0.0625mm	10

Summary

Boulders Cobbles	
Pebbles Gravel	
Sand	
Silt Clay	
Total	100

RIVPACS/RICT Sample Area Form (Page 2 of 2)

Sketch Map of Sample Area



(Please provide as much detail as possible so that someone else can return and find exactly same place in the future)

Water Clarity (tick)	Clear and Bright	✓	Cloudy		Turbid		
Water Colour (describe)	Brown Coloration						

Macrophytes

Record macrophytes found in the invertebrate sampling area (including mosses and algae). Identify to species where possible. Tick species sampled as part of the macroinvertebrate sample (including the search).

Macrophytes in sample area	Extra species in wider survey area
Thinleaved < 1% (later confirmed as Sparganium sp.)	5 Bullheads. 1 Minnow.

Cover %	Algae	0	Moss	0	Higher plants	<1%	Total <1%
Detritus (rotting vegetable matter, leaves)					Present	✓	Absent

Additional Information

Record any additional information (including changes in the sample area since the last visit). Note any signs of pollution including discharges or sewage fungus; any hydro-morphological degradation (e.g. evidence of dredging, over-widening, sheet piling or rip-rap); or any other factors present that might lead you to think the site is stressed in any way.

RIVPACS/RICT Sample Area Form (Page 1 of 2)

Photo ✓

Print double sided on waterproof paper and fill in using a sharpened pencil

Organisation	Forestry Commission
Region/Area	New Forest
River	Pondhead d/s 2
Site	d/s 2
Grid Reference (6 figure)	SU 32446 06961, Elevation 24
Sampler Name (in full)	John Davy-Bowker
Recorder Name (in full)	John Davy-Bowker & Adrian Pinder
Date (in full)	27 APR 2015, 15:10
Sample Time (minutes)	3 Minutes
Sampling Method	3MK + Search

Sample No.

pH 6-7
Temp 11.4°C
Cond 273 µS
DO 122.5%
13.38 mgl⁻¹
(YSI)

e.g. '3MK' = (RIVPACS 3-minute Kick/Sweep, plus 1 minute Search)
'LHPN' = (RIVPACS 3-minute Long Handled Pond Net from the bank , plus 1 minute margin Search)
'Airlift' = (RIVPACS 3-minute Airlift from a boat, plus 1 minute margin Search)

		Summary
Water Width in Sample Area (m)	2·8 (metres)	Width
Depth in Sample Area (cm) at widths: ¼ Width	15 (cm)	Mean Depth
½ Width	12 (cm)	
¾ Width	3 (cm)	

Estimated Surface Velocity in Main Flow Channel cm sec $^{-1}$ (tick ✓ one category only):

Category 1	Category 2	Category 3	Category 4	Category 5
<10 ✓	>10-25	>25-50	>50-100	>100

Velocity Category

Substratum in Sample Area

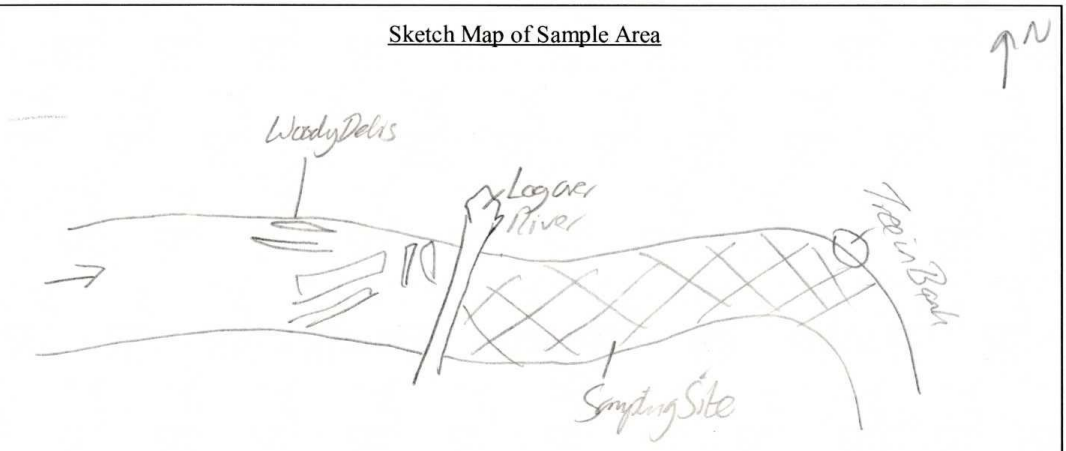
Estimate the percentage cover of the four categories listed below for the full width of the river at the sample area. Note that a Tennis Ball is approximately 6.4 cm in diameter and therefore approximates to the threshold between the 'Pebbles and Gravel' and the 'Boulders and Cobbles' categories. Include substratum under macrophytes in estimates of percentage cover. Exclude rock pavement from estimates of percentage cover. Percentage cover estimates should be whole numbers (no decimals); not include < or > values; and should total 100%.

		Percentage Cover (%)
Boulders & Cobbles	>6.4 cm along longest axis	0
Pebbles & Gravel	>2mm to 6.4cm	85
Sand	>0.0625mm to 2mm	10
Silt & Clay	< 0.0625mm	5

Summary	
Boulders Cobbles	
Pebbles Gravel	
Sand	
Silt Clay	
Total	100

RIVPACS/RICT Sample Area Form (Page 2 of 2)

Sketch Map of Sample Area



(Please provide as much detail as possible so that someone else can return and find exactly same place in the future)

Water Clarity (tick)	Clear and Bright	✓	Cloudy		Turbid	
Water Colour (describe)	Brown Coloration					

Macrophytes

Record macrophytes found in the invertebrate sampling area (including mosses and algae). Identify to species where possible. Tick species sampled as part of the macroinvertebrate sample (including the search).

Macrophytes in sample area	Extra species in wider survey area
Oenanthe sp.? <1% (later confirmed as Oenanthe sp.)	3 x Bullhead 1 x 3-Spine Stickleback

Cover %	Algae	0	Moss	0	Higher plants	<1%	Total	<1%
Detritus (rotting vegetable matter, leaves)					Present	✓	Absent	

Additional Information

Record any additional information (including changes in the sample area since the last visit). Note any signs of pollution including discharges or sewage fungus; any hydro-morphological degradation (e.g. evidence of dredging, over-widening, sheet piling or rip-rap); or any other factors present that might lead you to think the site is stressed in any way.

RIVPACS/RICT Sample Area Form (Page 1 of 2)

Photo ✓

Print double sided on waterproof paper and fill in using a sharpened pencil

Organisation	Forestry Commission
Region/Area	New Forest
River	Harvestlade
Site	1
Grid Reference (6 figure)	SU 20697 05556, Elevation 61m
Sampler Name (in full)	John Davy-Bowker
Recorder Name (in full)	John Davy-Bowker & Adrian Pinder
Date (in full)	27 Apr 2015 16:45
Sample Time (minutes)	3 minutes
Sampling Method	3MK+Seah

e.g. '3MK' = (RIVPACS 3-minute Kick/Sweep, plus 1 minute Search)
'LHPN' = (RIVPACS 3-minute Long Handled Pond Net from the bank , plus 1 minute margin Search)
'Airlift' = (RIVPACS 3-minute Airlift from a boat, plus 1 minute margin Search)

Sample No.

pH 7.0
Temp 13 °C
Cond 109 µS
DO 119%
12.6 mg l^{-1}
(YSI)

Water Width in Sample Area (m)	0.9 (metres)

Depth in Sample Area (cm) at widths:

¼ Width 5 (cm) ½ Width 7 (cm) ¾ Width 9 (cm)

Estimated Surface Velocity in Main Flow Channel cm sec $^{-1}$ (tick ✓ one category only):

Category 1	Category 2	Category 3	Category 4	Category 5
<10	>10-25 ✓	>25-50	>50-100	>100

Summary

Width	
Mean Depth	
Velocity Category	

Substratum in Sample Area

Estimate the percentage cover of the four categories listed below for the full width of the river at the sample area. Note that a Tennis Ball is approximately 6.4 cm in diameter and therefore approximates to the threshold between the 'Pebbles and Gravel' and the 'Boulders and Cobbles' categories. Include substratum under macrophytes in estimates of percentage cover. Exclude rock pavement from estimates of percentage cover. Percentage cover estimates should be whole numbers (no decimals); not include < or > values; and should total 100%.

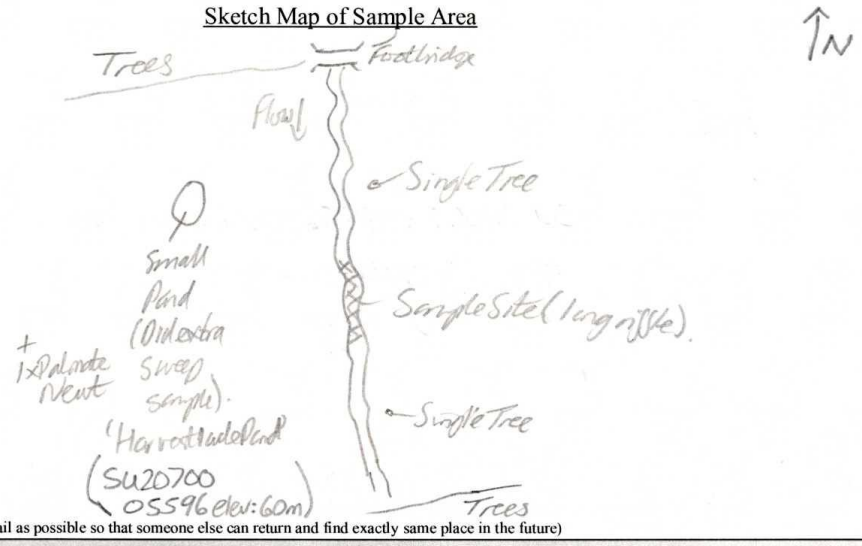
		Percentage Cover (%)
Boulders & Cobbles	>6.4 cm along longest axis	5
Pebbles & Gravel	>2mm to 6.4cm	85
Sand	>0.0625mm to 2mm	5
Silt & Clay	< 0.0625mm	5

Summary

Boulders Cobbles	
Pebbles Gravel	
Sand	
Silt Clay	
Total	100

RIVPACS/RICT Sample Area Form (Page 2 of 2)

Sketch Map of Sample Area



(Please provide as much detail as possible so that someone else can return and find exactly same place in the future)

Water Clarity (tick)	Clear and Bright	✓	Cloudy		Turbid	
Water Colour (describe)	Very faint brown coloration					

Macrophytes

Record macrophytes found in the invertebrate sampling area (including mosses and algae). Identify to species where possible. Tick species sampled as part of the macroinvertebrate sample (including the search).

Macrophytes in sample area	Extra species in wider survey area
Unknown Plant (Harestail Lodge) <1% (later confirmed as Ranunculus flammula)	1 x Bullhead

Cover %	Algae	2%	Moss	0	Higher plants	<1%	Total	2%
Detritus (rotting vegetable matter, leaves)					Present	✓	Absent	

Additional Information

Record any additional information (including changes in the sample area since the last visit). Note any signs of pollution including discharges or sewage fungus; any hydro-morphological degradation (e.g. evidence of dredging, over-widening, sheet piling or rip-rap); or any other factors present that might lead you to think the site is stressed in any way.