

Havant Thicket Reservoir Project

Environmental Statement Volume 4 - Appendices
Appendix A9 Biodiversity
A9.12 Invertebrate Survey Report

Portsmouth Water Ltd.



**HAVANT THICKET WINTER STORAGE RESERVOIR,
ROWLAND'S CASTLE, HAMPSHIRE**

**APPENDIX 9.12
INVERTEBRATE ASSESSMENT**

Final Document (Revision 2)

October 2019

Preliminary Ecological Appraisals • Protected Species Surveys and Licensing • NVC • EcIA • HRA • Management Plans
Habitats • Badger • Bats • Hazel Dormouse • Birds • Reptiles • Amphibians • Invertebrates • Riparian and Aquatic Species

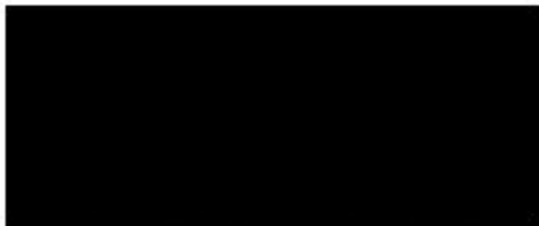
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ECOSA Quality Assurance Record

This report has been produced in accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Report Writing 2017 (CIEEM, 2017). Survey work has been undertaken in line with references within CIEEM's Source of Survey Guidance (CIEEM, 2017).

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*ECOSA produced this report as a stand-alone Ecological Impact Assessment. The document was converted into an Appendix to an Environmental Statement by Atkins, with approval of ECOSA, in August 2020. This has included removal of impact assessment and mitigation text which is covered in Chapter 9 (Biodiversity) of the ES.

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HAVANT THICKET WINTER STORAGE RESERVOIR, ROWLAND'S CASTLE, HAMPSHIRE

INVERTEBRATE SURVEY REPORT

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1.0 INTRODUCTION

1.1 Background

Ecological Survey & Assessment Limited (ECOSA) have been appointed by Portsmouth Water Limited (Portsmouth Water) to undertake an invertebrate survey and report of their land at Havant Thicket, Rowland's Castle, Hampshire. The site is centred on National Grid Reference (NGR): SU 715 097 (**Map L1**).

The invertebrate report is required as a result of Portsmouth Water's plan to construct a winter storage reservoir, Havant Thicket Winter Storage Reservoir (HTWSR), for public water supply in the centre of the site. At the time of survey, the final designs were not confirmed, although the extent of the development was proposed to be approximately 1.6 kilometres from east to west and 800 metres from north to south with a storage capacity of approximately 8,700 million litres. It was understood water would be pumped into the reservoir from Portsmouth Water sources at Havant and Bedhampton Springs, providing a sustainable supply of water with no requirement to change the existing abstraction licence.

At the time the surveys were undertaken the planning application red line boundary (see Figure 2.1 in ES Volume 3) had not been defined and therefore the Site Boundary (the site) and Ecological Enhancement Area (wider site) boundaries referred to in this report were provisional boundaries available at that time. Within this report where mention is made of 'the site' this refers to the reservoir footprint and other areas used for built development and habitat creation. This area is referred to as the 'Reservoir Footprint' in the Environmental Statement (as the Site includes the reservoir footprint, the pipeline corridor as well as land around the reservoir footprint being used for ecological mitigation and compensation). Where reference is made in this report to the 'wider site' this includes the reservoir and the area proposed for ecological enhancement within Forestry England's (FE) Havant Thicket woodland to the north and Bell's Copse to the west of the site and Staunton Country Park (SCP) to the south of the site. This area is similar to the area referred to as the 'Reservoir Site' in the Environmental Statement. The areas covered by 'the site' and 'wider site' in this report are shown in **Map L1** and the key ecological and landscape features mentioned in this report are shown in **Map L2**.

1.2 Aims and Scope of Report

The information within this report is based on a desktop study and invertebrate surveys carried out by ECOSA between 2005 and 2008 and June and August 2018. The report provides a detailed description of the ecological survey work undertaken in relation to invertebrates.

2.0 METHODS

2.1 Introduction

This section details the methods employed during the field survey and invertebrate surveys undertaken for the HTWSR site during 2018. Any significant limitations to the survey methods are also discussed. This section also includes the details of the invertebrate surveys undertaken within the site by ECOSA during 2005 and information sources used to inform the desktop study.

2.2 Zone of Influence

To define the total extent of the study area for this appraisal (Zone of Influence¹), the proposed scheme was reviewed to establish the spatial scale at which notable invertebrates could be affected. The appropriate survey radii for the various elements of the appraisal (i.e. desktop study and field survey) have been defined in the relevant sections below. These distances are determined based on the professional judgement of the ecologist leading the appraisal, taking into account the characteristics of the site subject to appraisal, its surroundings and the nature and scope of the development proposals and the ecology of the species of focus within this report.

2.3 Desktop Study²

2.3.1 Biological Records Centre

Hampshire Biodiversity Information Centre (HBIC) was consulted on 30th April 2018 for records of invertebrates located within two kilometres of the site boundary.

2.3.2 Multi-Agency Geographic Information for the Countryside

The Multi-Agency Geographic Information for the Countryside (MAGIC)³ database was reviewed on 12th June 2018 to establish the location of statutory designated sites located within the vicinity of the site which were either designated for invertebrates or include invertebrate species within their citation for a reason for designation. This included a search for all internationally and nationally designated sites such as Special Areas of Conservation (SACs), Wetlands of International Importance (Ramsar sites), Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs) and Local Nature Reserves (LNRs) within two kilometres of the site.

2.3.3 Other Sources of Information

Online mapping resources, including aerial photography, at an appropriate scale, were used to identify the presence of habitats such as woodland blocks, grassland,

¹ The Zone of Influence (Zoi), as defined by CIEEM, is the area over which ecological features may be subject to significant effects as a result of the proposed project and associated activities.

² Due to the age of this data an updated desk study has been undertaken in 2020 and details are included in Appendix 9.1.

³ www.defra.magic.gov.uk

heathland, ponds, and watercourses in the vicinity of the site. These habitats may offer resources and connectivity between the site and suitable habitat in the local area, which may be exploited by invertebrate species and assemblages.

ECOSA undertook invertebrate surveys at the site between 2005 and 2008 (ECOSA, 2013). In 2005 the invertebrate surveys comprised a total of six visits, commencing in April and continuing until late August. Survey dates were 18th April 2005, 13th May 2005, 27th June 2005, 14th July 2005, 8th August 2005 and 3rd September 2005. During 2006, 2007 and 2008 invertebrate surveys were limited to observations recorded during the course of other ecological surveys.

White Young and Green (WYG, 2014) undertook terrestrial invertebrate surveys during 2014 in relation to an outline planning application for new homes at land east of Horndean (East Hampshire District Council planning reference: 55562/001). This area is located to the north-west of the site.

During 2009 ARUP (ARUP, 2009) undertook an aquatic invertebrate survey on a section of stream within the site stretching from the lake within The Avenue (SU7147209979) for approximately 500 metres south-south-east to a location east of Middle Clearing (SU7141809542).

A report provided by Ashley Whitlock, Hampshire and Isle of Wight Butterfly Conservation Purple Emperor Co-ordinator (Hampshire and Isle of Wight Butterfly Conservation, 2018) on the status of purple emperor within Havant Thicket has been used to inform this report.

Data on glow-worm records from Havant Thicket was also received from John Goodspeed (per comms.).

2.4 Site Suitability Survey

2.4.1 Survey Methods

A field site suitability survey was undertaken to reassess the proposed reservoir site's suitability to support diverse communities of invertebrates. The assessment was based on the presence of habitat features which may support important invertebrate communities. These features include, for example, an abundance of dead wood, the presence of diverse plant communities, varied woodland structure, sunny woodland edges with a diverse flora, waterbodies and water courses and areas of free draining soil exposures.

2.4.2 Survey Details

The updating site suitability survey of the site was carried out by Simon Boswell, Principal Ecologist of ECOSA on 24th July 2018. The weather conditions were hot and sunny, an ambient temperature of 22°C and no wind.

The Havant Thicket woodland (wider site) survey was carried out by Simon Boswell on 21st September 2018. The weather conditions were sunny, an ambient temperature of 12-18°C and a light breeze.

During the surveys, the surveyor was equipped with 10x40 binoculars, a digital camera and information on previous survey work undertaken at the site.

2.4.3 Site Suitability Survey Limitations

There were no significant limitations to the site suitability survey.

2.5 Invertebrate Survey

2.5.1 Survey Methods

Survey methods involved visual searching of nectaring sites and basking areas, the use of a hand net or pooter to capture individual species, sweeping vegetation, beating foliage and grubbing.

The terrestrial and arboreal survey covered the main activity period for the invertebrate groups studied. The methods employed included standard techniques of sweeping grasses, rushes, sedges, herbs and foliage, beating the foliage, and branches of trees and bushes, especially blossom bearing plants such as hawthorn, rowan, blackthorn over a beating tray (Kirby, 1992), (Kirby, 1992).

It is impracticable to survey all the potential invertebrates, so specific groups of species, which are sufficiently well known as to provide meaningful comparisons to be made with other sites both locally and nationally were targeted. These species are also important as indicators of the quality of the site and the best habitats for invertebrates were targeted (Brooks, 1993). This survey focused on the nationally reviewed invertebrate groups, which have had status classifications assigned to each species based on the current and historic distributions (Ball, 1994). Invertebrate orders / suborders which were the focus of this study included:

- *Arachnida* (spiders, harvestmen and pseudoscorpions);
- *Odonata* (dragonflies and damselflies);
- *Hemiptera* (true bugs);
- *Orthoptera* (grasshoppers and crickets);
- *Dictyoptera* (cockroaches);
- *Lepidoptera* (butterflies and moths);

- *Diptera* (true flies);
- *Aculeate Hymenoptera* (ants, bees and wasps); and
- *Coleoptera* (beetles).

In addition, some species from other less well-known groups which have yet to have official statuses assigned to them were identified, mainly comprising parasitic wasps (*Hymenoptera*).

Prior to the survey key invertebrate survey areas were identified (see **Map L5**) based on:

- The distribution of notable⁴ species recorded in 2005;
- Habitat with high suitability for invertebrates such as south facing woodland edges, ditch lines etc.; and
- Important habitats such as well-structured broadleaved woodland, such as that present within The Avenue.

2.5.2 Survey Details

Dates and details of each invertebrate survey carried out in 2018 are provided in **Table L1**.

Table L1: Invertebrate survey details

Survey Date	Mean Temperature	Weather Conditions
8 th June 2018	22°C	Dry with long sunny spells and a light wind
26 th June 2018	23°C	Dry and sunny with a gentle breeze
24 th July 2018	24°C	Dry and mainly sunny with a light wind
15 th August 2018	22°C	Dry with long sunny spells and a light wind

The invertebrate surveys were coordinated by ECOSA Principal Ecologist Simon Boswell and carried out by Adam Wright, an experienced entomologist.

2.5.3 Survey and Desk Study Limitations

The extended dry period in the summer led to the grasslands becoming parched by July 2018. This may have affected the abundance of some species of invertebrate, however the spread of surveys over the period from the beginning of June to mid-August is considered to have resulted in a robust assessment of invertebrates at the site.

⁴ Details of notable invertebrate species criteria is presented in **Appendix L1**

There has been no official status review of picture-winged flies, Tachinid flies or *Hymenoptera* (bees, wasps and ants) since 1991 (Falk, 1991). During the intervening period there has been a significant increase in the knowledge of the distribution and abundance of species within these groups. For completeness this assessment follows the latest status criteria for these species (Falk, 1991).

As noted in Paragraph 2.5.2 it is impractical to survey all invertebrate groups at the site therefore this report is not designed to provide an exhaustive list of invertebrate species. Therefore, the lack of data for all species, and species groups, likely to be present at the site is not considered to be a significant limitation.

2.6 Discussion of Survey Results

Discussion of the invertebrates survey results is based on ECOSA's best professional judgement considering the following factors:

- **Rarity:** The rarity of invertebrates is based on categories of conservation importance and criteria defined in 'A Review of the Status of Microlepidoptera in Britain' (Davis, 2012). The criteria include those defined in the International Union for Conservation of Nature (IUCN) Red List (IUCN, 1994)⁵. A summary of the categories and criteria are provided in **Appendix L4**.
- **Species diversity:** In general, habitats with a greater diversity of species are considered to be of greater ecological value.
- **Species distribution:** The HBIC consultation and species-specific information from a range of sources is used to determine the distribution of rare invertebrate species at various geographic scales. A number of species are defined as notable at a county level and these categories are defined in **Appendix L4**.
- **Habitat quality and connectivity:** The assessment of habitat quality is species-specific and based on information within a number of publications, which are specified where relevant. Online mapping resources are referred to, to assess the habitat quality and connectivity in the wider area. For aquatic habitat this includes physical and chemical characteristics of the watercourse/waterbody.

In some cases there is insufficient baseline information to understand species rarity or distribution at the local, county or even national scale. Furthermore, criteria for defining

⁵ The IUCN Red List criteria have since been updated. However, the new criteria rely primarily upon rates of decline and are therefore impractical to use for most invertebrate groups, as such information is not available.

whether invertebrate species is complicated by the fact that many species groups have not had their statuses reviewed for many years. Therefore, various taxon still rely on pre-1994 IUCN criteria, whereas some use more up to date threat statuses. To ensure clarity through the report a table with the statuses of all notable species referenced is provided in **Appendix L1**.

3.0 BASELINE ECOLOGICAL CONDITIONS

3.1 Introduction

This section details the results of the 2018 invertebrate survey work undertaken for the HTWSR site, along with survey data from previous years. It assesses the baseline ecological conditions of the site in respect of invertebrates at the time the desktop study and field surveys. The baseline draws on a wealth of historical and recent data, relevant data from historic surveys has been included in the report to increase the understanding of the site in terms of invertebrates.

3.2 Baseline Ecological Conditions

Desktop Study Results

The HBIC data search returned 84 notable⁴ invertebrate species within or intersecting with the site. Only six of these species have been recorded using a detailed grid reference (100 metres squared or less) which intersect or are entirely within the site. These records are presented in **Map L3**.

Butterflies and moths were the only species group recorded at a high resolution with records that overlapped the site. The following records were returned; 38 records of silver-washed fritillary *Argynnis paphia*, 27 records of white admiral *Limenitis camilla*, eight records of purple emperor *Apatura iris*, four records of small heath *Coenonympha pamphilus*, four records of dark green fritillary *Argynnis aglaja* and a single record of knot grass *Acronicta rumicis*.

Table L2: HBIC desktop study notable⁴ invertebrate records from within or intersecting with the site

Species	Grid Reference	Location	Records	Max. Count	Year(s)
Silver-washed fritillary	SU720098	Eastern part of SCP	1	15	2006
Silver-washed fritillary	SU723097	Eastern edge of SCP	1	5	2007
Silver-washed fritillary	SU723096	South-eastern edge of SCP	12	6	2008-2010
Silver-washed fritillary	SU721095	South-eastern edge of SCP	13	9	2008-2010
Silver-washed fritillary	SU717095	Southern end of The Avenue	1	3	2005
Silver-washed fritillary	SU715098	Northern end of The Avenue	1	2	2013
Silver-washed fritillary	SU708099	East of Bell's Copse	4	15	2015

Species	Grid Reference	Location	Records	Max. Count	Year(s)
Silver-washed fritillary	SU708099	East of Bell's Copse	2	20	2014
Silver-washed fritillary	SU708103	North-east of Bell's Copse	1	12	2013
Silver-washed fritillary	SU715113	Northern corner of Havant Thicket Woodland	1	11	2013
Silver-washed fritillary	SU721101	Southern edge of Havant Thicket woodland	1	5	2010
White admiral	SU721101	Southern edge of Havant Thicket woodland	1	4	2010
White admiral	SU720098	Eastern part of SCP	1	3	2006
White admiral	SU723096	South-eastern edge of SCP	6	1	2008-2010
White admiral	SU721095	South-eastern edge of SCP	9	7	2008-2010
White admiral	SU717095	Southern end of The Avenue	1	5	2005
White admiral	SU708103	North-east of Bell's Copse	1	2	2013
White admiral	SU718101	Southern edge of Havant Thicket woodland	1	1	2011
White admiral	SU708099	East of Bell's Copse	3	9	2015
White admiral	SU708099	East of Bell's Copse	2	2	2014
White admiral	SU708103	North-east of Bell's Copse	1	5	2013
White admiral	SU715098	Northern end of The Avenue	1	2	2013
Knot Grass	SU723096	South-eastern corner of SCP	1	1	2008
Dark green fritillary	SU723096	South-eastern corner of SCP	2	1	2008
Dark green fritillary	SU721095	South-eastern corner of SCP	1	2	2008
Dark green fritillary	SU708099	East of Bell's Copse	1	1	2015
Small heath	SU723096	South-eastern corner of SCP	2	3	2008
Small heath	SU721095	South-eastern corner of SCP	2	1	2009-2010
Purple emperor	SU708103	North-east of Bell's Copse	1	2	2013
Purple emperor	SU708099	East of Bell's Copse	2	2	2015
Purple emperor	SU708099	East of Bell's Copse	1	5	2014

Species	Grid Reference	Location	Records	Max. Count	Year(s)
Purple emperor	SU708103	North-east of Bell's Copse	1	2	2013
Purple emperor	SU710110	North-west of Havant Thicket Woodland	1	3	2012
Purple emperor	SU715098	Northern end of The Avenue	1	1	2013
Purple emperor	SU715113	Northern corner of Havant Thicket Woodland	1	5	2013

In addition, 40 notable⁴ moth species have been recorded over the last 34 years at a location returned within the HBIC data called 'Leigh Park, Hants' within a 100 metres squared location centred on Winterslow Drive to the south of the site (SU713089). It is likely that these records relate to a moth trap in a member of the public's garden. These records have been included here as those notable species with a higher number of records and /or maximum counts are likely to be resident in the local landscape and therefore may be present within the site. Records from this garden are shown in **Table L3**.

All other HBIC notable species records which intersect with the site have grid references which could relate to the site or surrounding areas due to their low resolution and have therefore been excluded from the desktop study data presented in this report.

Table L3: Notable⁴ species records from moth trapping in Leigh Park, adjacent to the site (as returned in the HBIC data search)

Species	Total Records	Max. Count	Latest Year
Dark spectacle <i>Abrostola triplasia</i>	2	1	2004
Knot grass	112	7	2014
Brown-spot pinion <i>Agrochola litura</i>	11	3	2011
Beaded chestnut <i>Agrochola lychnidis</i>	44	9	2014
Green-brindled crescent <i>Allophyas oxyacanthae</i>	17	2	2013
Saltern ear <i>Amphipoea fucosa</i>	1	1	2013
Ear moth <i>Amphipoea oculea</i>	33	3	2014
Mouse moth <i>Amphipyra tragopoginis</i>	32	4	2004
Dusky brocade <i>Apamea remissa</i>	30	5	2014
Reddish light arches <i>Apamea sublustris</i>	1	1	2014
Small clouded brindle <i>Apamea unanimitis</i>	1	1	2013

Species	Total Records	Max. Count	Latest Year
Festoon <i>Apoda limacodes</i>	23	6	2005
Garden tiger <i>Arctia caja</i>	96	19	2014
Red-necked footman <i>Atolmis rubricollis</i>	1	1	2004
Minor shoulder-knot <i>Brachylomia viminalis</i>	5	2	2011
Bulrush veneer <i>Calamotropha paludella</i>	3	1	2003
Mottled rustic <i>Caradrina morpheus</i>	90	6	2014
Antler moth <i>Cerapteryx graminis</i>	1	1	2011
Sallow <i>Cirrhia icteritia</i>	41	3	2014
Lesser-spotted pinion <i>Cosmia affinis</i>	1	1	2008
Striped lychnis <i>Cucullia lychnitis</i>	2	1	2003
Small square-spot <i>Diarsia rubi</i>	139	46	2014
Small phoenix <i>Ecliptopera silaceata</i>	1	1	2013
September thorn <i>Ennomos erosaria</i>	70	6	2014
Dusky thorn <i>Ennomos fuscantaria</i>	13	2	2014
Orange footman <i>Eilema sororcula</i>	2	1	2004
Spinach <i>Eulithis mellinata</i>	3	1	2005
Jersey tiger <i>Euplagia quadripunctaria</i>	1	1	2012
White-lined dart <i>Euxoa tritici</i>	2	1	2012
Poplar kitten <i>Furcula bifida</i>	1	1	2012
Tawny shears <i>Hadena perplexa</i>	1	1	2006
Crescent <i>Helotropha leucostigma</i>	3	1	2012
Small emerald <i>Hemistola chrysoprasaria</i>	10	2	2013
Rustic <i>Hoplodrina blanda</i>	243	56	2014
Rosy rustic <i>Hydraecia micacea</i>	71	3	2014
Dog's tooth <i>Lacanobia suasa</i>	11	2	2005
Shoulder-striped wainscot <i>Leucania comma</i>	106	14	2014
Obscure wainscot <i>Leucania obsoleta</i>	1	1	2006
Four-spotted footman <i>Lithosia quadra</i>	2	1	2006
Rosy minor <i>Litoligia literosa</i>	15	4	2014

Species	Total Records	Max. Count	Latest Year
Brindled beauty <i>Lycia hirtaria</i>	3	3	2007
Lackey <i>Malacosoma neustria</i>	86	8	2012
Yellow pearl <i>Mecyna flavalis</i>	1	1	2013
Dot moth <i>Melanchra persicariae</i>	42	2	2014
Beautiful carpet <i>Mesoleuca albicillata</i>	1	1	2012
Marbled green <i>Nyctobrya muralis</i>	65	6	2014
Rosy-striped knot-horn <i>Oncocera semirubella</i>	1	1	2014
Grass rivulet <i>Perizoma albulata</i>	2	1	2013
Powdered Quaker <i>Orthosia gracilis</i>	10	2	2008
Barred umber <i>Plagodis pulveraria</i>	1	1	2012
Gold spot <i>Plusia festucae</i>	7	1	2011
Maple prominent <i>Ptilodon cucullina</i>	4	1	2003
Mullein wave <i>Scopula marginepunctata</i>	4	1	2003
Shaded broad-bar <i>Scotopteryx chenopodiata</i>	3	1	2003
White ermine <i>Spilosoma lubricipeda</i>	50	3	2014
Buff ermine <i>Spilosoma lutea</i>	174	16	2014
Hedge rustic <i>Tholera cespitis</i>	6	3	2013
Feathered gothic <i>Tholera decimalis</i>	15	8	2013
Blood-vein <i>Timandra comae</i>	97	5	2014
Cinnabar <i>Tyria jacobaeae</i>	16	4	2014
Oak hook-tip <i>Watsonalla binaria</i>	110	8	2014
Dark-barred twin-spot carpet <i>Xanthorhoe ferrugata</i>	8	5	2012

Detailed (100 metres squared resolution) records returned from HBIC which intersect or are entirely within the wider site are presented in **Table L4** and **Map L3**. These records include a small number of duplicates from **Table L2** where records overlap with both site and wider site boundaries.

Butterflies and moths were the main species group recorded at a high resolution. The following records were returned; buff ermine, chalk hill blue *Polyommatus coridon*, dark green fritillary, knot grass, purple emperor, silver-washed fritillary, small heath and

white admiral. The only non-Lepidopteran record recorded at high resolution was a single record of a mason wasp *Symmorphus crassicornis*.

Table L4: HBIC desktop study summary of notable⁴ invertebrate records from within the wider site

Species	Location	Records	Max. Count	Year(s)
Purple emperor	Bell's Copse, Havant Thicket	1	1	2013
	Havant Thicket	20	27	2011-2015
White admiral	Bell's Copse, Havant Thicket	1	1	2013
	Havant Thicket	39	81	Various years 1990-2016
	SCP	7	2	2008 and 2013
Silver-washed fritillary	Havant Thicket	1	1	Various years 1990-2016
	SCP	16	6	Various years 2010-2016
Buff ermine	Havant Thicket	1	1	2012
Chalk hill blue	Havant Thicket	1	1	2012
Dark green fritillary	SCP	2	1	2008
A mason wasp <i>Symmorphus crassicornis</i>	Havant Thicket	1	1	2007
Small heath	Havant Thicket	5	4	Various years 1994-2013
	SCP	5	3	Various years 2008-2016

During terrestrial invertebrate surveys undertaken by WYG in 2014 on 'land east of Horndean' approximately 350 metres north-west of the site (WYG, 2014) a number of notable species were recorded. Records included seven notable species of butterflies and moths, comprising; small heath, cinnabar, dusky brocade, dusky thorn, rosy rustic, large wainscot *Rhizodra lutosus* and shaded broad-bar. Other notable invertebrate species included four flies (*Diptera*), four beetles (*Coleoptera*) and a single cockroach (*Dictyoptera*) species, comprising; dusky cockroach *Ectobius lapponicus*, the robberfly *Choerades marginatus*, the picture-winged fly *Myopites inulaedyssentericae*, the picture-winged fly *Orellia falcata*, the picture-winged fly *Dorycera graminum*, the jewel

beetle *Agrilus laticornis*, the soldier beetle *Cantharis fusca*, the longhorn beetle *Leptura aurulenta* and a weevil *Curculio villosus*. Details of these species' records are provided in **Table L5** and **Map L4**.

Table L5: Notable⁴ species recorded by WYG at land east of Horndean north-west of the site in 2014

Species	Notes
Dusky cockroach	Two specimens swept from woodland with several more specimens found by beating oak leaves on 19th June 2014.
Small heath	Small numbers were recorded from the grassland on site during June 2014.
Cinnabar	Larvae were swept from ragwort within on-site grassland compartments during July 2014.
A robberfly <i>Choerades marginatus</i>	A least three specimens of this robberfly were recorded from a woodland glade at SU70971176 on 10th July 2014.
A picture-winged fly <i>Myopites inulaedyssentericae</i>	A single specimen of this picture-winged fly was swept from common fleabane <i>Pulicaria dysenterica</i> (the larval foodplant) at SU71141203 on 7th August 2014.
A picture-winged fly <i>Orellia falcata</i>	This species of picture-winged fly was recorded on 29th May 2014 in 'low numbers' within one field at land east of Horndean where the larval foodplant, goat's beard <i>Tragopogon pratensis</i> is present.
A picture-winged fly <i>Dorycera graminum</i>	At least 15 specimens of this picture-winged fly were recorded in a relatively small area around SU71211276 on 29th May 2014.
A jewel beetle <i>Agrilus laticornis</i>	A single specimen of this jewel beetle was beaten from leaves on a mature oak at SU70731203 on 10th July 2014 and 7th August 2014.
A soldier beetle <i>Cantharis fusca</i>	A frequently recorded soldier beetle from rank grassland within the land east of Horndean site. At least 15 individuals recorded.
A longhorn beetle <i>Leptura aurulenta</i>	This species of longhorn beetle was recorded from oaks at the land east of Horndean site on 7th August 2014 at SU70781209.
A weevil <i>Curculio villosus</i>	A single specimen of this weevil was recorded from grasses around mature oaks at the land east of Horndean site on 29th May 2014.
Dusky brocade	One individual recorded at a 12V actinic light trap placed adjacent to deciduous woodland at SU7114112211 on 6th August 2014.
Dusky thorn	Two individuals recorded at a 12V actinic light trap placed adjacent to deciduous woodland at SU7114112211 on 6th August 2014.
Rosy rustic	One individual recorded at a 12V actinic light trap placed within an area of grazed grassland near woodland at SU71099 11723 on 20th August 2014.

Species	Notes
Large wainscot	Two individuals recorded at a 12V actinic light trap placed within an ungrazed grassland near hedgerows at SU71357 12738 on 17th July 2014.
Shaded broad-bar	24 individuals recorded at a 12V actinic light trap placed within an ungrazed grassland near hedgerows at SU71357 12738 on 17th July 2014.

ARUP aquatic invertebrate surveys (ARUP, 2009) undertaken in 2009 covering a 500 metre stretch of stream within the site reported that the aquatic invertebrate community structure was generally unremarkable. A stonefly *Nemouridae* species⁶ recorded in October 2009 was the only species of particular note, and this was considered to be an opportunistically colonisation, given that the species had not been recorded in surveys undertaken in July of the same year. For completeness the full ARUP aquatic invertebrate survey report is provided in **Appendix L2**.

John Goodspeed, a local resident, has recorded glow worm *Lampyrus noctiluca* from Havant Thicket woodland. The records were located along the main track (approximately SU7214110549 to SU7187110408) and a small number of associated side tracks. Whilst the glow-worm is not a notable species, these records have been included given that this species is of particular interest to members of the public.

Hampshire and Isle of Wight Butterfly Conservation data shows that purple emperor has been recorded widely within Havant Thicket woodland, albeit in low numbers. Between 2008 and 2011 there were no records from Havant Thicket woodland, possibly as a result of limited observer effort (Hampshire and Isle of Wight Butterfly Conservation, 2018). However, since 2012 records have been made every year with the key locations comprising rides with willow *Salix* species associated with Bell's Copse and Havant Thicket woodland. A small number of records have been made from The Avenue and SCP. The Hampshire and Isle of Wight Butterfly Conservation 2018 purple emperor records are presented on **Map L4**.

The ECOSA invertebrate surveys carried out in 2005 recorded a total of 15 notable invertebrate species that are Nationally Scarce or Nationally Rare/Red Data Book (RDB) species (ECOSA, 2013). The area covered by these surveys broadly overlapped with the 2018 surveys.

Long-winged conehead *Conocephalus discolor* was classed as notable during the 2005 survey. Due to a substantial increase in the range and abundance the status of this species has now been downgraded, therefore it has been removed from **Table L6**.

⁶ Specific species not recorded in ARUP report

In addition, since the 2005 surveys were undertaken the hoverflies *Criorhina asilica*, *Criorhina ranunculi*, *Xanthandrus comtus* and *Xylota florum* have all had their status downgraded (Ball, 2014). These species have now been recorded in a significant number of hectads (10x10 kilometre squares) indicating that they are far more widespread, or have increased since the last time their status was assessed (Falk, 1991).

Details of the invertebrate notable status category definitions used in **Table L6** and **Table L7** are provided in **Appendix L4**. The locations of these records are presented on **Map L4**.

Table L6: Notable⁴ invertebrate species recorded during ECOSA 2005 survey at the site

Common name	Scientific Name	Notes	Status
Lepidoptera (Butterflies and moths)			
Silver-washed fritillary	<i>Argynnis paphia</i>	Silver-washed fritillary were seen flying through The Avenue. Larvae of this species feed on common dog violet <i>Viola riviniana</i> , which is present along some of the ride margins within the woodland.	Hampshire BAP, County of Interest
White admiral	<i>Limenitis camilla</i>	This butterfly was recorded in small numbers within The Avenue.	S41 Species ⁷
Diptera (Flies)			
A hunchbacked fly	<i>Ogcodes pallipes</i>	Several specimens were swept from birch <i>Betula</i> species bordering a drainage ditch to the north-east of The Avenue on 27 th June 2005. Larvae of this species develop as internal parasites of spiders, perhaps particularly <i>Clubiona</i> species. The adult fly has reduced or absent mouthparts and is incapable of feeding; inevitably this results in the adults not living for more than a few days. Records for this hunchbacked fly are largely from southern England, extending northwards to Northamptonshire and Glamorgan. Falk notes very few post-1960 records and a decline over recent decades (Falk, 1991). Other recorders state that records are sparse within its range, and suggest that many records are associated with chalk or limestone grasslands (Stubbs & Drake, 2001).	Nationally Scarce (N)
A picture-winged fly	<i>Myopites inulaedyssentericae</i>	Several specimens were swept from stands of the host plant common fleabane <i>Pulicaria dysenterica</i> . Larvae of this picture-winged fly develop in the seed heads of the plant. It was most frequent on plants bordering the main bridleway to the east of The Avenue.	Rare (RDB3)

⁷ **Appendix L5** provides details of S41 species of principal importance which have been designated under the Natural Environment and Rural Communities (NERC) Act (2006)

Common name	Scientific Name	Notes	Status
A tachinid fly	<i>Gymnosoma rotundatum</i>	This species was collected during general sweeping in the grasslands to the north of The Avenue.	Rare (RDB3)
Hymenoptera (Bees, wasps and ants)			
Club-horned sapyga	<i>Sapyga clavicornis</i>	This species proved to be relatively frequent during June 2005, when adults could be observed investigating nest holes of the bee <i>Chelostoma florissomne</i> , which were common on the decaying fence posts bordering the main east-to-west bridleway. Larvae of this species develop in the nests of <i>Chelostoma florissomne</i> and bees of the genus <i>Osmia</i> . Modern records for this club-horned sapyga exist for approximately forty 10-kilometre squares (Edwards, 1998).	Nationally Scarce (Nb)
A mining bee	<i>Lasioglossum malachurum</i>	This species was found to be present in low densities in the drier areas of grassland during 2005. <i>Lasioglossum malachurum</i> requires warm, light, disturbed soils in which to nest, and is primarily associated with the southern coastal counties of England. Evidence presented prior to 1991 indicated a population decline, particularly at inland sites (Falk, 1991).	Nationally Scarce (Nb)
A mining bee	<i>Melitta tricincta</i>	This species was recorded in late summer 2005. A number of males were seen flying rapidly around the flowers of red bartsia <i>Odontites verna</i> at SU 71967 09876, on the main east-to-west bridleway. Females of this mining bee are monoleptic ⁸ , collecting all their pollen provisions from the flowers of red bartsia. The species is associated with chalk grassland and open woodland on chalky soils, although the host plant is not confined to these situations. The species is most common in south and south-east England.	Nationally Scarce (Nb)
A bee	<i>Osmia bicolor</i>	This bee was encountered around the edge of The Avenue. Females of this species build their nests in empty snail shells. Pollen is collected from a variety of plant species. Most records of this bee are from southern England and South Wales, where it is mainly associated with calcareous grassland or woodland on chalk or limestone soils.	Nationally Scarce (Nb)
Arachnida (Spiders)			
Wasp spider	<i>Argiope bruennichi</i>	This species was present in some numbers within the grassland areas, perhaps being most common in the dry ditches lining the main east to west bridleway.	Nationally Scarce (Nb)

⁸ An insect which collects pollen from the flowers of a single plant species.

Site Suitability Survey Results

During the 2018 site suitability survey the habitat within the site comprised a combination of neutral grassland, rush pasture, woodland, stream corridors, ditches and boundary vegetation. The on-site habitats were broadly similar to those recorded in 2005-2008, apart from the Gypsies Plain area (see **Map L2**) which was previously heavily grazed by horses but has since become more tussocky, as a result of reduced grazing pressure.

Given that the site has not significantly changed since the 2005 survey it was considered that the site was still suitable to support a variety of invertebrates including notable species.

During 2018 the watercourses which run into the site from Havant Thicket woodland dried in May and did not flow again until October. This indicates that the watercourses within the site are highly ephemeral with limited suitability to support a diverse aquatic fauna.

Invertebrate Survey Results

During the 2018 invertebrate survey work a number of notable species were recorded, these are considered in more detail in **Table L7**. A list of all invertebrate species recorded during the 2018 surveys is provided in **Appendix L2**. Details of the status category definitions and criteria are provided in **Appendix L4**. The locations of Nationally Scarce and RDB species were recorded and are shown in **Map L6**.

Table L7: Notable⁴ Invertebrate Survey Results 2018

Common name	Scientific Name	Notes	Status
Dictyoptera (Cockroaches and mantids)			
Dusky cockroach	<i>Ectobius lapponicus</i>	A single specimen was swept from vegetation along the main track through Havant Thicket woodland on 8 th June 2018. The species was not recorded from the site. The dusky cockroach has a life cycle which takes two years to complete. It is associated with a range of warm, sheltered habitats, particularly in scrub and rank grassland, woodland rides and scrubby heath. It is an omnivorous species. The dusky cockroach has the most restricted range of Britain's three native cockroach species, being confined to central southern England (Marshall & Haes, 1988).	Nationally Scarce (Nb)
Lepidoptera (Butterflies and moths)			
Small heath	<i>Coenonympha pamphilus</i>	Specimens of the small heath were recorded on three separate dates during the survey. It was found in numbers around the dry ditch in the south-east of the survey area on 8 th June	S41 species ⁷ ,

Common name	Scientific Name	Notes	Status
		2018. On 26th June 2018 specimens were recorded from a grassy track to the west of the Avenue. On 15th August 2018 specimens were found on grassland around SU 7168 0986 to the west of The Avenue. Larvae of this butterfly feed on fine grasses such as annual meadow grass <i>Poa annua</i>. The small heath is primarily associated with open grassland sites. It is widespread in Britain, but due to a considerable recent national decline has been included as an S41 species⁷ under the NERC Act. The small heath remains a relatively common butterfly in Hampshire.	
Silver-washed fritillary	<i>Argynnis paphia</i>	Silver-washed fritillary were seen along the southern boundary track through Havant Thicket on 26 th June and 24 th July 2018. Larvae of this species feed on dog violet, which is present along some of the ride margins within the woodland. The larval food plant is susceptible to over-shading. The silver-washed fritillary is a Hampshire Biodiversity Action Plan (HBAP), Hampshire is also a 'County of Interest' for silver-washed fritillary because approximately 10% of the UK population is supported by the County (HBIC per comms.).	Hampshire BAP, County of Interest
White admiral	<i>Limenitis camilla</i>	White admiral is another notable woodland butterfly, since it appears to also be in considerable national and local decline. This butterfly was also recorded in small numbers along the southern track through Havant Thicket woodland on 26 th June 2018. Larvae of this species feed on honeysuckle <i>Lonicera periclymenum</i> although they only utilise plants in very densely-shaded areas.	S41 Species ⁷
Cinnabar	<i>Tyria jacobaeae</i>	A common species whose larvae develop on ragwort <i>Senecio</i> species, a plant which is present in some quantity on the northern section of the reservoir. cinnabar caterpillars were noted feeding on ragwort along a grassy track to the west of The Avenue on 24 th July 2018. The moth remains widespread and frequent through much of the British Isles. It has, however declined considerably over the last 35 years, and for this reason has been listed under Section 41 of the NERC Act.	S41 Species ⁷
Diptera (Flies)			
A hoverfly	<i>Heringia (Neocnemodon) latitarsis</i>	A specimen of this aphidophagus ⁹ hoverfly was recorded on wild Angelica <i>Angelica sylvestris</i> along a track in on the southern edge of Havant Thicket woodland on 15 th August 2018. This hoverfly is a scarce woodland species, most frequently found in	Nationally Scarce (N)

⁹ A species which feeds on aphids

Common name	Scientific Name	Notes	Status
		coniferous or mixed woodland. Larvae are known to attack aphids on fir <i>Abies</i> species, poplar <i>Populus</i> species and elm <i>Ulmus</i> species. (Ball, et al., 2011) state that this hoverfly is widely distributed across southern England and Wales, but suggest there are few modern records for the species. There would appear to be only one or two other records of the species from Hampshire.	
A picture-winged fly	<i>Campiglossa producta</i>	A single specimen was swept from cat's-ear <i>Hypochaeris radicata</i> within rank grassland near the base of The Avenue on 15 th August 2018. Larvae of this species are believed to develop in the seed heads of yellow composites, but the exact British hosts remain unknown. This would appear to be a genuinely scarce species. Recent records from only 18 10-kilometre squares in the UK (Clemens, 2008). Many of the records are from Dorset, and the map shows only two other recent records for South Hampshire, both in the east of the county.	Nationally Scarce (N)
A picture-winged fly	<i>Merzomyia westermanni</i>	This species is amongst the largest of British Tephritids ¹⁰ , and has very heavily patterned brown wings and a brown body. Specimens were swept from grassland around SU 7158 0966 near the base of The Avenue, and from ragwort at SU 7085 1039 on the track along the southern edge of Havant Thicket woodland on 24 th July 2018. A further two specimens were recorded from grassland around SU 7157 0967 near the base of The Avenue on 15 th August 2018. Larvae of this species develop in the capitula of hoary ragwort <i>Senecio erucifolius</i> and, rarely, common ragwort <i>Senecio jacobaea</i> . The species is widely distributed in south east England and the Midlands, and is particularly frequent around the greater London area. It is scarce in northern England and apparently absent from the south west. There are a number of modern records of the species from south Hampshire.	Nationally Scarce (N)
A picture-winged fly	<i>Myopites inulaedyssentericae</i>	Specimens of this fly were found by sweeping common fleabane in rank grassland at SU 71580966 near the base of The Avenue and at SU 71561040 along the southern boundary track within Havant Thicket woodland on 24 th July 2018. Further specimens were recorded from a track to the east of The Avenue at SU71680986 and from the southern boundary of Havant Thicket woodland at SU 71101037 on 15 th August 2018. Larvae of this species develop in the seed heads of common fleabane. In the past the species was an extremely localised species in southern and south-eastern England. South Hampshire appears to be	Rare (RDB 3)

¹⁰ Picture-winged flies

Common name	Scientific Name	Notes	Status
		one of the strongholds for this species, although it has become commoner in recent years.	
A tachinid fly	<i>Gymnosoma rotundatum</i>	Two specimens of this species were swept from vegetation bordering a track on the southern edge of Havant Thicket woodland at SU 71561040 and SU 70851039 respectively on 24 th July 2018 (Belshaw, 1993) cites only 14 British records, with most of these coming from Sussex and Surrey (Belshaw, 1992). Although this tachinid fly is confined to south-east England, the frequency of records has increased significantly in the last twenty years and it appears that this species has become more common than previously. It is considered likely that the current RDB3 status may require review. In Britain, larvae of this species are parasitic on the shieldbug <i>Palomena prasina</i> . This bug is a common and widespread species in southern and central England, which feeds on a wide variety of plants. Most records for this tachinid fly are from dry sandy areas on downland or heathland. It is known from several other sites in south Hampshire.	Rare (RDB 3)
Hymenoptera (Bees, wasps and ants)			
A mason wasp	<i>Symmorphus crassicornis</i>	A single specimen of this mason wasp was recorded on 24 th July 2018 flying around aspen <i>Populus tremula</i> saplings near the base of The Avenue at SU 71620968, an area where the leaf beetle <i>Chrysomela populi</i> was present. This mason wasp is known to provision its nest with full grown larvae of the leaf beetle. Nests are built in holes in wood or other cavities. A search of young aspen along the track at the western edge of Havant Thicket woodland around SU 70851045, where the leaf beetle had been recorded, failed to yield further specimens of the wasp. Although this mason wasp is widespread in southern Britain, until recently it was seldom found. Only six British records exist for the species between 1970 and 1999. However, it is suspected that the species is under-recorded rather than particularly rare, perhaps due to the fact that previously collectors were unaware of the association between the mason wasp and the leaf beetle (Baldock, 2010). Concerted efforts searching sites in Surrey where the beetle was known to occur showed that the wasp is reasonably frequent within the county, and it is known from 36 modern sites (Baldock, 2010). Baldock states that the wasp has now been found at all sites in Surrey where the beetle is known to occur.	Rare (RDB 3)

Common name	Scientific Name	Notes	Status
A social wasp	<i>Dolichovespula media</i>	This social wasp was recorded on a hogweed <i>Heracleum sphondylium</i> inflorescence along the southern boundary track within Havant Thicket woodland on 24 th August 2018. This species is a relatively recent colonist in Britain, having first been found in East Sussex in 1980. It spread quickly to become established in south eastern England, and has now been recorded from Kent to Cornwall, in north Wales and as far north as Durham and Cumbria. Due to this rapid establishment, the status of this social wasp is no longer accurate and should be downgraded in any future review (Edwards, 1997). The species is an aerial nester, suspending its nest from the branches of trees and bushes.	Nationally Scarce (Na)
A mining bee	<i>Lasioglossum puncticolle</i>	This mining bee was recorded during sweeping cat's ear in grassland near the base of The Avenue on 15 th August 2018. The species requires warm, disturbed soils in which to nest, and is primarily associated with the southern coastal counties of England. This mining bee appears to have suffered recent population declines, particularly at inland sites, but remains reasonably common in Hampshire, especially in coastal situations.	Nationally Scarce (Nb)
Coleoptera (Beetles)			
Alder leaf beetle	<i>Agelastica alni</i>	Several specimens of the alder leaf beetle were recorded on alder leaves near the base of The Avenue at SU 71680961 on 8 th June 2018. During a visit to trees in the same location on 15 th August 2018, large numbers of both adult and larvae were feeding on the alder leaves. A conservative estimate was of at least 100 individuals in total. The alder leaf beetle feeds primarily on alders, both as an adult and as larvae, although it has also been recorded from hazel <i>Corylus avellana</i> , goat willow <i>Salix caprea</i> , hybrid black poplar <i>Populus x canadensis</i> and downy birch <i>Betula pubescens</i> on occasion (Cox, 2007). It is not stated whether these alternative plant hosts are from British or continental observations. New generation adults appear in July or August before aestivating, but become active for a short period in the autumn. They then hibernate for the winter and emerge the following spring. Originally the species was classified as extinct in Britain (Shirt, 1987), but Hyman and Parsons reclassified the beetle as RDB K (Insufficiently Known) (Hyman & Parsons, 1992). They considered the species to be only an immigrant to Britain. In 2004 larvae were recorded in north England (Hubble, 2015) gives records for several sites in south Hampshire for 2014 where alder leaf beetle is now well established. It is likely that these	RDB K - Data deficient (DD)

Common name	Scientific Name	Notes	Status
		colonies are the result of establishment by migrant specimens, since the beetle is distinctive and brightly metallic coloured and thus unlikely to be overlooked if it were a native species.	
A tumbling flower beetle	<i>Variimorda villosa</i>	A single specimen was taken whilst sweeping vegetation bordering the southern track through Havant Thicket woodland on 24 th July 2018. This tumbling flower beetle is associated with semi-natural broad-leaved woodland, where it is believed to develop in either dead wood or plant stems. The latter is believed more likely. Adults are most frequently found at umbel inflorescences. Although widespread in the southern half of England and in south Wales, the distribution of the species within this area is localised.	Nationally Scarce (Nb)
Arachnida (Spiders)			
Wasp spider	<i>Argiope bruennichi</i>	The wasp spider was recorded from rough grassland near the base of The Avenue on 24 th July 2018. This species was a colonist from continental Europe, and was first recorded in England in the 1920's. Nationally, the species is now encountered in rank grassland in southern and central England, where it appears to be increasing in frequency. It is likely that its status will be downgraded in any future review.	Nationally Scarce (Nb)

Other Notable Invertebrates Recorded

On 2nd July 2018 Simon Boswell Principal Ecologist of ECOSA recorded numerous white admiral and silver-washed fritillary along the southern track within Havant Thicket Woodland. At least two purple emperor were also recorded from willow on the eastern edge of Bell's Copse (SU7084710337) on the same day.

As part of a bat survey undertaken on 27th June 2018 at least two glow-worm were recorded in grassland to the west of The Avenue (SU7170709430). The species was not recorded on other bat surveys undertaken during 2018.

3.3 Discussion

The invertebrate surveys carried out during 2018 recorded a total of four Red Data Book species, eight Nationally Scarce species, three S41 species⁷ and one Hampshire BAP species. Five Nationally Scarce species and one S41 species were recorded in 2005 but not 2018.

The Red Data Book species are the tachinid fly *Gymnosoma rotundatum*, the picture-winged fly *Myopites inulaedyssentericae*, the mason wasp *Symmorphus crassicornis* and the alder leaf beetle *Agelastica alni*.

Due to a recent increase in frequency of occurrence, it is likely that any future review would downgrade the status of the tachinid fly *Gymnosoma rotundatum*, and the picture-winged fly *Myopites inulaedyssentericae*, although both remain largely restricted to the south-east of England.

Myopites inulaedyssentericae was also recorded during invertebrate surveys undertaken by WYG during 2014 on land to the north-west of the site, and from within Havant Thicket woodland indicating that populations of this species are present across the local landscape.

The tachinid fly *Gymnosoma rotundatum* was only recorded off-site within Havant Thicket woodland north of The Avenue during 2005 and 2018. Most records of this species are from dry sandy areas on downland or heathland, habitat types which are not present within the footprint of the reservoir. As a result, this species is unlikely to be present within the site.

The alder leaf beetle *Agelastica alni* appears to have become well established in Hampshire within the last few years, and is now recorded regularly at sites in the region where alder occurs. Accurate data on the current distribution of the species appears to be lacking. If expansion continues, it is very likely that the status of this beetle should be downgraded.

The rare (RDB 3) mason wasp *Symmorphus crassicornis* remains a scarce and elusive species, although recent studies in Surrey (Baldock, 2010) suggest that it may not be as rare as previously thought. The species was also returned in the HBIC data search from Havant Thicket woodland to the north of the site, suggesting this species is present in other locations locally.

The seven Nationally Scarce species recorded were dusky cockroach, the hoverfly *Heringia latitarsis*, the picture-winged flies *Campiglossa producta* and *Merzomyia westermanni*, the social wasp *Dolichovespula media*, the mining bee *Lasioglossum puncticolle*, the tumbling flower beetle *Variimorda villosa* and the wasp spider *Argiope bruennichi*. Of these, the social wasp *Dolichovespula media* and the wasp spider are now well established in the UK and no longer qualify for Nationally Scarce status. Based on current information, the other five species are considered to meet the criteria required to retain their current Nationally Scarce status.

The hoverfly *Heringia latitarsis*, dusky cockroach and the tumbling flower beetle *Variimorda villosa* were only recorded from Havant Thicket woodland to the north of the site. The hoverfly *Heringia latitarsis* is most frequent around coniferous or mixed woodland which is limited in extent within the site but present extensively within Havant Thicket woodland. The dusky cockroach prefers sheltered areas within a variety of

habitats which are present throughout the local landscape such as rank grassland, woodland rides and scrubby heath. As a result, the species may be present on site, although Havant Thicket provides the most suitable habitat for this species. The tumbling flower beetle *Variimorda villosa* is associated with semi-natural broadleaved woodland, and therefore may be present within the site, particularly The Avenue.

The remaining three species; picture-winged flies *Campiglossa producta* and *Merzomyia westermanni* and mining bee *Lasioglossum puncticolle* are all grassland species that are supported by the site.

In addition to the scarce and threatened insect species recorded, small heath, and the cinnabar were also recorded from the site during 2018. During 2005 white admiral and silver-washed fritillary were also recorded from The Avenue, however these species were not recorded here in 2018. Given the suitable habitat present both species are still likely to use The Avenue occasionally, although they are far more frequent in Havant Thicket woodland to the north of the site. Four of these species are classified as Section 41 species of principal importance under the NERC Act (2006) (see **Appendix L5**) and silver-washed fritillary is listed in the Hampshire BAP. These species remain frequent and widespread in Hampshire, although a decline in their frequency has been recorded.

Five other notable species were recorded from the site in 2005 only; the hunchbacked fly *Ogcodes pallipes*, club-horned sapyga, mining bees *Lasioglossum malachurum*, and *Mellitta tricincta* and bee *Osmia bicolor*. Of these species the status of *Lasioglossum malachurum* would be likely to be downgraded in any future review due to a significant increase in range since about 1990, and is now common at many sites in southern England (Bees Wasps and Ants Recording Society, 2018). The status of the remaining four species remains Nationally Scarce.

Club-horned Sapyga was recorded in association with its bee host *Chelostoma florissomne* which was nesting in decaying fenceposts within the site during 2005. In spring 2018 fencing across the site was replaced to re-instate grazing at the site. This action is likely to have resulted in a reduction, or loss, of *Chelostoma florissomne* from the site and may explain the lack of records of club-horned sapyga in 2018.

The mining bee *Mellitta tricincta* is reliant on red bartsia for pollen collection. During 2018 red bartsia was not recorded from the site during a detailed botanical survey, and therefore the species pollen source may now be absent, or be very rare at the site. The reasons for the reduction / loss of red bartsia is unknown, however it has likely resulted in the loss of *Mellitta tricincta* from the site.

The mining bee *Lasioglossum malachurum* requires warm, light disturbed soils to nest. These areas may have become scarcer at the site following a reduction in grazing pressure at the site after 2005, however there are areas where disturbed soils are still present within the site and therefore the continued presence of this species cannot be ruled out, especially considering the increase in the species' population since about 1990.

The hunchbacked fly *Ogcodes pallipes* was recorded from on-site birch trees immediately north of The Avenue during 2005. This species does not have working mouthparts and is parasitic on spiders. The exact habitat requirements of this species are not fully known, although it has been recorded from chalk and limestone grassland. It is unclear why this species was recorded in 2005 but not 2018.

The final species recorded in 2005 but not 2018 was the bee *Osmia bicolor*, a species that has mostly been recorded from southern England. Foodplants include a variety of species which are present on-site and within the surrounding landscape including willows species, ground-ivy *Glechoma hederacea*, daisy *Bellis perennis* and dandelion *Taraxacum officinale* aggregate.

A number of notable moth species have been recorded from a moth trap in Leigh Park to the south of the site between 1985 and 2014, including four of the five notable moth species recorded by WYG to the north-west of the site during 2014. The distribution of these species nationally and locally is provided in **Appendix L6**, along with an assessment of the likelihood of the species being present within the site. A summary of the species considered most likely to be supported by the site is presented in **Table L8**. None of the moth species likely to be supported by the site are particularly rare in Hampshire, range restricted or limited to scarce habitat types. It is likely that populations of these species are also supported by SCP and or Havant Thicket woodland.

Table L8: Notable moth species likely to be supported by the site based on HBIC data search records (see **Appendix L6** for further details)

Species	Suitable On-site Habitat	Hampshire Status Notes (Wall, 2018)
Festoon	Broadleaved woodland	Recent population increase
Red-necked footman	Broadleaved woodland	Recent population increase
Small Phoenix	Broadleaved woodland	Widespread and common
Orange footman	Broadleaved woodland	Possible recent range extension
Jersey tiger	Broad habitat tolerance	Recent colonist, likely to increase

Species	Suitable On-site Habitat	Hampshire Status Notes (Wall, 2018)
Four-spotted footman	Broadleaved woodland	Away from the New Forest records are presumed immigrants rather than resident populations
Beautiful carpet	Broadleaved and coniferous woodland	Widespread but scarce
Barred umber	Broadleaved woodland	Widespread but relatively scarce
Dusky brocade	Broad habitat tolerance	Widespread and moderately common
Dusky thorn	Broadleaved woodland with ash	Recent substantial increase in records after historic decline
Rosy rustic	Broad habitat tolerance	Widespread and locally common
Buff ermine	Broad habitat tolerance	A common and widespread species
Brown-spot pinion	Broad habitat tolerance	Widespread and moderately common
Beaded chestnut	Broad habitat tolerance	Widespread and common
Green-brindled crescent	Broadleaved woodland, scrub etc.	Widespread and moderately common
Ear moth	Grassland	Widespread but relatively scarce
Mouse moth	Broad habitat tolerance	Widespread and moderately common
Garden tiger	Broad habitat tolerance	Widespread but recent decline
Minor shoulder-knot	Willows	Widespread and common
Mottled rustic	Broad habitat tolerance	Widespread and common
Sallow	Willows	Widespread and common
Small square-spot	Rough grassland and damp woodland	Widespread and common
September thorn	Broadleaved woodland	Widespread and common
Rustic	Woodland and rough grassland	Widespread and common
Shoulder-striped wainscot	Grassland and marshy areas	Widespread and moderately common
Brindled beauty	Broadleaved woodland and scrub	Widespread and moderately common
Lackey	Broadleaved woodland	Widespread and usually common
Dot moth	Broad habitat tolerance	Widespread and common
Powdered Quaker	Ditch lines and associated willows	Widespread and moderately common

Species	Suitable On-site Habitat	Hampshire Status Notes (Wall, 2018)
White ermine	Broad habitat tolerance	Widespread and common
Feathered gothic	Rough grassland and woodland edges	Substantial decline since the 1950's
Blood-vein	Marshy grassland	Widespread and common
Oak hook-tip	Woodland and hedgerows	Widespread and common
Dark-barred twin-spot carpet	Broad habitat tolerance	Widespread and common

An aquatic invertebrate survey undertaken by ARUP in 2009 on a section of stream within the site recorded a limited species diversity. Other sections of stream and ditch running through the site are highly ephemeral and, given the result of the 2009 ARUP survey, are considered unlikely to contain diverse aquatic invertebrate assemblages. ARUP reported that the aquatic invertebrate community structure was generally unremarkable. During 2018 the streams within the site were again confirmed to be highly ephemeral with limited suitability to support a freshwater invertebrate community.

4.0 CONCLUSIONS

4.1 Conclusion

A small number of notable invertebrate species will be impacted by the proposals, although the species impacted, were either confirmed from or likely to be resident in the local landscape.

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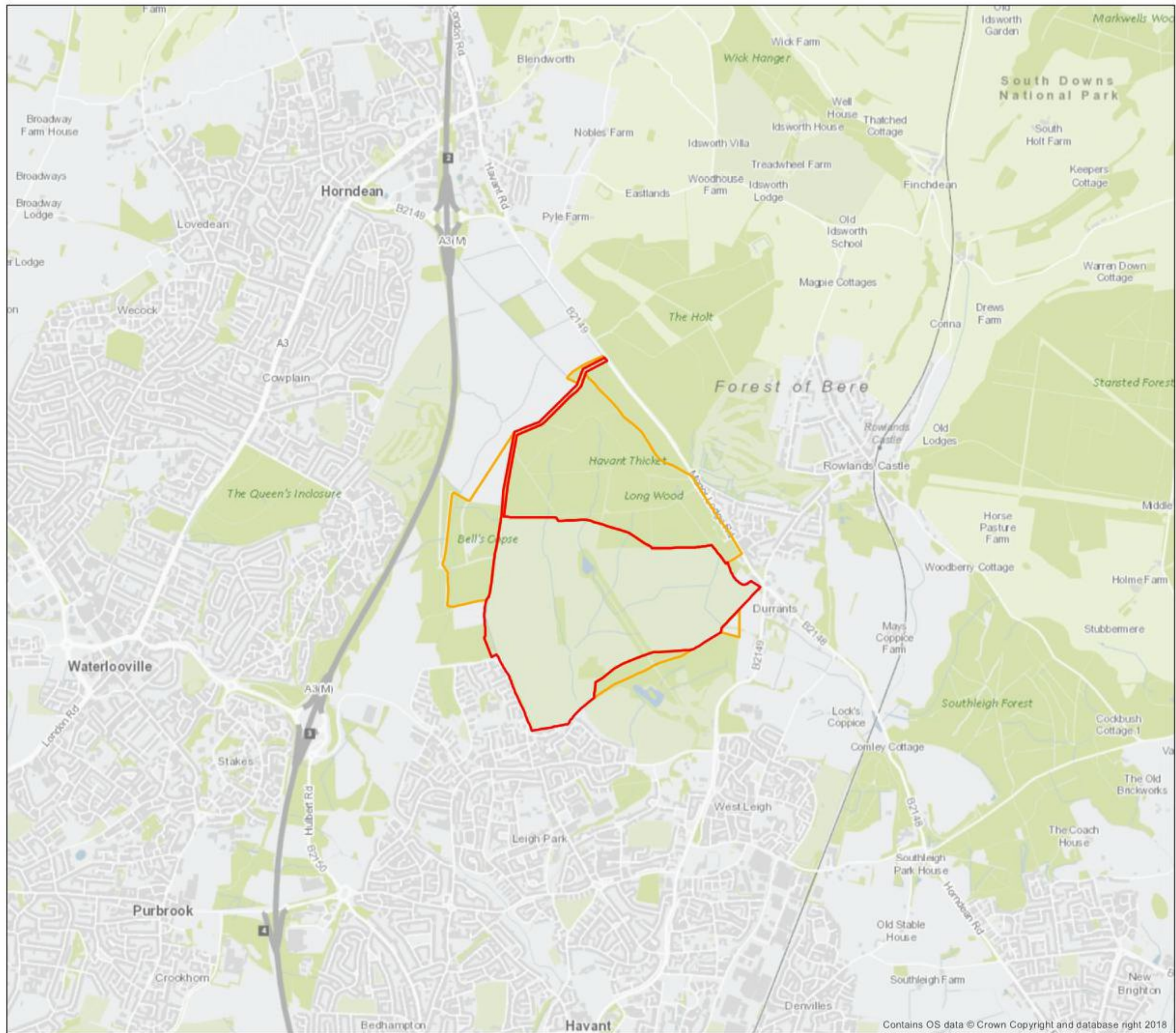
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Map L1

Site Location Plan



HAVANT THICKET WINTER STORAGE RESERVOIR

INVERTEBRATE ASSESSMENT

Map L1 - Site Location Plan

Client: Portsmouth Water

Date: December 2018

Status: Final

KEY

-  Site Boundary (the site)
-  Ecological Enhancement Area (wider site)

Scale at A3: 1:25,000

0 500 1,000 Metres



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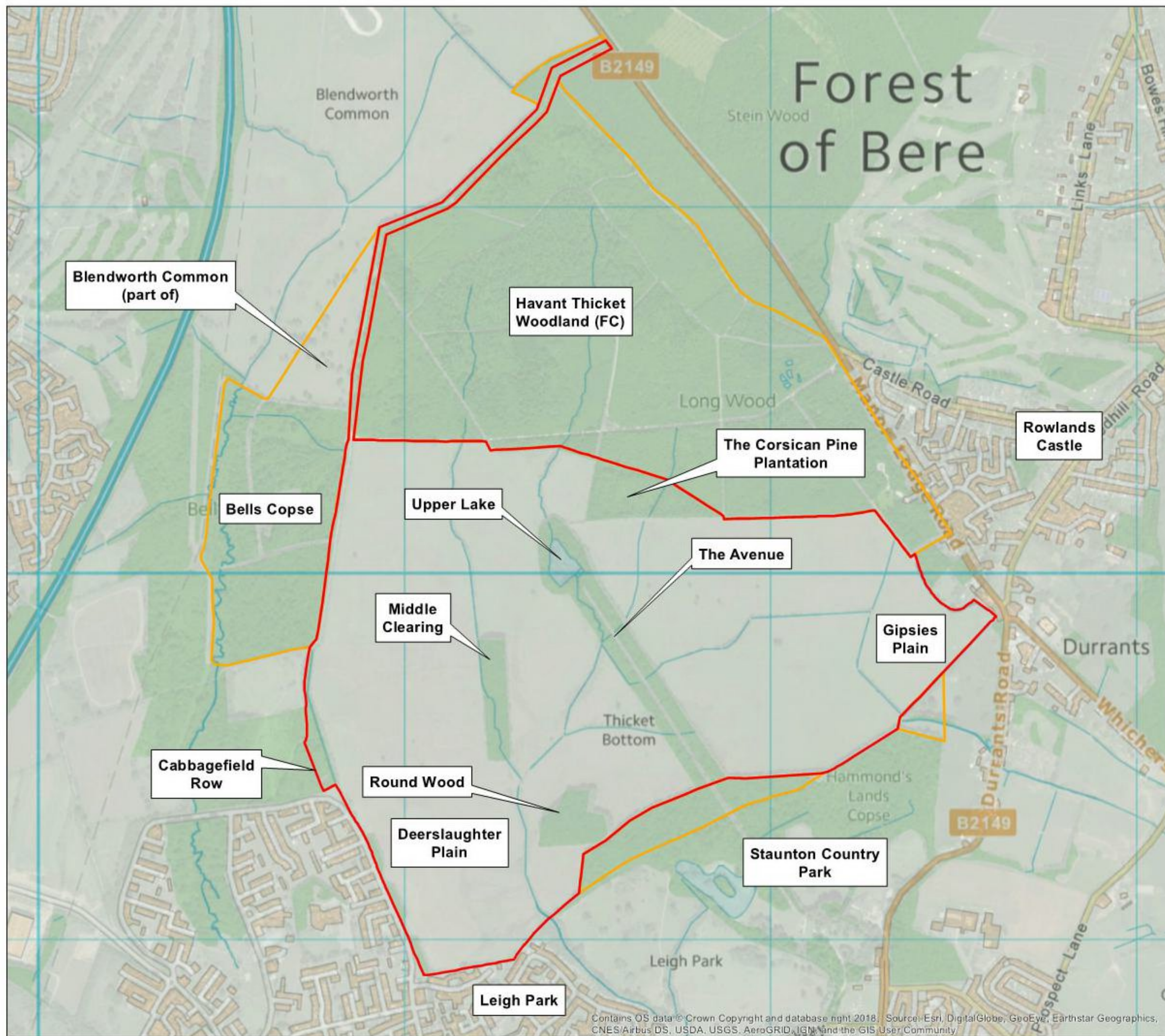
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Map L2

Key Site Features



HAVANT THICKET WINTER STORAGE RESERVOIR

INVERTEBRATE ASSESSMENT

Map L2 - Key Site Features

Client: Portsmouth Water

Date: March 2019

Status: Final

KEY

- Site Boundary (the site)
- Ecological Enhancement Area (wider site)

Scale at A3: 1:10,000

0 250 500 Metres



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Map L3 Invertebrate Desktop Study Data - HBIC

HAVANT THICKET WINTER STORAGE RESERVOIR

INVERTEBRATE ASSESSMENT

Map L3 - Invertebrate Desktop Study Data:
Hampshire Biodiversity Information Centre

Client: Portsmouth Water

Date: February 2019

Status: Final

KEY

-  Site Boundary (the site)
-  Ecological Enhancement Area (wider site)
-  Hampshire Biodiversity Information Centre (HBIC) Invertebrate Records

N.B. Hampshire Biodiversity Information Centre (HBIC) records shown on map are located within 100m x 100m resolution grid squares.

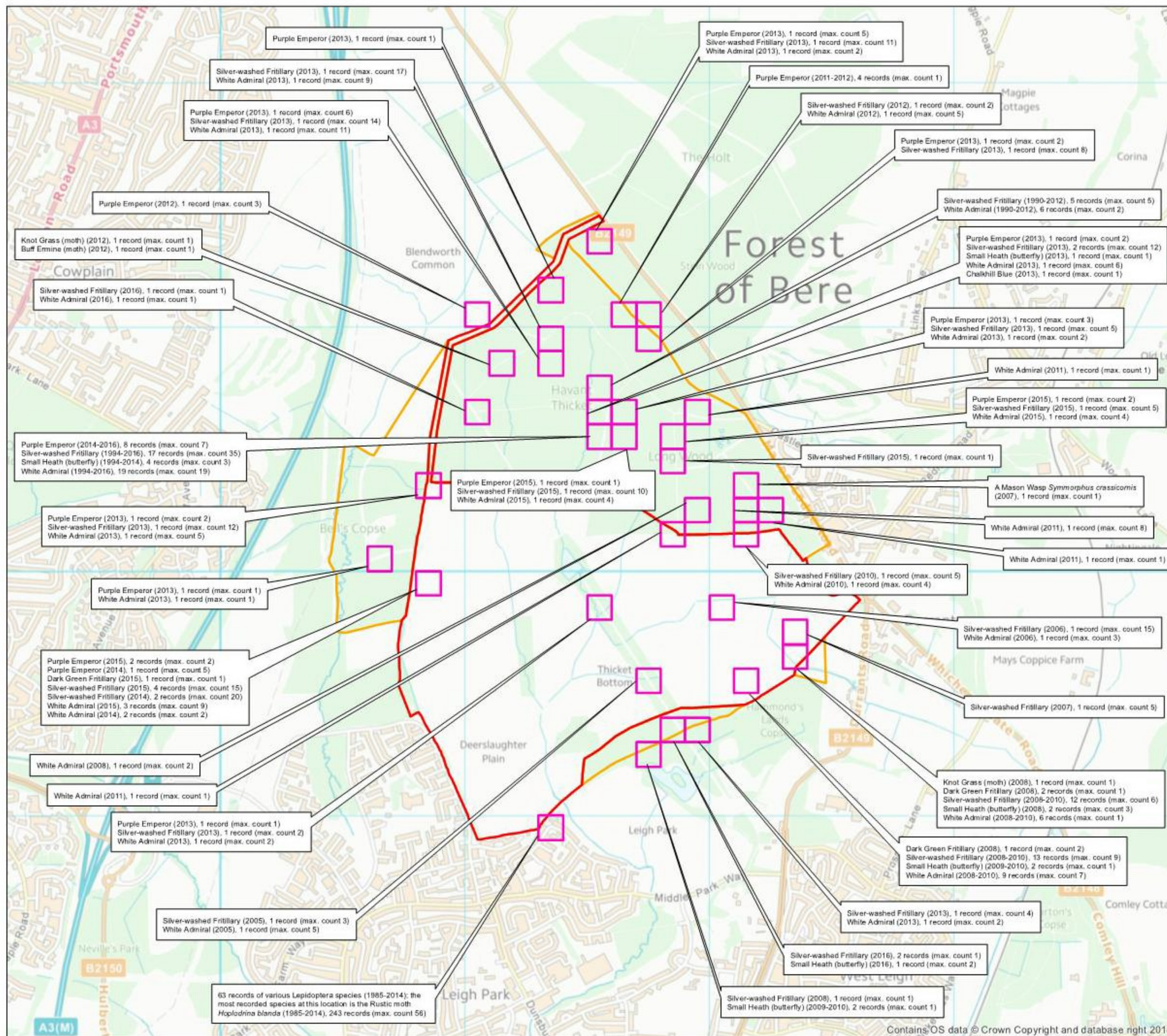
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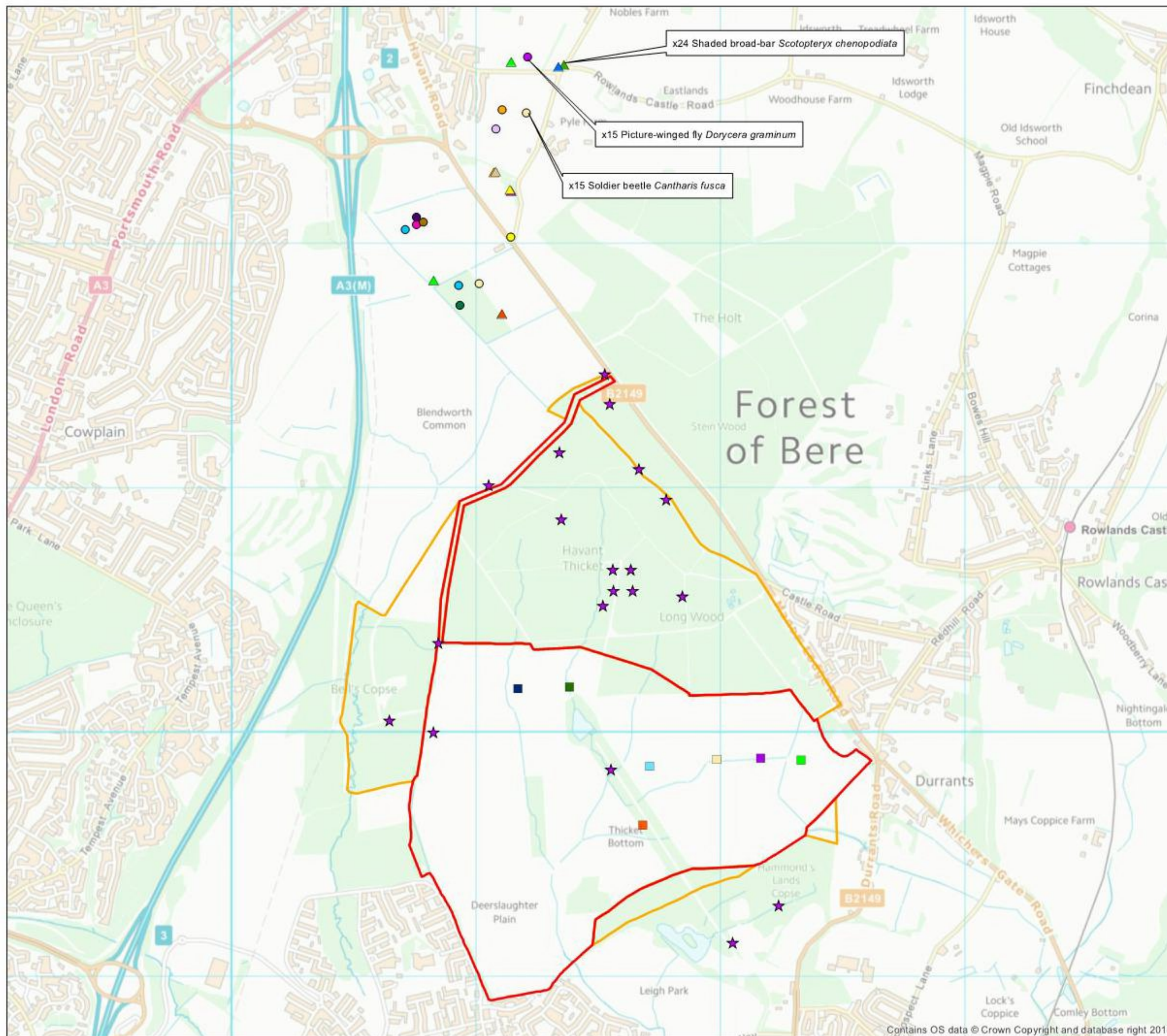
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Map L4 Invertebrate Desktop Study Data - Other Sources



HAVANT THICKET WINTER STORAGE RESERVOIR

INVERTEBRATE ASSESSMENT

Map L4 - Invertebrate Desktop Study Data:
Other Sources

Client: Portsmouth Water

Date: February 2019

Status: Final

KEY

- Site Boundary (the site)
- Ecological Enhancement Area (wider site)
- ★ Butterfly Conservation Purple Emperor Records (2018)
- WYG Notable Invertebrate Records (2014)**
 - ▲ Buff ermine, Spilosoma luteum
 - ▲ Cinnabar moth, Tyria jacobaeae
 - ▲ Dusky brocade, Apamea remissa
 - Dusky cockroach, Ectobius lapponicus
 - ▲ Dusky thorn, Ennomos fuscantaria
 - Jewel beetle, Agrilus laticornis
 - ▲ Large wainscot, Rhizodra lutos
 - Longhorn beetle, Leptura aurulenta
 - Picture-winged fly, Dorycera graminum
 - Picture-winged fly, Myopites inulaedysentericae
 - Picture-winged fly, Orellia falcata
 - Robberfly, Choerades marginatus
 - ▲ Rosy rustic, Hydraecia micacea
 - ▲ Shaded broad-bar, Scotopteryx chenopodiata
 - Small heath, Coenonympha pamphilus
 - Soldier beetle, Cantharis fusca
 - Weevil, Curculio villosus
 - ▲ White ermine, Spilosoma lubricipeda
- ECOSA Notable Invertebrate Records (2005)**
 - Club-horned wasp, Sapyga clavicornis
 - Hunch-backed fly, Ogcodes pallipes
 - Mining bee, Melitta tricincta
 - Picture-winged fly, Myopites inulaedysentericae
 - Silver-washed fritillary, Argynnis paphia
 - Tachinid fly, Gymnosoma rotundatum
 - Wasp spider, Argiope brueunichii

N.B. Mining bee *Lasioglossum malachurum* was also recorded on site during the 2005 survey; however, the location has not been identified. White admiral was also recorded along The Avenue but this has not been mapped.

Scale at A3: 1:15,000

0 200 400 800 Metres

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Map L5 Key Invertebrate Survey Areas 2018

HAVANT THICKET WINTER STORAGE RESERVOIR

INVERTEBRATE ASSESSMENT

Map L6 - Notable Species Records

Client:	Portsmouth Water
Date:	February 2019
Status:	Final

KEY

- Site Boundary (the site)
- Ecological Enhancement Area (wider site)

ECOSA Invertebrate Records 2018

- Alder leaf beetle, *Agelastica alni*
- Cinnabar moth, *Tyria jacobaeae*
- Dusky cockroach, *Ectobius lapponicus*
- Hoverfly, *Heringia (Neocnemodon) latitarsis*
- Mason wasp, *Symmorphus crassicornis*
- Mining bee, *Lasioglossum puncticolle*
- Picture-winged fly, *Campiglossa producta*
- Picture-winged fly, *Merzomyia westermanni*
- Picture-winged fly, *Myopites inulaedysentericae*
- Small heath, *Coenonympha pamphilus*
- Social wasp, *Dolichovespula media*
- Tachinid fly, *Gymnosoma rotundatum*
- Tumbling flower beetle, *Varimorda villosa*
- Wasp spider, *Argiope bruennichi*

N.B. White admiral and silver-washed fritillary were also recorded within Havant Thicket woodland; however, their locations are not mapped here.

Scale at A3: 1:6,500

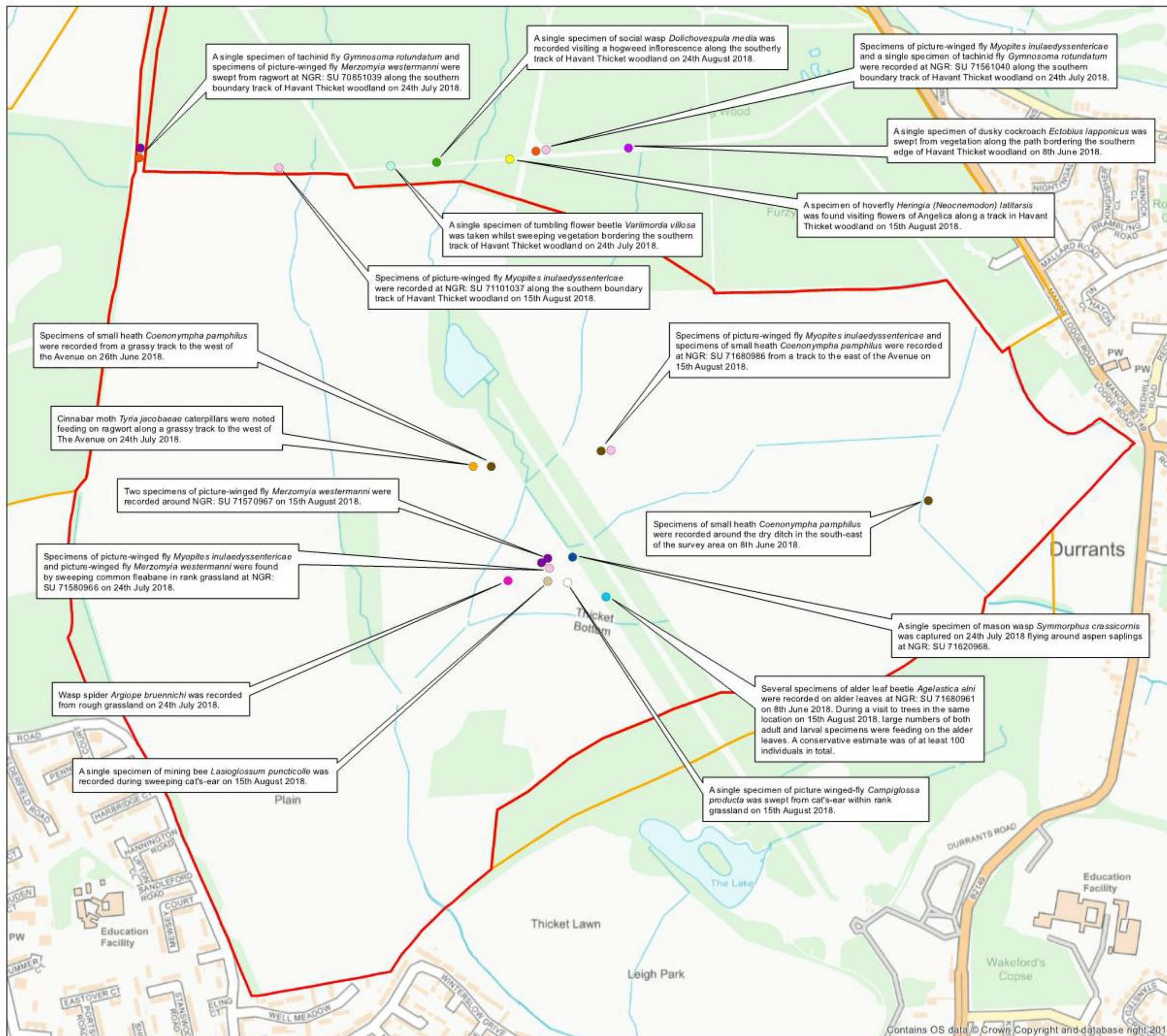
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Map L6 Location of Notable Species 2018

HAVANT THICKET WINTER STORAGE RESERVOIR

INVERTEBRATE ASSESSMENT

Map L6 - Notable Species Records

Client:	Portsmouth Water
Date:	February 2019
Status:	Final

KEY

- Site Boundary (the site)
- Ecological Enhancement Area (wider site)

ECOSA Invertebrate Records 2018

- Alder leaf beetle, *Agelastica alni*
- Cinnabar moth, *Tyria jacobaeae*
- Dusky cockroach, *Ectobius lapponicus*
- Hoverfly, *Heringia (Neocnemodon) latitarsis*
- Mason wasp, *Symmorphus crassicornis*
- Mining bee, *Lasioglossum puncticolle*
- Picture-winged fly, *Campiglossa producta*
- Picture-winged fly, *Merzomyia westermanni*
- Picture-winged fly, *Myopites inulaedysentericae*
- Small heath, *Coenonympha pamphilus*
- Social wasp, *Dolichovespula media*
- Tachinid fly, *Gymnosoma rotundatum*
- Tumbling flower beetle, *Varimorda villosa*
- Wasp spider, *Argiope bruennichi*

N.B. White admiral and silver-washed fritillary were also recorded within Havant Thicket woodland; however, their locations are not mapped here.

Scale at A3: 1:6,500

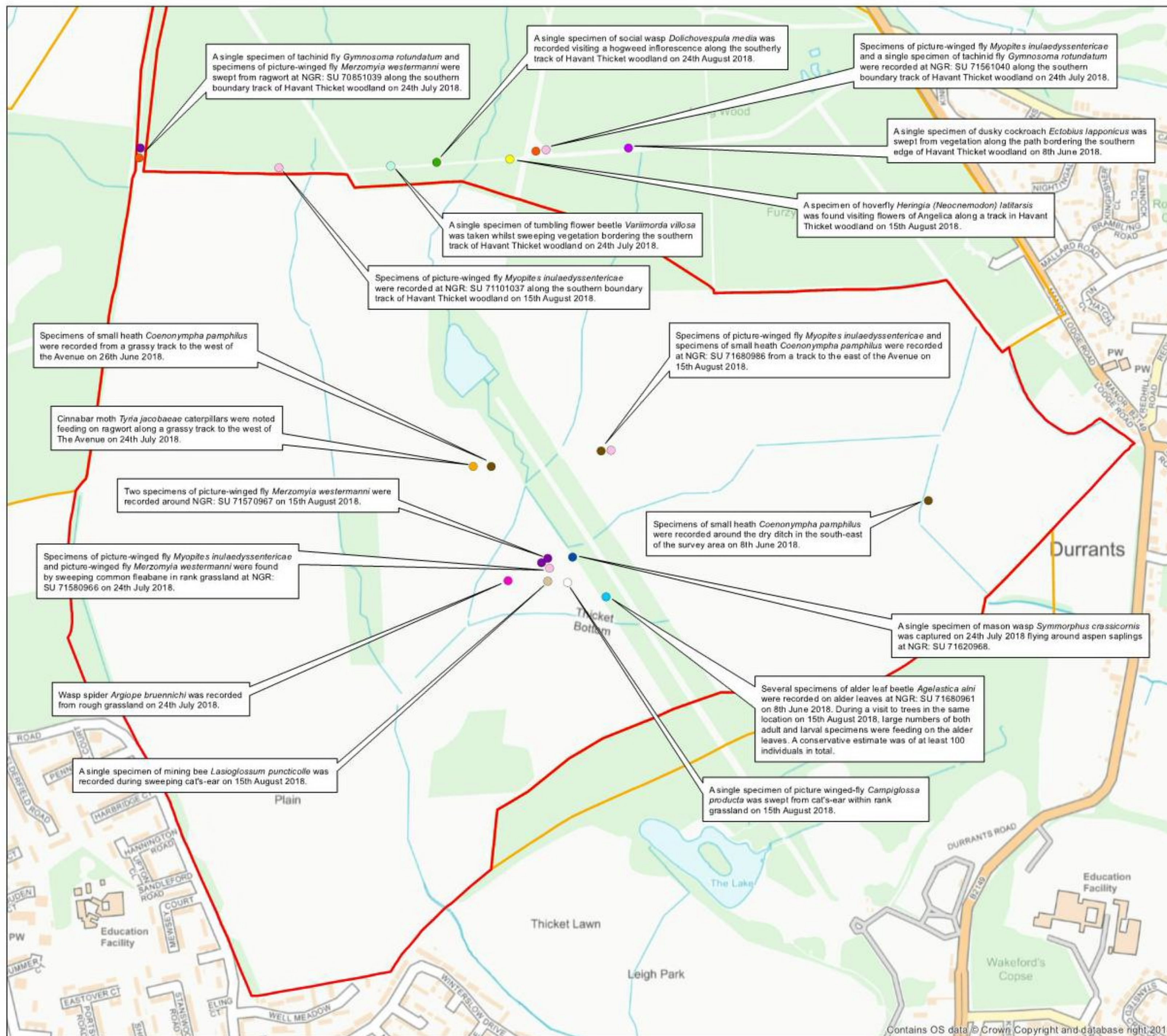
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Appendix L1 Notable Invertebrate Species Criteria for those Recorded During Survey and in the Desktop Study

Table L9: Notable Invertebrate Species Criteria

Species	Scientific Name	Group	S41 Species	Rare (RDB 3)	Nationally Scarce	Nationally Scarce A	Nationally Scarce B	Hampshire BAP	Data Deficient	County Interest	County Scarce	IUCN_GB_2001	Habitats Directive
Wasp spider	<i>Argiope bruennichi</i>	Arachnida (Spiders)					X						
A jewel beetle	<i>Agilus laticornis</i>	Coleoptera (Beetles)					X						
A longhorn beetle	<i>Leptura aurulenta</i>	Coleoptera (Beetles)				X							
A soldier beetle	<i>Cantharis fusca</i>	Coleoptera (Beetles)		X									
A tumbling flower beetle	<i>Variimorda villosa</i>	Coleoptera (Beetles)					X						
A weevil	<i>Curculio villosus</i>	Coleoptera (Beetles)					X						
Dusky cockroach	<i>Ectobius lapponicus</i>	Coleoptera (Beetles)					X						
Alder leaf beetle	<i>Agelastica alni</i>	Coleoptera (Beetles)							X				
A hoverfly	<i>Heringia latitarsis</i>	Diptera (Flies)			X								
A hunchbacked fly	<i>Ogcodes pallipes</i>	Diptera (Flies)											
A picture-winged fly	<i>Campiglossa producta</i>	Diptera (Flies)			X								
A picture-winged fly	<i>Dorycera graminum</i>	Diptera (Flies)	X	X									
A picture-winged fly	<i>Merzomyia westermanni</i>	Diptera (Flies)											
A picture-winged fly	<i>Myopites inulaedyssentericae</i>	Diptera (Flies)		X									
A picture-winged fly	<i>Orellia falcata</i>	Diptera (Flies)			X								
A robberfly	<i>Choerades marginatus</i>	Diptera (Flies)			X								
A tachinid fly	<i>Gymnosoma rotundatum</i>	Diptera (Flies)											
A bee	<i>Osmia bicolor</i>	Hymenoptera (Bees, Wasps and Ants)											
A mason wasp	<i>Symmorphus crassicornis</i>	Hymenoptera (Bees, Wasps and Ants)		X									
A mining bee	<i>Lasioglossum malachurum</i>	Hymenoptera (Bees, Wasps and Ants)											
A mining bee	<i>Lasioglossum puncticolle</i>	Hymenoptera (Bees, Wasps and Ants)					X						
A mining bee	<i>Melitta tricincta</i>	Hymenoptera (Bees, Wasps and Ants)											
Club-horned sapyga	<i>Sapyga clavicornis</i>	Hymenoptera (Bees, Wasps and Ants)											
A social wasp	<i>Dolichovespula media</i>	Hymenoptera (Bees, Wasps and Ants)				X							
Antler moth	<i>Cerapteryx graminis</i>	Lepidoptera (Butterflies and Moths)									X		
Buff ermine	<i>Spilosoma lutea</i>	Lepidoptera (Butterflies and Moths)	X										
Chalk hill blue	<i>Polyommatus coridon</i>	Lepidoptera (Butterflies and Moths)											
Cinnabar	<i>Tyria jacobaeae</i>	Lepidoptera (Butterflies and Moths)	X										
Dark green fritillary	<i>Argynnis aglaja</i>	Lepidoptera (Butterflies and Moths)									X		
Dark spectacle	<i>Abrostola triplasia</i>	Lepidoptera (Butterflies and Moths)									X		
Dusky brocade	<i>Apamea remissa</i>	Lepidoptera (Butterflies and Moths)	X										
Dusky thorn	<i>Ennomos fuscantaria</i>	Lepidoptera (Butterflies and Moths)	X										
Jersey tiger	<i>Euplagia quadripunctaria</i>	Lepidoptera (Butterflies and Moths)											Annex II - non-priority
Knot grass	<i>Acronicta rumicis</i>	Lepidoptera (Butterflies and Moths)	X										
Large wainscot	<i>Rhizedra lutosa</i>	Lepidoptera (Butterflies and Moths)	X										
Lesser-spotted pinion	<i>Cosmia affinis</i>	Lepidoptera (Butterflies and Moths)									X		
Orange footman	<i>Eilema sororcula</i>	Lepidoptera (Butterflies and Moths)						X					
Poplar kitten	<i>Furcula bifida</i>	Lepidoptera (Butterflies and Moths)									X		
Purple emperor	<i>Apatura iris</i>	Lepidoptera (Butterflies and Moths)						X			X	Near-threatened	
Reddish light arches	<i>Apamea sublustris</i>	Lepidoptera (Butterflies and Moths)									X		
Red-necked footman	<i>Atolmis rubricollis</i>	Lepidoptera (Butterflies and Moths)									X		
Rosy rustic	<i>Hydraecia micacea</i>	Lepidoptera (Butterflies and Moths)	X										

Species	Scientific Name	Group	S41 Species	Rare (RDB 3)	Nationally Scarce	Nationally Scarce A	Nationally Scarce B	Hampshire BAP	Data Deficient	County Interest	County Scarce	IUCN_GB_2001	Habitats Directive
Saltern ear	<i>Amphipoea fucosa</i>	Lepidoptera (Butterflies and Moths)									X		
Shaded broad-bar	<i>Scotopteryx chenopodiata</i>	Lepidoptera (Butterflies and Moths)	X										
Silver-washed fritillary	<i>Argynnis paphia</i>	Lepidoptera (Butterflies and Moths)						X		X			
Small clouded brindle	<i>Apamea unanimitis</i>	Lepidoptera (Butterflies and Moths)									X		
Small heath	<i>Coenonympha pamphilus</i>	Lepidoptera (Butterflies and Moths)	X									Near-threatened	
Small phoenix	<i>Ecliptopera silaceata</i>	Lepidoptera (Butterflies and Moths)	X										
Tawny shears	<i>Hadena perplexa</i>	Lepidoptera (Butterflies and Moths)									X		
The festoon	<i>Apoda limacodes</i>	Lepidoptera (Butterflies and Moths)						X					
White admiral	<i>Limenitis camilla</i>	Lepidoptera (Butterflies and Moths)	X									Vulnerable	
White ermine	<i>Spilosoma lubricipeda</i>	Lepidoptera (Butterflies and Moths)	X										
Brown-spot pinion	<i>Agrochola litura</i>	Lepidoptera (Butterflies and Moths)	X										
Beaded chestnut	<i>Agrochola lychnidis</i>	Lepidoptera (Butterflies and Moths)	X										
Green-brindled crescent	<i>Allophyas oxyacanthae</i>	Lepidoptera (Butterflies and Moths)	X										
Ear moth	<i>Amphipoea ocella</i>	Lepidoptera (Butterflies and Moths)	X										
Mouse moth	<i>Amphipyra tragopoginis</i>	Lepidoptera (Butterflies and Moths)	X										
Garden tiger	<i>Arctia caja</i>	Lepidoptera (Butterflies and Moths)	X										
Minor shoulder-knot	<i>Brachylomia viminalis</i>	Lepidoptera (Butterflies and Moths)	X										
Bulrush veneer	<i>Calamotropha paludella</i>	Lepidoptera (Butterflies and Moths)			X								
Mottled rustic	<i>Caradrina morpheus</i>	Lepidoptera (Butterflies and Moths)	X										
Sallow	<i>Cirrhia icteritia</i>	Lepidoptera (Butterflies and Moths)	X										
Striped lychnis	<i>Cucullia lychnitis</i>	Lepidoptera (Butterflies and Moths)	X					X					
Small square-spot	<i>Diarsia rubi</i>	Lepidoptera (Butterflies and Moths)	X										
September thorn	<i>Ennomos erosaria</i>	Lepidoptera (Butterflies and Moths)	X										
Spinach	<i>Eulithis mellinata</i>	Lepidoptera (Butterflies and Moths)	X										
White-lined dart	<i>Euxoa tritici</i>	Lepidoptera (Butterflies and Moths)	X								X		
Crescent	<i>Helotropha leucostigma</i>	Lepidoptera (Butterflies and Moths)	X								X		
Small emerald	<i>Hemistola chrysoprasaria</i>	Lepidoptera (Butterflies and Moths)	X										
Rustic	<i>Hoplodrina blanda</i>	Lepidoptera (Butterflies and Moths)	X										
Dog's tooth	<i>Lacanobia suasa</i>	Lepidoptera (Butterflies and Moths)									X		
Shoulder-striped wainscot	<i>Leucania comma</i>	Lepidoptera (Butterflies and Moths)	X										
Rosy minor	<i>Litologia literosa</i>	Lepidoptera (Butterflies and Moths)	X										
Brindled beauty	<i>Lycia hirtaria</i>	Lepidoptera (Butterflies and Moths)	X										
Lackey	<i>Malacosoma neustria</i>	Lepidoptera (Butterflies and Moths)	X										
Dot moth	<i>Melanchra persicariae</i>	Lepidoptera (Butterflies and Moths)	X										
Marbled green	<i>Nyctobrya muralis</i>	Lepidoptera (Butterflies and Moths)									X		
Powdered Quaker	<i>Orthosia gracilis</i>	Lepidoptera (Butterflies and Moths)	X										
Gold spot	<i>Plusia festucae</i>	Lepidoptera (Butterflies and Moths)									X		
Mullein wave	<i>Scopula marginipunctata</i>	Lepidoptera (Butterflies and Moths)	X										
White ermine	<i>Spilosoma lubricipeda</i>	Lepidoptera (Butterflies and Moths)	X										
Hedge rustic	<i>Tholera cespitis</i>	Lepidoptera (Butterflies and Moths)	X								X		
Feathered gothic	<i>Tholera decimalis</i>	Lepidoptera (Butterflies and Moths)	X										
Blood-vein	<i>Timandra comae</i>	Lepidoptera (Butterflies and Moths)	X										
Oak hook-tip	<i>Watsonalla binaria</i>	Lepidoptera (Butterflies and Moths)	X										
Dark-barred twin-spot carpet	<i>Xanthorhoe ferrugata</i>	Lepidoptera (Butterflies and Moths)	X										

Appendix L2 ARUP Aquatic Invertebrate Survey Report

Portsmouth Water

**Havant Thicket Winter
Storage Reservoir**

River Habitat Surveys &
Invertebrate Survey
Report

DRAFT 1

HTWSR Handover

ARUP

Environmental Handover Report
Appendix D – Skeleton ES Report

**Appendix G – River Habitat Surveys &
Invertebrate Survey Report**

(ARUP_ENV_D[R]_EIA_RHS_012_V2.pdf)

Portsmouth Water

**Havant Thicket Winter
Storage Reservoir**

**River Habitat Surveys &
Invertebrate Survey
Report**

June 2009

Draft

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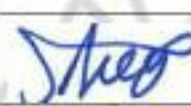
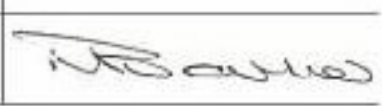
This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

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Document title	River Habitat Surveys and Invert Survey Report	File reference
		0-12-8

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1 Introduction

Arup has been commissioned by Portsmouth Water to undertake River Habitat Surveys (RHS) and macro-invertebrate surveys as part of the collection of baseline data for the Environmental Statement for the proposed Havant Thicket Winter Storage Reservoir.

The information gathered during the surveys will provide baseline data of the ecology, habitat and water quality of the streams impacted by the proposed reservoir.

Figure 1 depicts the study area. The water courses included in the surveys are Park Lane Stream, Riders Lane Stream, unnamed streams draining the Havant Thicket plantation, streams draining the proposed reservoir site and the Hermitage Stream. The watercourses form part of the Hermitage Catchment (with an approximate area of 19 km²).

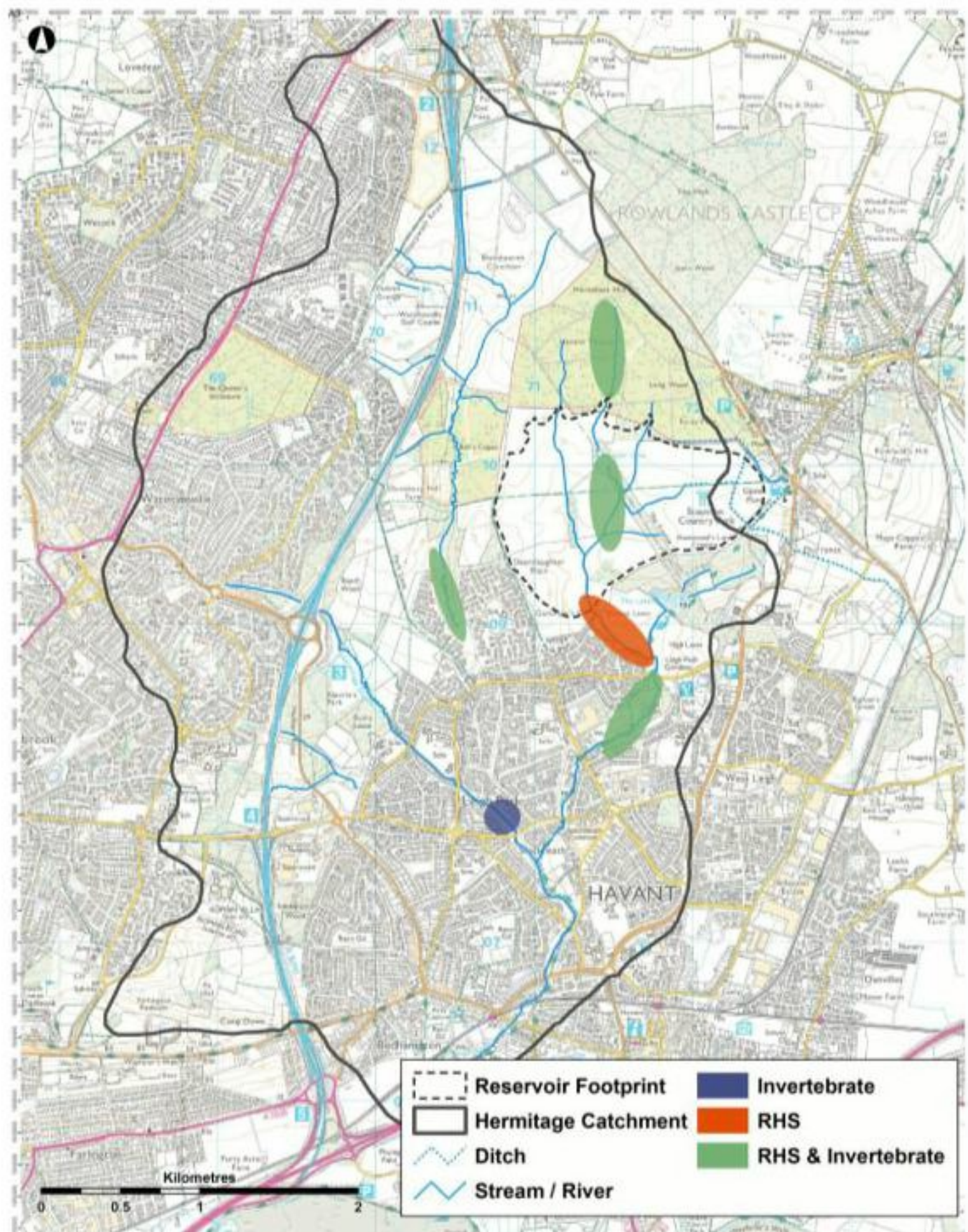


Figure 1: Location map of study area and sample sites

The figure shows the locations where the surveys were undertaken. Physical habitats will be lost and / or altered as a result of the reservoir development and it is important to understand the current situation in context of the proposals. A key requirement of environmental impact assessment (EIA) is to determine the current value of a site and predict the ecological changes that could be caused during and after proposed works. Establishing a baseline that can be used to assist in 'before and after' appraisals of physical alterations to the environment are therefore important. HQA and HMS scores can be used to assist this process.

The report is divided into two sections, the first focussing on the River Habitat Surveys and the second on the Invertebrate surveys.

2 River Habitat Surveys

River Habitat Survey is a method designed to characterise and assess, in broad terms, the physical structure of freshwater streams and rivers. River habitats are important because they form part of the landscape, play a significant role in many human activities and can support a rich variety of wildlife (Raven *et al.*, 1998). The RHS methodology enables qualitative and quantitative data on river hydromorphology, geomorphology, habitat and land use to be collected at several different scales in a structured and repeatable fashion. The data collected are used to calculate Habitat Quality Assessment (HQA) and Habitat Modification Score (HMS) indices.

2.1 Methodology

The RHS standard methodology was used to collect the data (see Figure 2). A survey stretch is 500m in length with bank and channel features recorded at 10 spot-checks, spaced every 50m. At each of the spot-check locations, physical features (e.g. flow type, substrate type, and channel / bank modifications), land use and channel vegetation types are recorded. Along the 500m stretch additional characteristics are recorded, i.e. land use, bank profile, extent of trees, extent of channel features (e.g. riffles, pools, bars), channel dimensions (at a representative point along the 500m stretch), features of special interest and evidence of recent management.

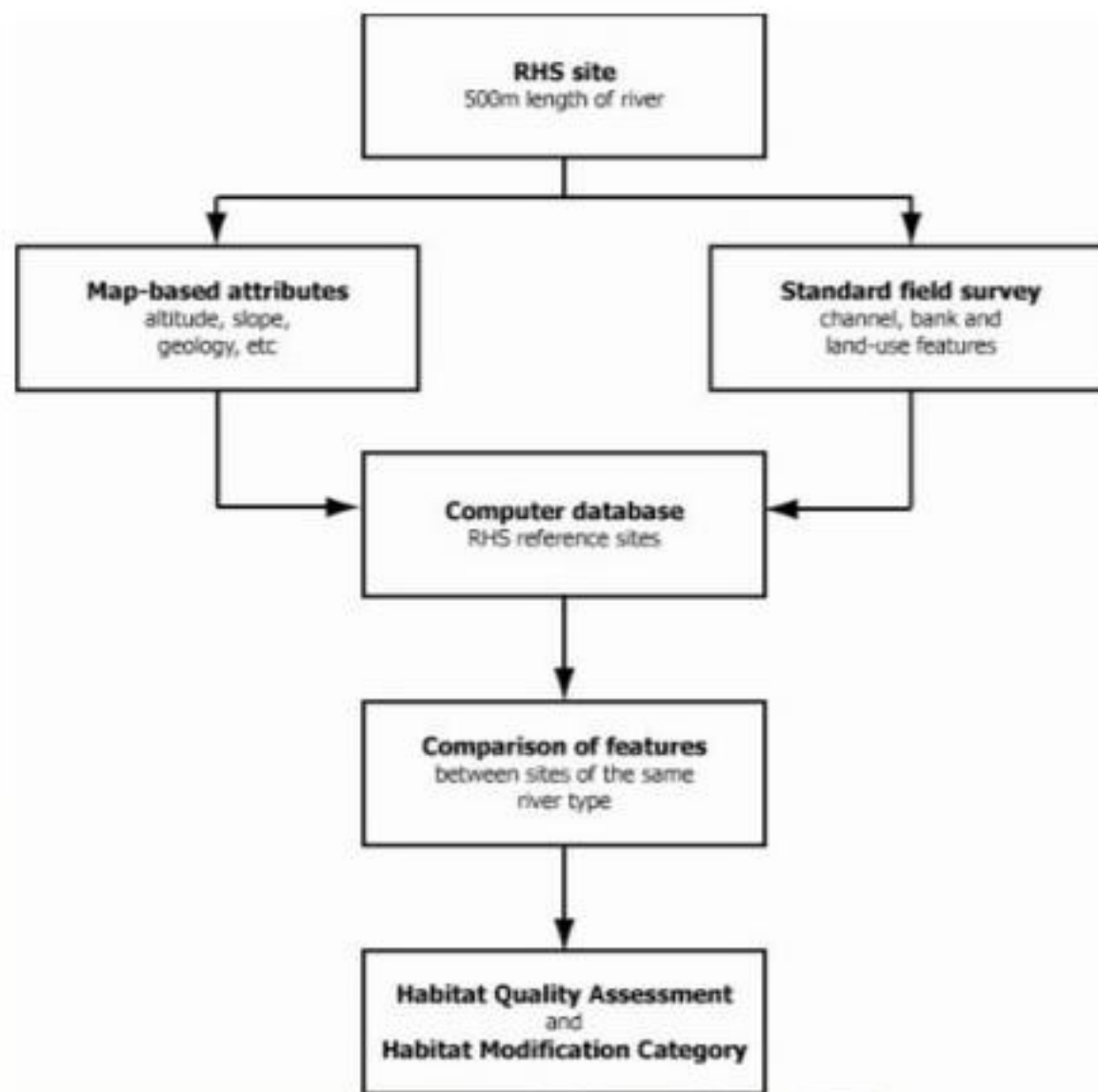


Figure 2: RHS methodology (Raven *et al.*, 1998)

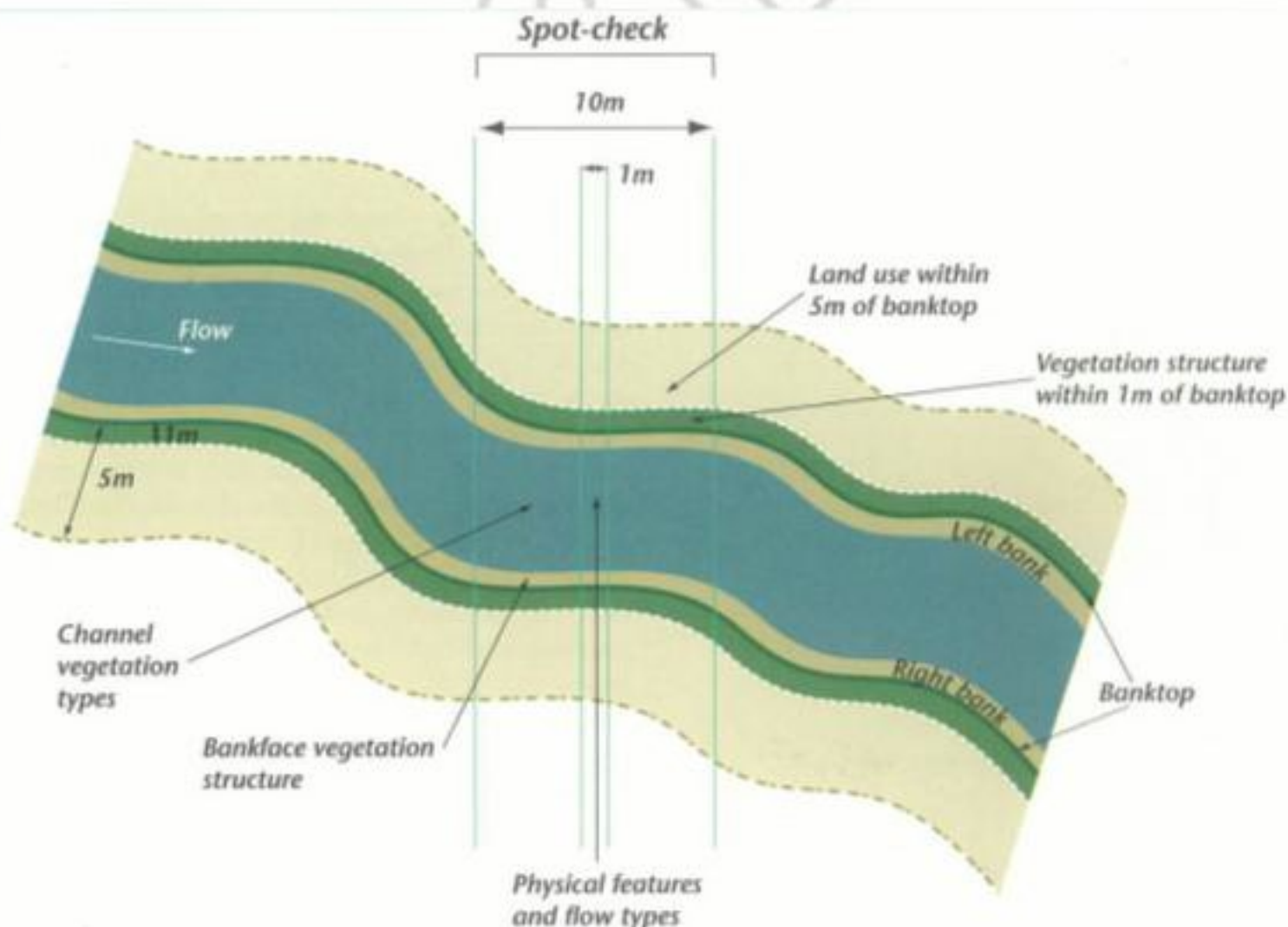


Figure 3: Features recorded at RHS spot checks (Raven *et al.*, 1998)

Before the field based part of the surveys started, a desk top exercise was undertaken to gather any relevant data that could be of use during the survey or write-up stage. Any information from previous baseline surveys was requested from the Environment Agency (EA). The 1:10,000 Ordnance Survey maps were studied to establish representative survey

areas to complement the geomorphology and invertebrate surveys. Historical maps of the area were also studied to get an understanding of the changes to the riverine environment in the last 150 years.

Overall, five sites within the study area were visited (Figure 3 shows the reaches surveyed). These reaches were chosen to mostly coincide with the survey areas for the invertebrate surveys (see Section 3). Initially it was planned to survey the section of the Hermitage Stream that was restored during 1998/99, however after the geomorphology surveys undertaken in June 2008, it was decided that it will not be necessary to conduct a RHS on this stretch, due to its uniformity and lack of variability in stream flow. However, the characteristics of this stretch will be discussed in Section 3 and is also elaborated on in Section 3 of the Baseline Geomorphology Assessment report.

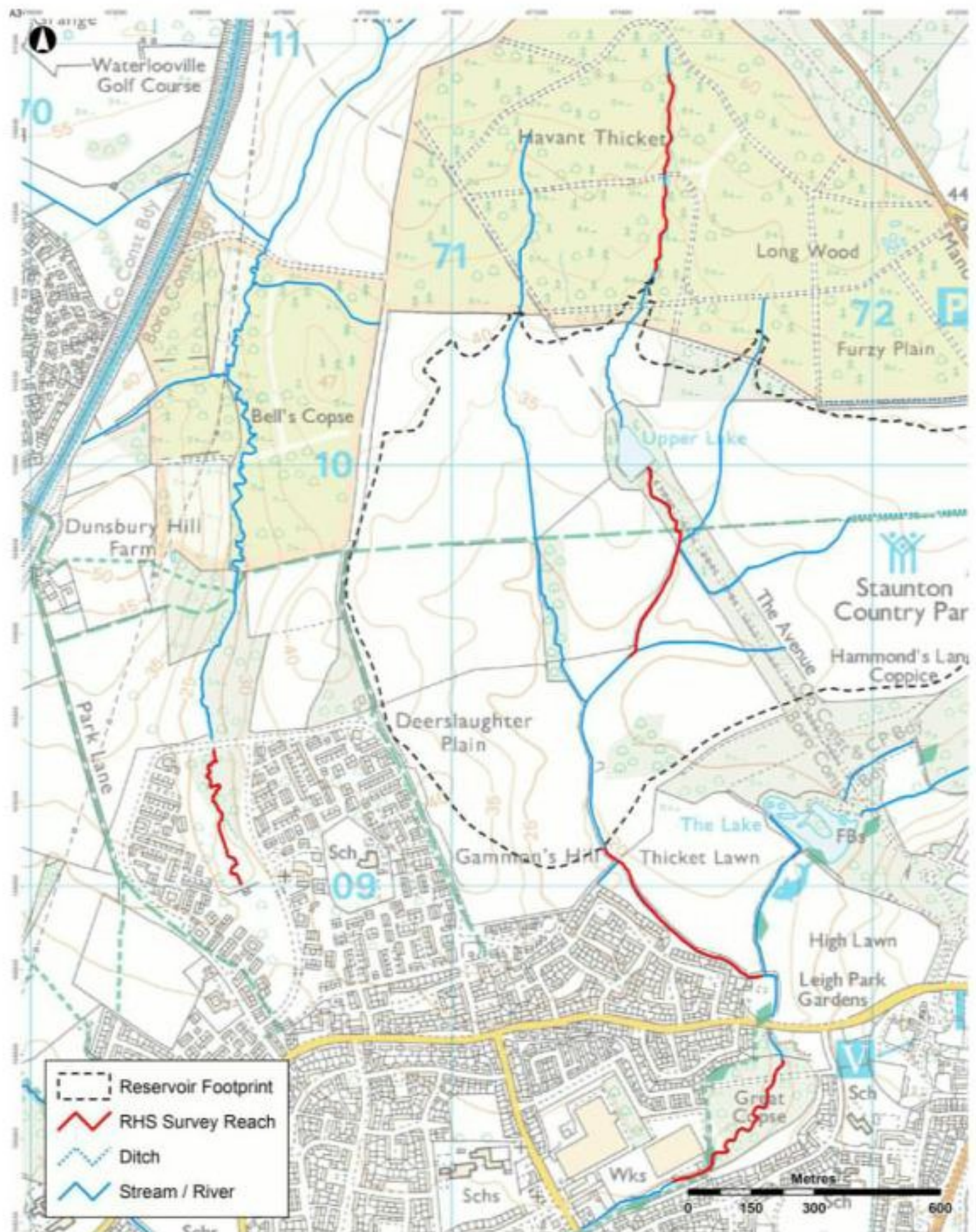


Figure 4: 500m stream reach sections for River Habitat Survey

Once the data was captured in an Excel spreadsheet, the morphological variability / degradation and habitat diversity and quality was calculated using the Habitat Quality Assessment (HQA) and Habitat Modification Score (HMS) indices. The HQA index incorporates a variety of measures to assess habitat quality, e.g. the number of different flow types, channel substrate and deposition features. The HMS index quantifies the extent and impact of anthropogenic modifications such as bank reinforcement, channel re-sectioning, culverts and the number of weirs (Szozkiewicz *et al.*, 2006).

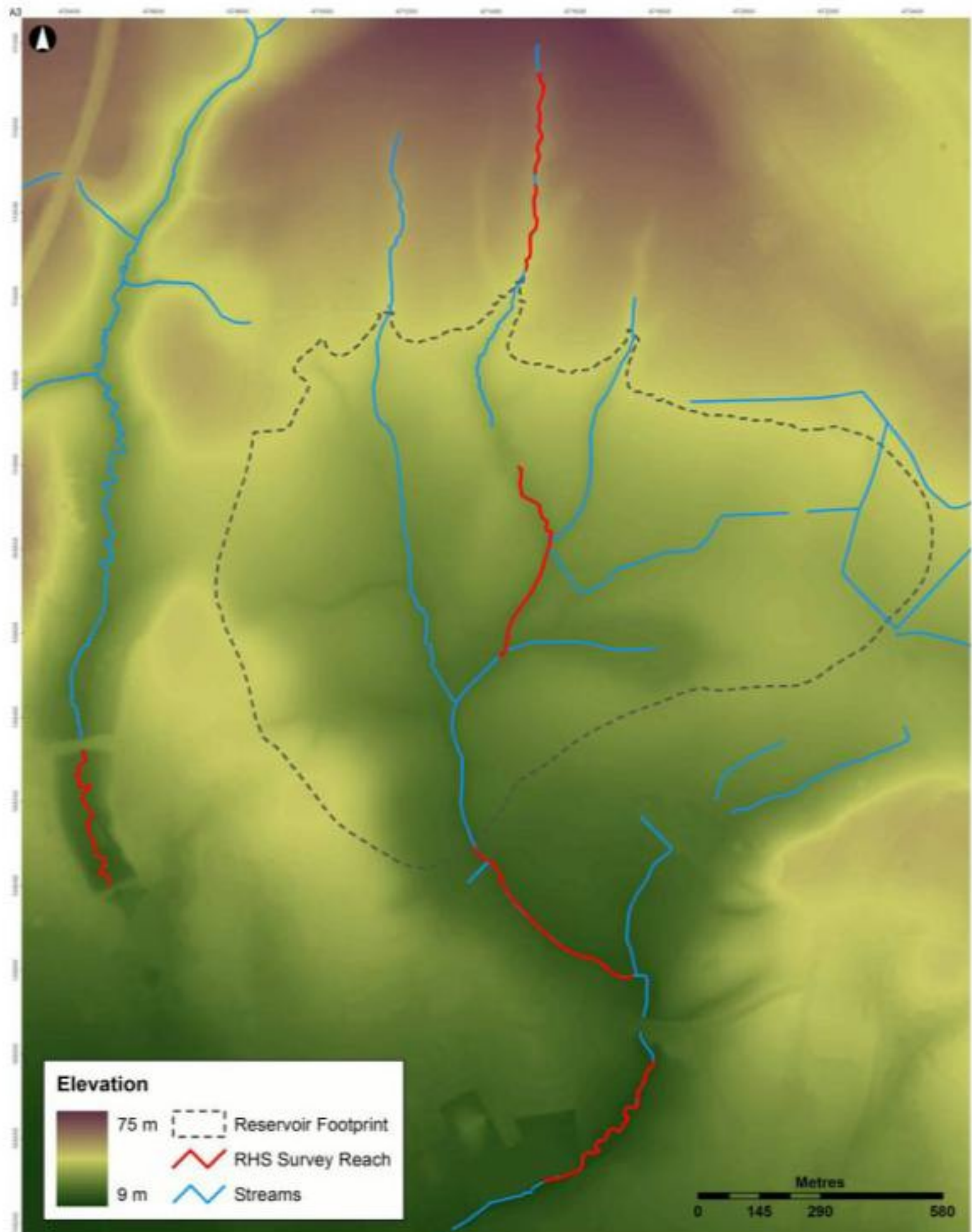


Figure 5: Topography of RHS survey reaches

The surveys were undertaken during July and October 2008 (the RHS survey season is between April and October).

2.2 RHS reference sites

To establish a geographically representative baseline sample of river habitat features, the Environment Agency (EA) commissioned baseline surveys to be undertaken during 1995/96 and again during 2007/08. A network of reference sites based on a stratified random sample of those rivers classified for water quality purposes was chosen and surveyed. This information is recorded in a database and managed by the RHS team in the EA (Raven *et al.*, 1998).

During the desktop phase of the project, data received from the EA relating to two surveys undertaken during the baseline survey of 1995 was studied. These sites were slightly outside of the study area for this project, but nevertheless provide information of the condition of streams close to the survey area which are of similar characteristics (Figure 3).

The HMS Class for these were 4 (Site 1) and 3 (Site 2), which are described as "Significantly modified" and "Obviously modified" respectively.

2.3 Riders Lane Stream – Great Copse

The section of Riders Lane Stream flowing through the Great Copse was surveyed during July 2008. This reach of the stream is relatively sinuous within an asymmetrical valley form with no distinct valley bottom. No obvious natural terraces exist within the surveyed section. The elevation of the stream course within the surveyed section drops from approximately 15 m above sea level to 14 m. The plan form of the stream has not changed significantly from the historic situation in 1869 (see Figure 4) and the land use is also still very similar for the majority of the reach length. The only significant change is on the last 90 m of the section, where the woodland has been replaced by light industrial and urban development largely between 1963 and 1975.

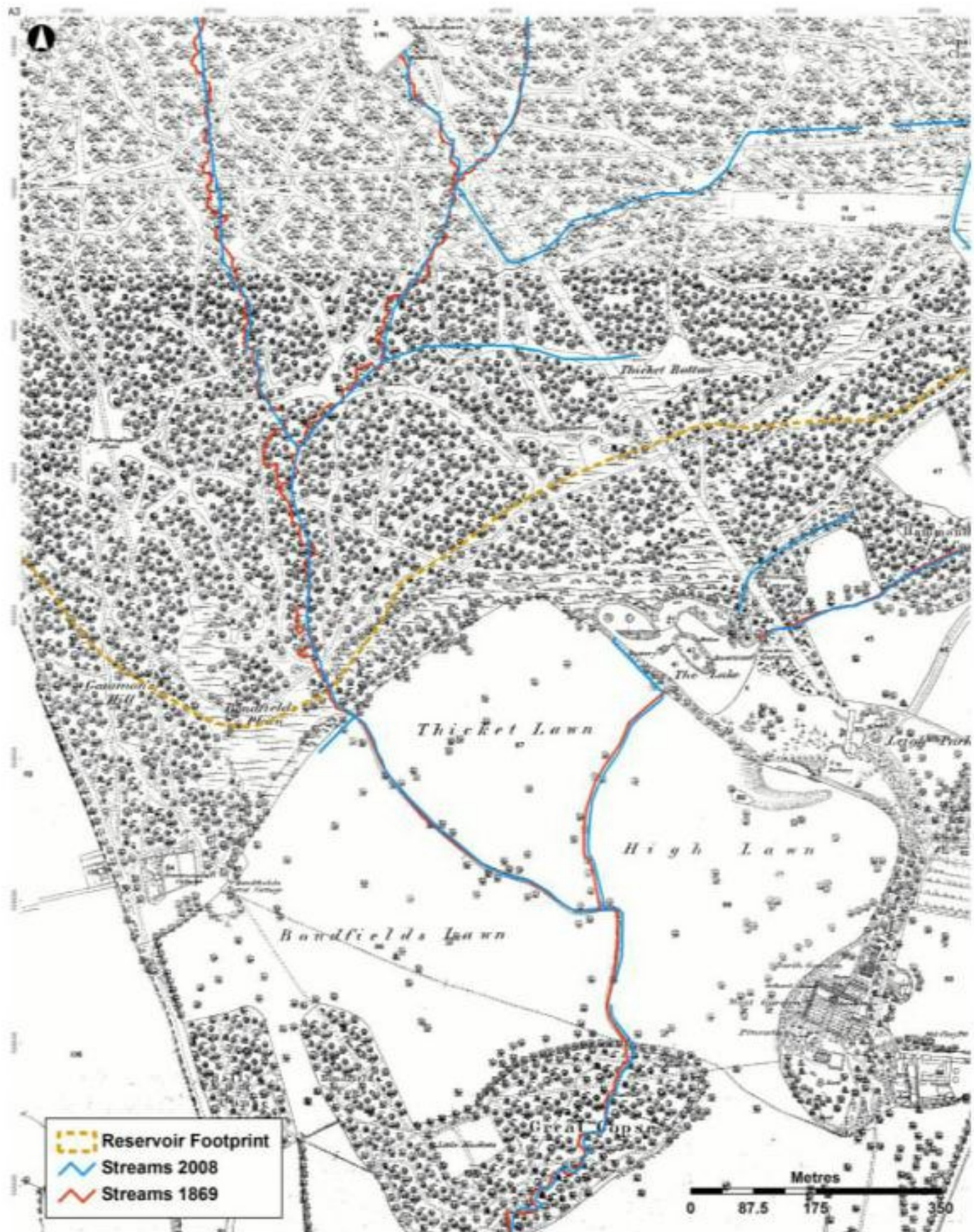


Figure 6: Historical map of proposed reservoir site

The reach has a number of riffles, pools and evidence of active deposition in the form of un-vegetated point bars and an extensive number of un-vegetated side bars. The stream is highly ephemeral and evidence of flash flood events is present. This will have a significant impact on the natural ecology of stream.

The substrate of the reach is mainly gravel / pebble with heavy silt deposits in places. There is evidence of re-sectioning on both the left and right banks and vertical bank profiles are also extensive. The bank full width of the channel is on average almost twice that of the low flow channel (2.1 m vs. 1.2 m at sample point) with a water depth of 0.25 m. Over-deepening of the channel is visible in various locations.

Major and minor culverts are present within the survey reach as well as a major and a minor foot bridge. These areas have been re-sectioned and are reinforced. Vertical undercutting also occurs in a number of places.



Photo 1: Major culvert & dumping in Riders Lane

The flow types represented in the reach are minimal, although extensive rippled flow is present. Other flow types are smooth flow, no perceptible flow. Limited marginal deadwater areas were present. The bank side features include eroding and stable cliff features.

The channel is extensively shaded, with a number of overhanging bows, exposed bankside roots and extensive large woody debris, including fallen trees. However, the stream runs through a wooded area that is surrounded by urban (residential) development and is impacted by road run-off, litter and tipping. The channel is nowhere completely choked. No obvious nuisance plants were identified and no alders were present either.

2.4 Riders Lane Stream – north of Great Copse

The reach of the Riders Lane Stream to the north of Great Copse, crossing Thicket Lawn, was surveyed in October 2008. The left bank floodplain of this reach is undeveloped, but the right bank (previously known as Bondfields Lawn) has been developed since the 1930s.

The predominant valley form is a shallow vee with no distinct valley bottom or natural terraces. The elevation drops gently from approximately 18 m above sea level to 15 m. The reach also has a significant number of riffles and pools. The reach has a couple of intermediate deflectors as well as two outfalls draining from the residential area to the southwest. The banks on these sections are therefore reinforced. Sections bordered by grassland experience poaching.



Photo 2: Un-vegetated side bars & riffles

The bank material is mainly clay with a gravel / pebble substrate. Evidence of erosion and deposition is visible. Bar deposition is common and vegetated and un-vegetated point bars are present as well as an extensive number of un-vegetated side bars. Vegetated side bars are less common, but nonetheless present.

Submerged linear-leaved vegetation was found at the start of the survey, but no further locations of in-stream channel vegetation were recorded. There are areas with overhanging bows and the channel is shaded in certain locations. Exposed bankside roots and underwater tree roots are also found. Extensive dams of large woody debris are found with a number of fallen trees in the channel. Land use within 50m of the site is dominated by broadleaved trees, residential and parkland with scrub and improved grassland present as well.

The flow types recorded range from chute flow, unbroken standing waves, rippled flow and smooth flow. The bank full width of the channel is in places five times the low flow channel width (6 m vs. 1.2 m at sample point), however this is not the case all along the channel. The water depth at the sample point was 0.05 m.

Due to the close presence of housing, tipping and strewn litter is present on various locations along and inside the channel (Photo 3). Evidence of flash flooding is present and silting has also been recorded.



Photo 3: Strewn litter on bank & motorcycle in stream course

Vertical undercutting and vertical undercutting with a toe is present in a number of places on both banks, as well as gentle slopes. There is one side channel flowing into the stream at the beginning of the survey reach. Other features of interest are debris dams, leafy debris and marshy areas along various sections on the reach. The channel is nowhere completely choked, the downstream end of the channel is heavily overgrown and difficult to access. No nuisance species were identified during the survey. Alders were also not present.

2.5 Park Lane Stream

Park Lane Stream was surveyed in July 2008. This section was included in the survey because the spillway for emergency flooding was planned to flow down this watercourse. The design and location of the spillway has since changed, however the analysis for the Park Lane Stream is included in this report for completeness and also to give an overall indication of habitat quality and modification for the study area. All 10 spot checks were not completed because the stream is culverted and a weir structure is located at the end of Spot Check 9 (Photo 4).

The stream is located in a deep vee valley with no distinct valley bottom or natural terraces. The elevation of the survey reach drops from approximately 28 m above sea level to 19 m. The land use surrounding the area has changed significantly since the 1860s, when the area was dominated by farm land and woodland. The current land use within a 50m radius of the stream is predominantly residential, with woodland along the edges of the watercourse.

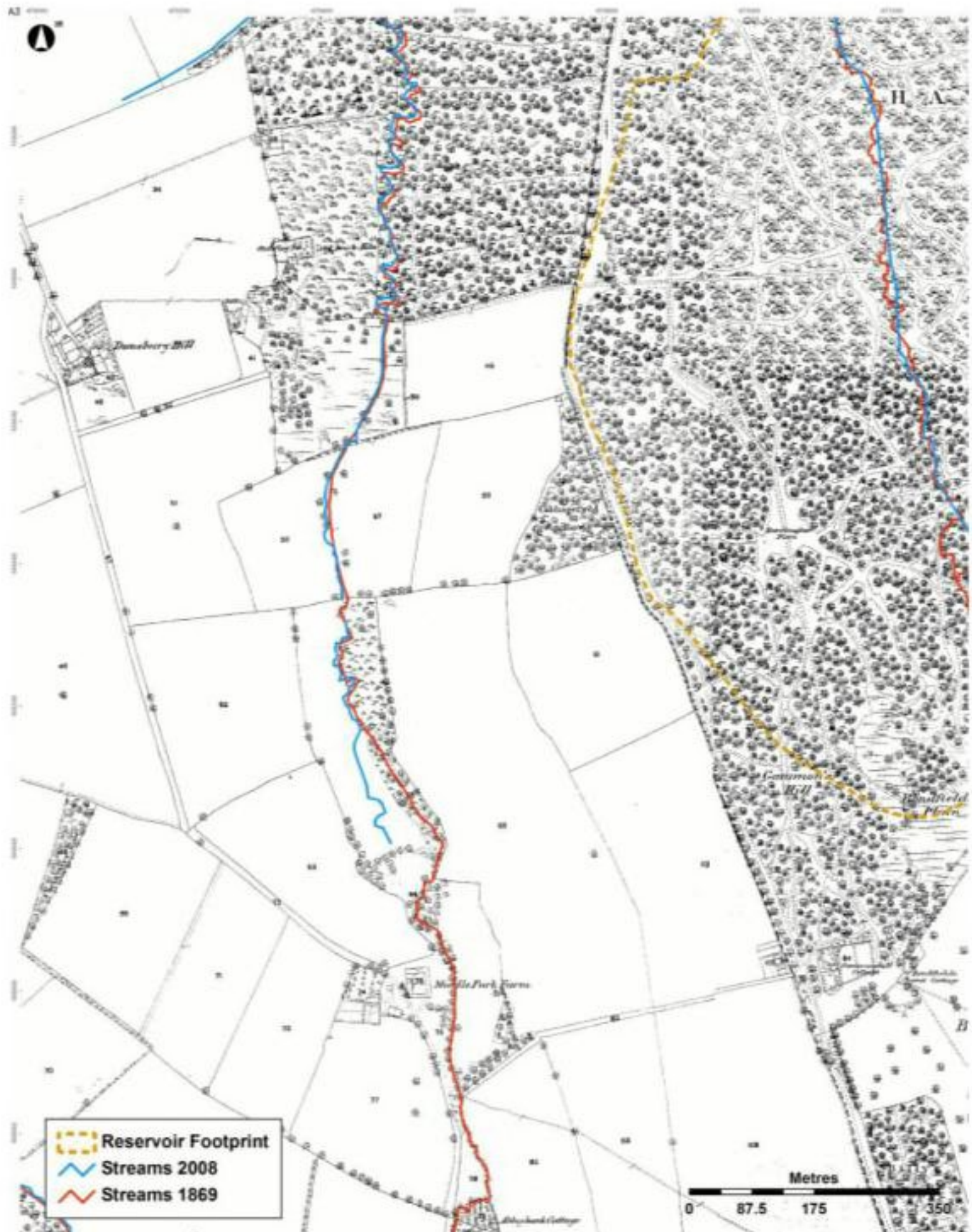


Figure 7: Historical map of Park Lane Stream

Intermittent riffles and pools are found along the stream reach with a number of un-vegetated point bars as well as side bars present. Vertical undercutting is found on both banks along the survey reach, with gentle slopes also present in various locations. A major culvert is located at the beginning of the survey where the river flows underneath a road. The channel is reinforced and re-sectioned at this point. Evidence of over-deepening is present towards the southern sections of the survey reach.



Photo 4: Major culvert & weir on Park Lane Stream

The channel substrate is dominated by gravel / pebble material with silt deposits recorded in a number of locations. Discrete un-vegetated gravel deposits were also present. The bank materials of both the left and right banks are clayey, with concrete at reinforced sections. Eroding cliff features are extensive and stable cliff features were also found.

Flow types recorded range from unbroken standing waves, rippled flow and smooth flow. No marginal deadwaters were present at the time of survey, although sections of no perceptible flow were extensive. No channel vegetation was distinguished.

The channel has continuous tree distribution along both banks, resulting in extensive shading of the channel and sections of large woody debris accumulation. The bank full width of the channel is 2.5 m in some sections, however this is reduced in the lower sections of the stream. The water depth at the sample point was 0.2m, with bank heights typically 1m, although this reduces dramatically further downstream.

A side channel feeds into the stream almost halfway along the survey reach. Debris dams and leafy debris is extensive, however the channel was not completely choked at any point. Due to the proximity of residential areas, there is significant litter and tipping present. Evidence of flash flooding has been found.

No evidence of nuisance plant species was recorded. Alders were present along certain sections of the stream.

2.6 Havant Thicket Plantation

The reach within the Havant Thicket plantation was surveyed in July 2008. This area will not be flooded once the reservoir is constructed and the watercourses flowing through the woodland will naturally flow into the reservoir. The survey of this reach was undertaken in July 2008.

The predominant valley form is a shallow vee, with no distinct valley bottom or natural terraces. The elevation drops from about 58m above sea level to 40m. The channel flows through a mixture of broadleaved and coniferous woodland, very similar to the 1860s. However, a number of ponds along the watercourse have been created since then. The area is currently managed by the Forestry Commission (FC).



Figure 8: Historical map of Havant Thicket

At the time the stream was surveyed, the ephemeral nature of the watercourse was very evident (Photo 5). The flow in the channel for most of the spot checks was recorded as dry. Un-vegetated silt deposits were present as well as discrete un-vegetated gravel deposits.



Photo 5: Dry stream & pond

The channel is culverted to allow the stream to flow underneath a forest road and it has been straightened at a number of locations, shortening the overall channel length. Although the channel flows through a woodland area, the banktop vegetation is predominantly bare or has a uniform or simple structure. No channel vegetation was identified. Some areas have been cleared and the land use here is mostly improved grassland.

The bank material is predominantly clayey in nature with a channel substrate dominated by silt, with gravel / pebble regions. Eroding and stable cliff features are also present. The bank profile is predominantly gentle in nature, with re-sectioned areas identified. Poaching is also present next to the culverted section.

Since the channel was mostly dry, not all channel dimensions were recorded. The bankful width at the sample point was 1.5m, with the bank heights being about 0.3m.

As a result of the continues woodland areas, the channel is shaded in most sections, with overhanging bows, exposed bankside roots, underwater tree roots and large woody debris (including fallen trees) present. Some marshy areas were also present as well as small side channels in the lower section of the reach. Evidence of sections of choked channel was also found. No nuisance plants were recorded. Alders were present and dragonflies were also spotted.

2.7 Reservoir Site

The stream reach flowing through the proposed reservoir site surveyed in July 2008 is a section that includes the woodland area of the Avenue and the grassland area to the southwest. The area have been heavily modified since the 1860s when the whole site now earmarked for the reservoir location was a woodland area (Figure 6). The area was gradually cleared during the 1970s, leaving only the section now known as The Avenue as woodland. This woodland area is designated as ancient woodland. The channel has been straightened and deepened to assist with drainage, with some sections reinforced. Vertical or undercut bank profiles are present in some locations.

The predominant valley form of the area is a shallow vee with no distinct valley bottom or natural terraces. The stream is highly ephemeral and a number of sections were recorded with no perceptible flow or as dry. The bank material is clayey in nature with a mixture of gravel / pebble and silt within the channel substrate. The survey commenced downstream of a ponded area known as Upper Lake.



Photo 6: Outfall pipe from Upper Lake & gravel / pebble substrate

A significant number of pools were recorded and although no riffles were noted, the channel substrate suggests that during the wet season rippled flow will be present. Erosion and deposition is present along the reach, with un-vegetated point bars recorded at a few places.

The stream flows partly through broadleaf woodland area and partly through an area dominated by rough pasture. Poaching was visible where the stream starts flowing through the grassland area. The vegetation structure next to the stream banks are either bare or has a simple structure with a mixture between scrub and trees. Marshy areas are also present on the right bank. A complex vegetation structure was noted on the left bank top at the downstream part of reach.

The channel is predominantly shaded, with extensive overhanging boughs and exposed bankside tree roots. Underwater tree roots, fallen trees and large woody debris were also present.

Due to the low flow present in the channel at the time of the survey, the dimensions of the channel were taken at a pool, upstream of a debris dam. The bank full width was 2.5m compared to the low flow width of 0.8m, with a water depth of only 0.03m. Three side channel flow into the main surveyed reach.

The extensive gravel deposits within the stream suggest that it is possibly on top of a gravel lens.

2.8 HMS and HQA

The Water Framework Directive (WFD) has set environmental objectives for rivers and aquatic ecosystems, requiring surface water bodies to have achieved 'good ecological and chemical status' or 'good ecological potential' by 2015, dependent on the level of modification present (Directive 2000/60/EC, 2000).

The assessment of habitat modification and quality is therefore important to assist the management and improvement of surface waters. Through the RHS, the morphological degradation and habitat diversity and quality were calculated using the Habitat Quality Assessment (HQA) and Habitat Modification Score (HMS). The results are shown in Table 1.

Table 1: HMS and HQA results

Location	HMS	HQA
Riders Lane Stream – Great Copse	1,435	65
Riders Lane – North of Great Copse	550	72
Park Lane Stream	535	65
Havant Thicket	495	58

Habitat Modification Score description:

0 – 16: Pristine / Semi-natural

17 – 199: Predominantly unmodified

200 – 499: Obviously modified

Location	HMS	HQA	
Reservoir Site	1,350	65	500 – 1,399: <i>Significantly modified</i> 1,400+: <i>Severely modified</i>

In terms of Habitat Modification, the Riders Lane Stream section flowing through Great Copse and the reach flowing through the reservoir site are modified the most. The reach of Riders Lane to the north of Great Copse and Park Lane Stream has very similar scores and can be described as *Significantly Modified*. The site surveyed in the Havant Thicket plantation has the best habitat score and is classified as *Obviously Modified*.

It is important to view the habitat modification in conjunction with habitat quality and it is clear from the scores calculated that there is not a major difference between the quality of the different survey areas, however the section of Riders Lane Stream north of Great Copse does show up as slightly better than the other survey areas.

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3 Macro-Invertebrate Surveys

Following discussions on water quality and stream habitats leading to, or from the proposed reservoir, it was proposed that a survey of macro-invertebrates be undertaken to compliment intended geomorphological and habitat surveys. Accordingly a survey of macro-invertebrate and general freshwater communities was requested. Such surveys can provide information on water quality, using recognised scoring systems and standard diversity indices can indicate overall community balance and health in relation to anthropogenic or natural factors.

Water quality scores - Biological Monitoring Working Party (BMWP) and Average Score Per Taxon (ASPT) - utilise the relative sensitivity of scoring macro-invertebrate families. These can indicate the influence of pollutants such as trace elements, organic material and hydrocarbons potentially associated with runoff from agriculture, road surfaces or other sources. Low scores may indicate a stressed community dominated by pollution tolerant families/species. However, it should be considered that low scores may be confounded by other environmental factors such as unsuitable habitat, other natural factors such as highly acidic streams, or community interactions such as predation by dominant species resulting in low diversity scores.

3.1 Site descriptions and methods

3.1.1 Description of sampling site

To obtain an overview of stream macro-invertebrate communities in relation to the proposed reservoir, it was necessary to establish suitable survey sites before work was undertaken. Accordingly five sites were chosen based on them being representative of local streams and the prevailing geology, habitats and areas with anthropogenic influence.

The sites were:

- 1) The Hermitage Stream Leigh Park, Havant. A restored stream of sloping profile with large cobble artificial bed, steep sided banks approximately 0.5m. Evidence of filamentous algae and fine silt. Sampled locations were: Site 1 (SU70860, 07730), a shallow run; Site 2 (SU70818, 07775), a shallow run; Site 3 (SU70742, 07850), an artificial riffle of large cobbles just below a small footbridge. At time of initial viewing, flows were moderate reflecting recent rain fall.
- 2) Great Copse, Leigh Park, Havant. A natural stream impacted by vandalism, dumping and use as a cycle track. Local walkers / dog walkers use the woods within which the stream runs. The banks were very bare and relatively steep sided ranging from 0.75-1.5m deep, where the stream has incised a channel in the clay/gravel geology. Bank erosion has led to silt being carried onto the bed. Highly shaded stream with a meandering planform. At time of initial viewing, flows were moderate reflecting recent rain fall. Sample locations were: Site 1 (SU71786, 08586) a shallow glide with fine silt bed, fully shaded; Site 2 (SU71787 08588) a heavily silted pool of limited or no perceptible flow, fully shaded; Site 3, (SU71780 08606) a riffle of marine won gravel (possible previous restoration work – cockle shells (*Cerastoderma edule*) in evidence) with silt and mud at margins, open to light.
- 3) Park Lane Stream. Park Lane Stream consisted of a meandering planform watercourse. After exiting a culvert under Calshot Road (the northerly perimeter of Leigh Park estate) it courses over a riffle of approximately 40m in length before entering a steep-banked glide, pool, glide sequence which was deeply incised into the clay/sand geology. Banks were up to 2.5m high in the pool – glide sequence, whereas in the riffle, banks were only approximately 0.5m high. Riffle sediment showed evidence of considerable downstream transport possibly associated with flashy flow often associated with clay bed streams. Conversely in the over deepened pool-glide sequence, flow was relatively sluggish. Sites were located at SU70420, 09281 (pool), SU 70436, 09828 (pool/run dependent on flow) and SU70439, 09309 (riffle).

- 4) The Avenue, Staunton Country Park. A narrow meandering stream of silt and gravels with some larger gravels having been washed off a footpath creating an artificial riffle. At time of initial viewing, flows were moderate reflecting recent rainfall. Banks were shallow angled to steep, but only to a maximum of 0.5m deep. Site appears to have intermittent water supply within indication of flashy water levels. Sample locations were close to each other as access to the stream was restricted due to dense woodland and undergrowth. Locations were a pool at SU71544, 09834, an artificial riffle (created due to gravel substrate being washed from a footpath) at SU71536, 09828 and a pool/run (dependent on flow recorded) at SU71544, 09844.
- 5) Havant Thicket Stream. Havant Thicket Stream consisted of a relatively steep profiled straight cut stream draining soil in the Forestry Commission land. At the initial survey it was flowing slowly from a pool at its head, but for the first survey visit, flow had ceased, therefore only the pool could be sampled. After rain, on the second visit, flow was restored. At this visit both stream and pool were surveyed. This stream runs through dense deciduous and coniferous woodland and the narrow channel has considerable organic matter within it. The stream had a relatively steep slope out of the woodland and banks were steep sided, but only approximately 0.25m high. The stream width was only a maximum of 0.5m, preventing replicated edge and centre samples. Sites sampled within the stream were at SU71509 10710 (mid stream, high organic matter – October only), SU71522 10739 (mid stream, high organic matter – October only) and SU71495 10927 (pool, surveyed July and October 2008).

3.2 Methods

Within each stream, three sampling locations were identified during the initial site visit. Where possible, a pool, run/glide, riffle sequence was used to provide background on the habitat continuum. At each location, three 30 second replicated kick samples were taken in both the margin and centre channel habitats. Samples were taken working upstream to ensure no drift of macro-invertebrate species occurred, potentially contaminating downstream samples. The method gave a total of 18 replicates per stream taken in July 2008 and, for temporal comparison, 18 per stream in October 2008. Samples were preserved in the field with formalin and identified to family level in the laboratory; where of possible value to conclusions.

At the time of sample collection, a mean conductivity value was taken, in conjunction with a qualitative assessment of sediment type and cover and dominant habitat type (in stream vegetation - marginal, floating, upright etc).

Water quality results indicated from macro-invertebrate families were created from the Average Score Per Taxon (ASPT). This score is created by dividing the Biological Monitoring Working Party (BMWP) score for each site by the number of scoring families (averaging). This is because a weakness of the BMWP system is the effect of sampling effort. A longer sampling effort may produce a higher score, but effort can decline with number of samples and time thus impacting resultant scores. The ASPT overcomes the sampling variability and provides an unbiased assessment of water quality as indicated by macro-invertebrate family. However, it should also be considered that low ASPT scores do not necessarily suggest anthropogenic pollution, rather it may indicate water quality variably due to natural factors such as sediments, flow rate, background geology and vegetation.

To provide an indication of community variability and whether it may have been dominated by less sensitive families, diversity values (using the inverse Shannon Weiner index) were calculated. A three way Analysis of Variance (ANOVA) was used to show if diversity differed significantly both spatially and temporally. As rivers are a continuum and temporal data may be regarded as not being independent, the level of significance acceptable in the ANOVA was reduced to $P < 0.01$, ensuring that conclusions were based on the 1 in 100 possibility of error (see Connell & Gladsby, 1999, Connell, 2000, 2001, for validation of this process).

A Principal Component Analysis was used to show site clustering based on biotic and abiotic factors and a Detrended Canonical Correspondence Analysis indicated the relative importance of measured environmental variables in influencing communities.

3.3 Results

3.3.1 ASPT Scores

For temporal and spatial comparison, ASPT scores are shown in Figure 9. This is not intended to suggest streams are a continuum with a related pollution gradient, however, results are presented broadly in line of more to less anthropogenic influence (left to right - Figures 9, 10 and 11).

Hermitage stream results indicate little change in the relatively poor scoring community between both edge and centre sites and between July and October samples. In comparison, Great Copse (indications of rubbish and waste disposal) showed little variation between edge and centre locations, but a greater effect of increased water flow in October over July. This is with the exception of site three (the artificial riffle) where presence of Gammaridae (freshwater shrimp) and Baetidae (mayfly - *Baetis rhodani*) indicated a localised effect of increased flow presumably enhancing water/oxygen content. However, it should be noted that the ASPT for Great Copse was lower than the Hermitage, which is in a highly urbanised area affected by road runoff etc. In both the Hermitage (throughout the length surveyed) and in the riffle in Great Copse, Bullhead (*Cottus gobio*) were found (listed on Annex II of the EC Habitats Directive). This is a relatively pollution intolerant fish species generally preferring well oxygenated waters with gravel/stony substrate.

Park Lane showed little spatial and temporal variation although site 1 (a riffle) gave slightly higher ASPT scores than downstream sites and margin samples were higher scoring than centre sites; presumably because of habitat diversity/shelter. It was notable that relatively high BMWP scoring caddis flies Polycentropidae and Limnephilidae were found in the Park Lane riffle site 1 and again, in greater abundance in the margins. By comparison Avenue edge and centre results differed slightly within the exception of site 2, however temporal changes showed an increase in ASPT. There was a notable increase in flow at the Avenue sites between July and October. The site has very little influence from anthropogenic sources, indicating that it may be highly flow dependent for community structure and presence of indicative species. The only temporal comparison for Havant Thicket stream was for site 3, which showed a marked reduction in ASPT over July, due to more flow allowing presence of less sensitive species in the stream flow rather than the high scoring families of Aeshnidae (dragonfly) and Coenagruidae (damselfly) which were present in the pond only (site 3) in July and October. This undisturbed site shows that ASPT scores, whilst a useful pollution indicator, should not be considered alone as reasons for family/species presence or absence.

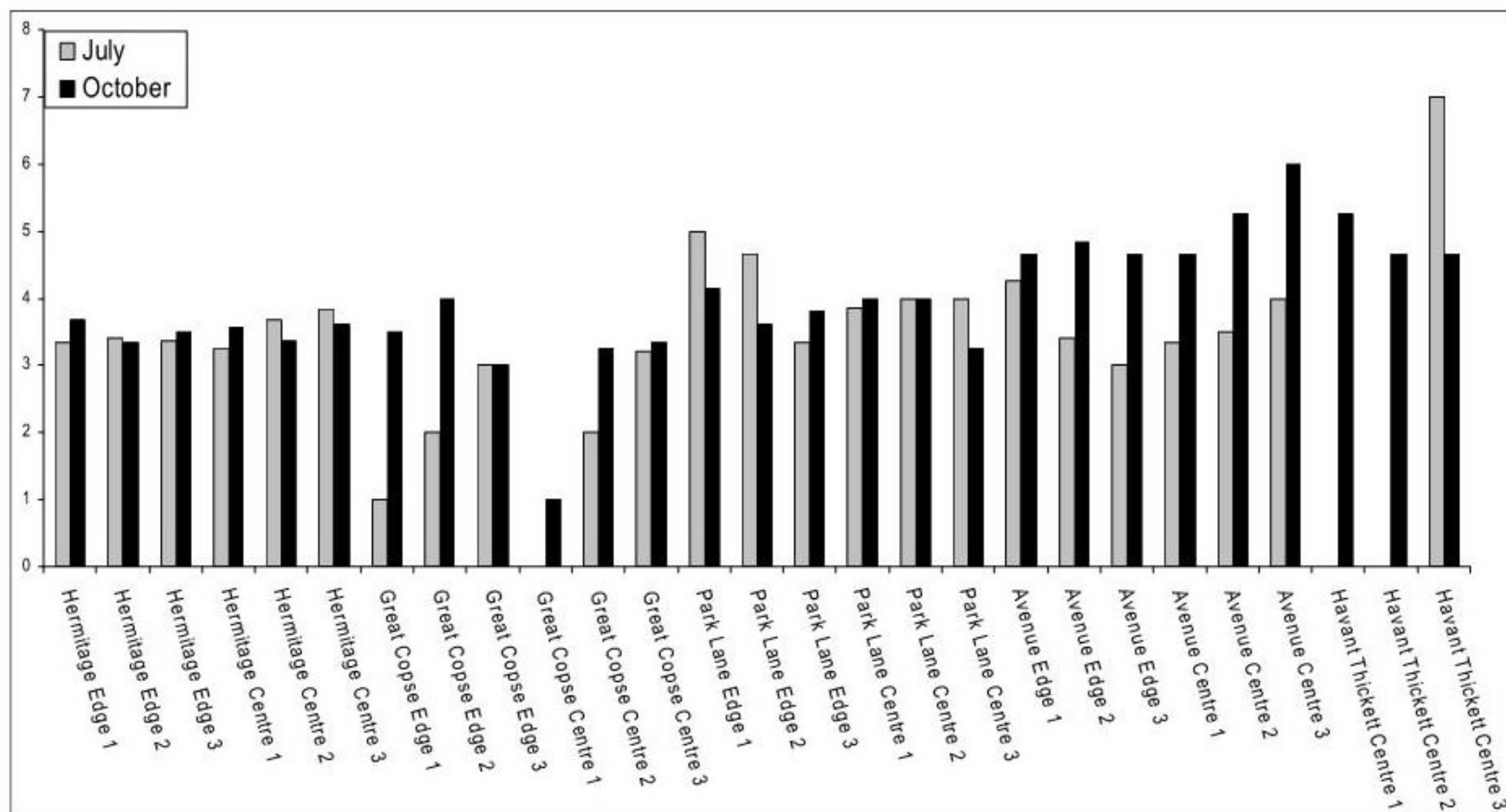


Figure 9: Average Score Per Taxon (ASPT) for edge and centre sites

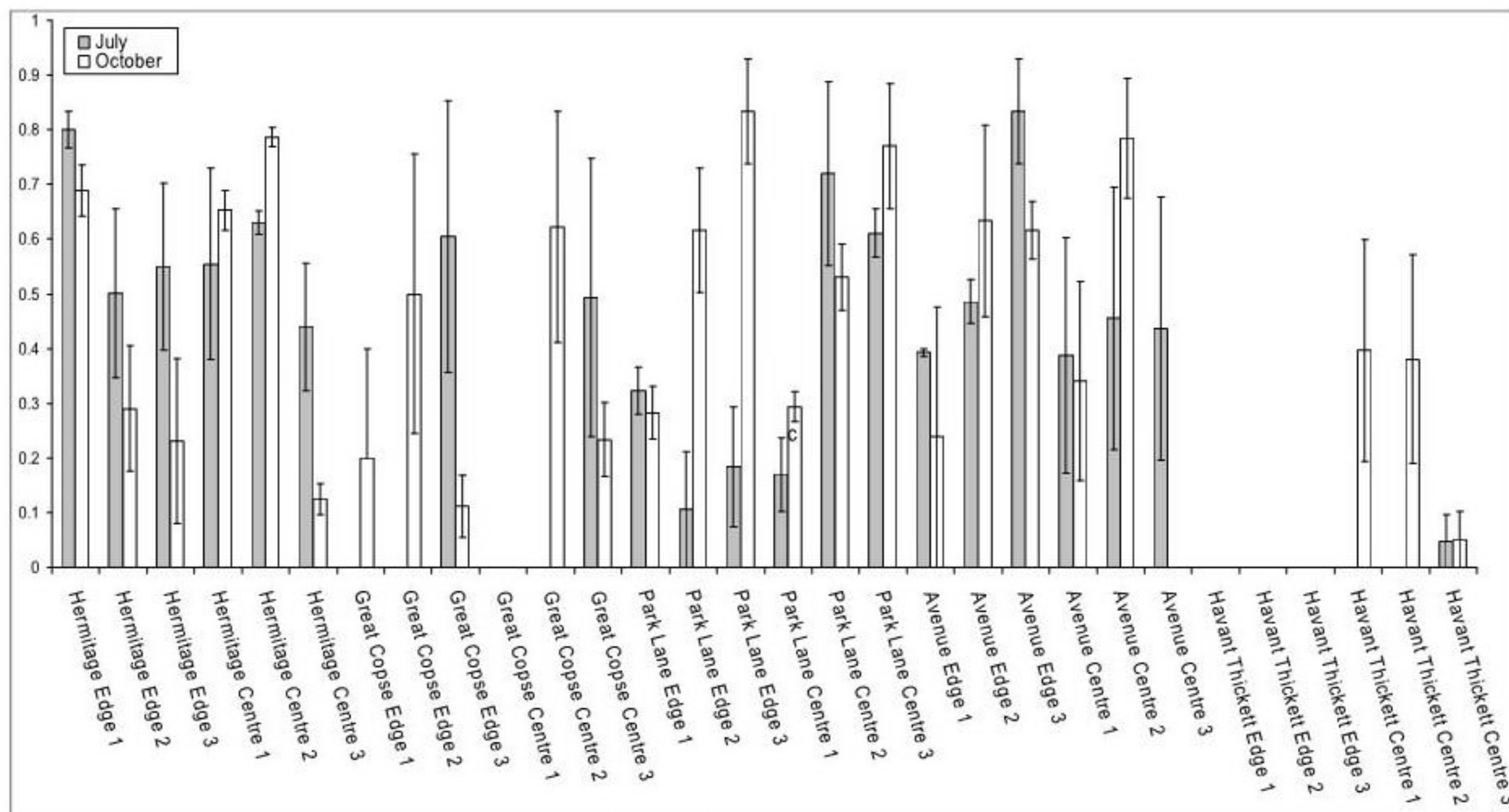


Figure 10: Simpson's Unbiased macro-invertebrate diversity for sampled stream edge and centre sites (± 1 Standard Error of the Mean)

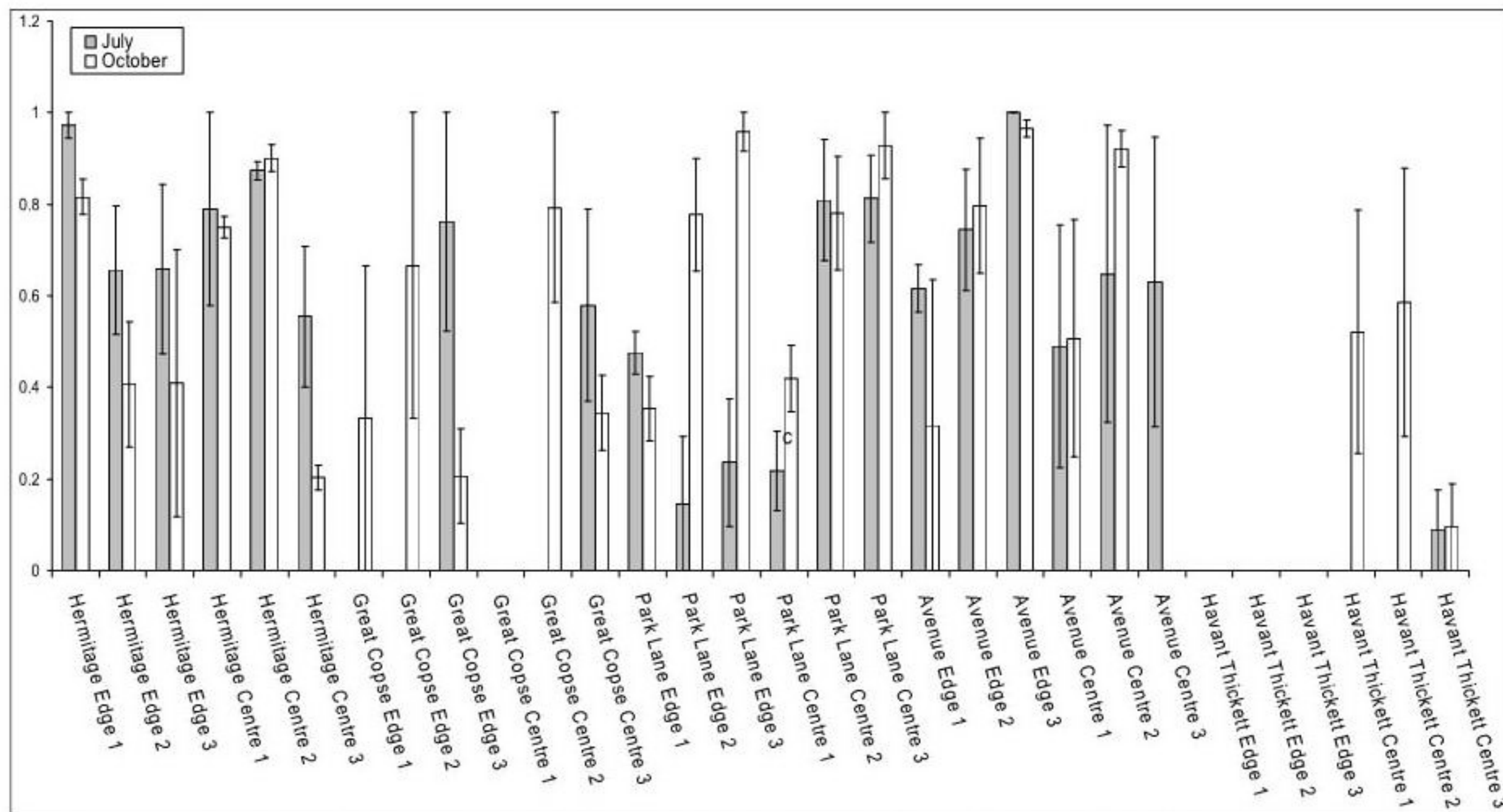


Figure 11: Equitability for macro-invertebrate diversity for sampled stream edge and centre sites (± 1 Standard Error of the Mean)

3.4 Diversity

Diversity indices are not necessarily a good indicator of water quality, however they do provide an overview of community structure and any possible bias towards dominant, potentially more pollution tolerant species.

From a possible maximum of 1 Simpsons Unbiased index results (Fig 10) show that community diversity was relatively unchanged over time for the Hermitage with little variation between edge and centre sites. Great Copse was highly variable over time and space with no species in July in sites 1 and 2, but site 3 (riffle) having higher diversity in July. Park Lane edge sites were variable over time, but less so for centre locations, flow being less of an issue at this site. Diversity at The Avenue sites changed little over time and space although edge and centre 1 sites were notably lower than others at the site. For Havant Thicket, diversity scores were moderate in October for sites 1 and 2, however the pool (site 3 – the only one with temporal replication) showed very low diversity, albeit the site being inhabited by two pollution intolerant families.

Overall, diversity for all sites ranged from low to relatively high, but error bars indicate the within sampling location variability was generally high. Equitability (evenness of family numbers within the community – possible maximum, score of 1) (Figure 11) showed again that spatial and temporal patterns were repeated and that where diversity was relatively high, so was equitability.

Where evenness and diversity were high, this suggests relatively robust communities being tolerant to prevailing conditions with no one family dominating.

Statistical comparison (ANOVA) showed that between site differences were significant ($P < .001$) with post hoc tests showing that Hermitage, Park Lane and The Avenue all had greater diversity than Havant Thicket and Great Copse. This is noteworthy as Great Copse is highly disturbed by anthropogenic sources but conversely Havant Thicket is undisturbed. However, Havant Thicket is not an entirely valid comparisons as in July no flow was recorded thus diversity was zero for downstream sites, but it does highlight the stressed nature of the community due to 'natural' fluctuations.

3.5 Species of note

The EU Annex II species *Cottus gobio* (Bullhead) was noted in several locations. In the Hermitage Stream it was found in centre and edge samples of the riffle (site 3) and generally in centre replicates of the other two sampling locations. For Great Copse, Bullhead were found in the artificial riffle only; this is perhaps surprising as water quality and habitats appeared poor. Despite habitat suitability and a relatively continuous flow, no Bullhead were found at Park Lane and The Avenue and Havant Thicket streams were not suitable, possibly due to ephemeral flow conditions rather than water quality.

The Avenue stream in Staunton County Park was generally unremarkable as regards community structure, however in October, when flow had returned to the stream, a species of stonefly (Nemouridae) was found within the artificial riffle (see site description for location). Nemouridae are a relatively sensitive family (scoring 7 in the BMWP) and were not recorded in July at the Avenue, suggesting that opportunistic colonisation of the riffle may have occurred as flow improved by the Autumn.

No families of particular note were recorded at Park Lane or The Avenue.

As previously discussed, in Havant Thicket stream water quality sensitive species of Coenagruidae and Aeshnidae were recorded in both July and October. In addition, in October when flow was restored to this ephemeral stream, caddis fly families Limnephilidae (species *Micropterna sequax*) and Polycentropidae (*Polypsectropus irroratus* and *Plectrocnemia conspersa*) plus beetle larvae (Scirtidae) were found.

M. sequax prefers high organic levels (Tolkamp, 1982) and may be associated with streams that dry out (Wallace *et al.*, 1990). *P. conspersa* is opportunistic and can exist in many habitats occurring at all times of the year (Townsend and Hildrew, 1979).

3.6 Dominant factors

To clearly identify which species were important in dominating community structure and to subsequently show where sites were dominated by more tolerant organisms, a Principal Component Analysis was carried out. For July, the initial PCA results showed that Gammaridae dominated all variation explaining 92% of that seen, however if a PCA axis explains over 90% of the results, caution is advised and it may also be masking underlying aspects.

Figure 12 shows that for July 2008, with Gammarids removed from the analysis, that Hermitage Stream sites were clearly associated with Chironomids (midge larvae) and Arrenuridae (mites that feed on Oligochaete worms); both families are indicative of poorer water quality. The only other location to stand out was edge and centre sites in Park Lane Stream where Planariidae (flat worms which feed on abundant Gammarids) were highly abundant.

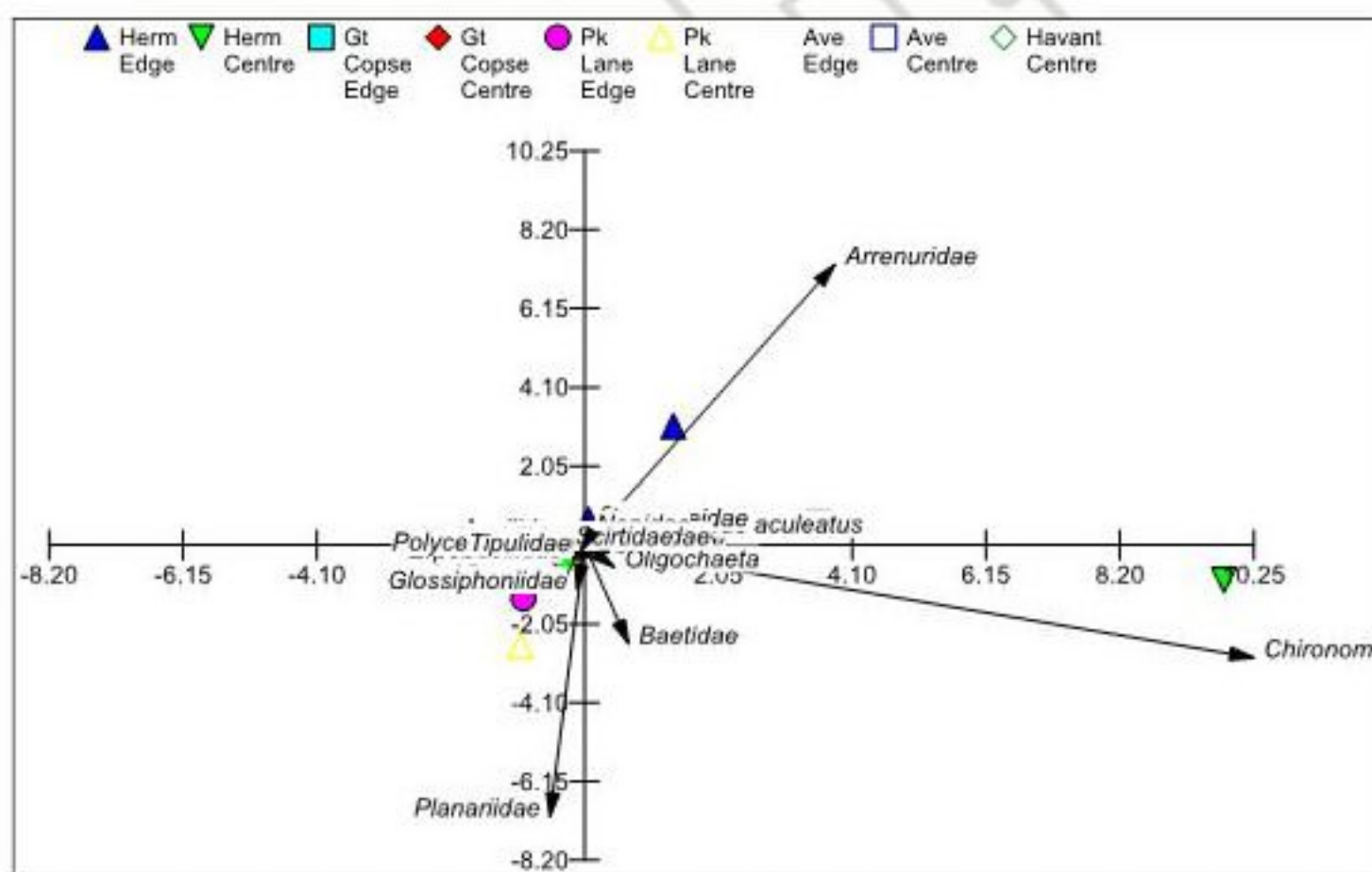


Figure 12: Principal component analysis of invertebrate fauna for sample sites edge and centre locations (Gammaridae removed) – July 2008

Data for October 2008 sites (Figure 13), become slightly more distinct in the analysis, possibly related to an increase in flow rates altering habitat variables. Hermitage edge sites were strongly clustered based on the community of species particularly relating to more tolerant families (e.g. Lymnaeidae) and centre locations were generally dominated by leech, apart from the riffle site where Baetidae (*Baetis rhodani*) were common. Park Lane was still evident through the continuing presence of abundant Planariidae and high numbers of hog louse (Asselidae) which are moderate to high pollution tolerant (BMWP score 3). The only other outstanding feature in October 2008 was the increase in flow at Havant Thicket, which allowed opportunistic and pollution intolerant species to colonise or to continue existence.

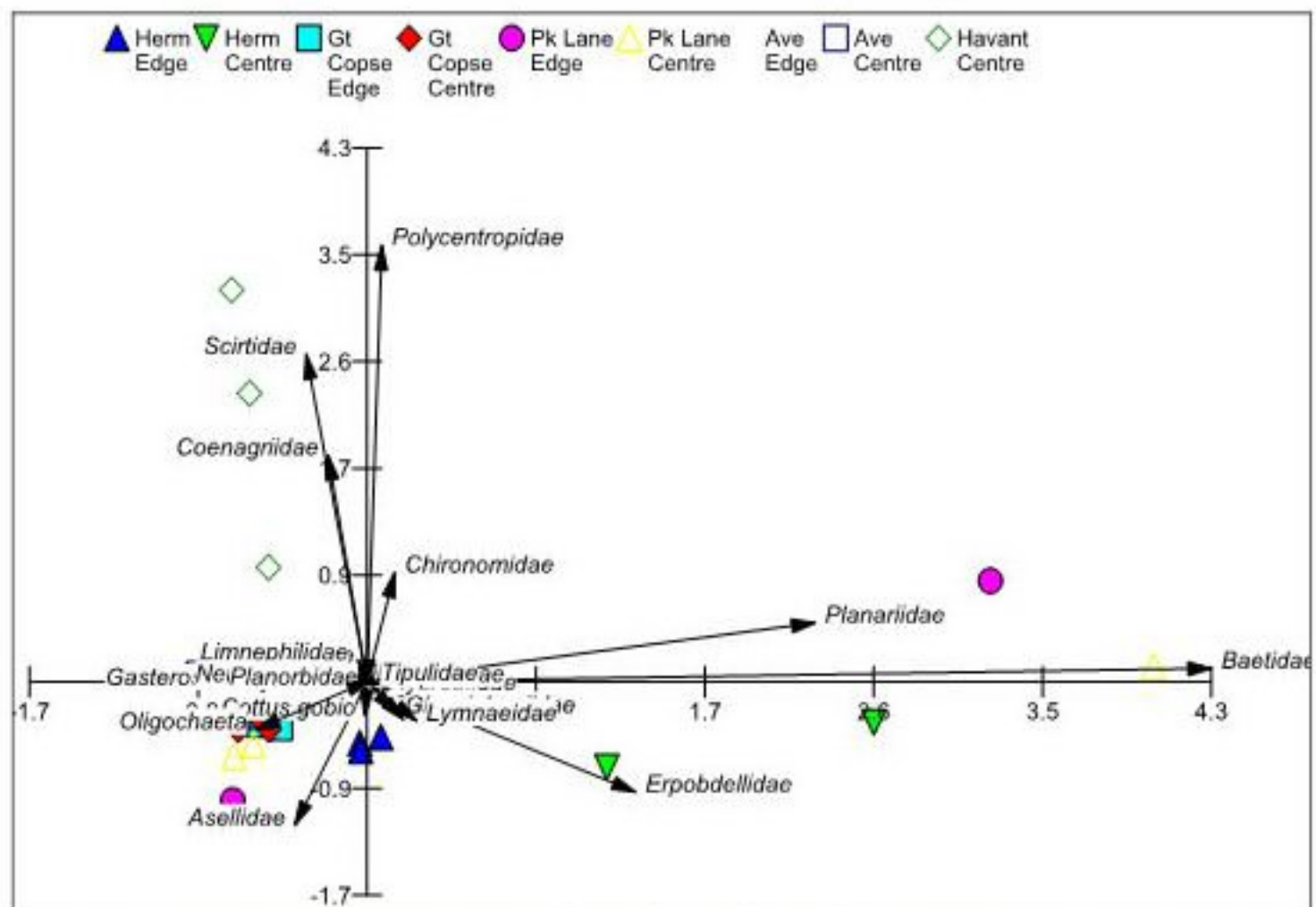


Figure 13: Principal component analysis of invertebrate fauna for sample sites edge and centre locations (Gammaridae removed) – October 2008

Detrended canonical correspondence analysis utilises macro-invertebrate data and relates it to measured environmental variables. For July 2008 (Figure 14), conductivity is important for at least one Great Copse location with the presence of in-stream algae/flora dictating (providing refuge) Hermitage communities (families shown by clear diamonds). Few other sites stand out with the exception of Great Copse edge and Avenue centre locations where ephemeral/low flows were highly influential. This is slightly misleading as only one site at Havant Thicket provided species (the pond) as flow had ceased. Therefore, the importance of flow and its ephemeral nature at this site is not truly represented. No other sites stood out from general clustering in relation to measured environmental variables.

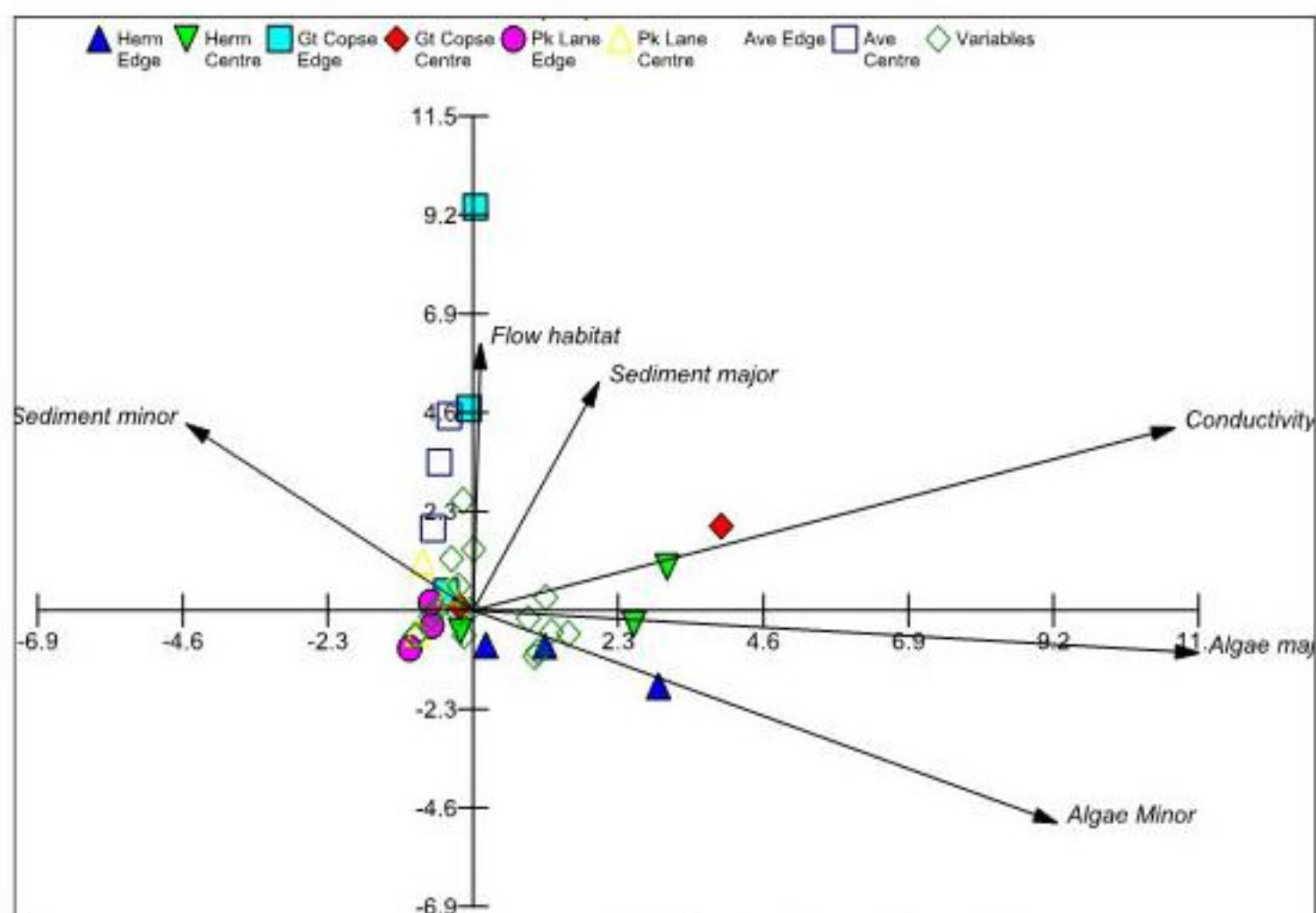


Figure 14: Detrended canonical correspondence analysis invertebrate fauna for sample sites edge and centre locations in relation to environmental variables - July 2008

For October 2008 (Figure 15), it is clarified that the ephemeral flow rate at Havant Thicket and to a lesser extent Park Lane edge and centre sites is important in structuring the community (families represented by clear circles).

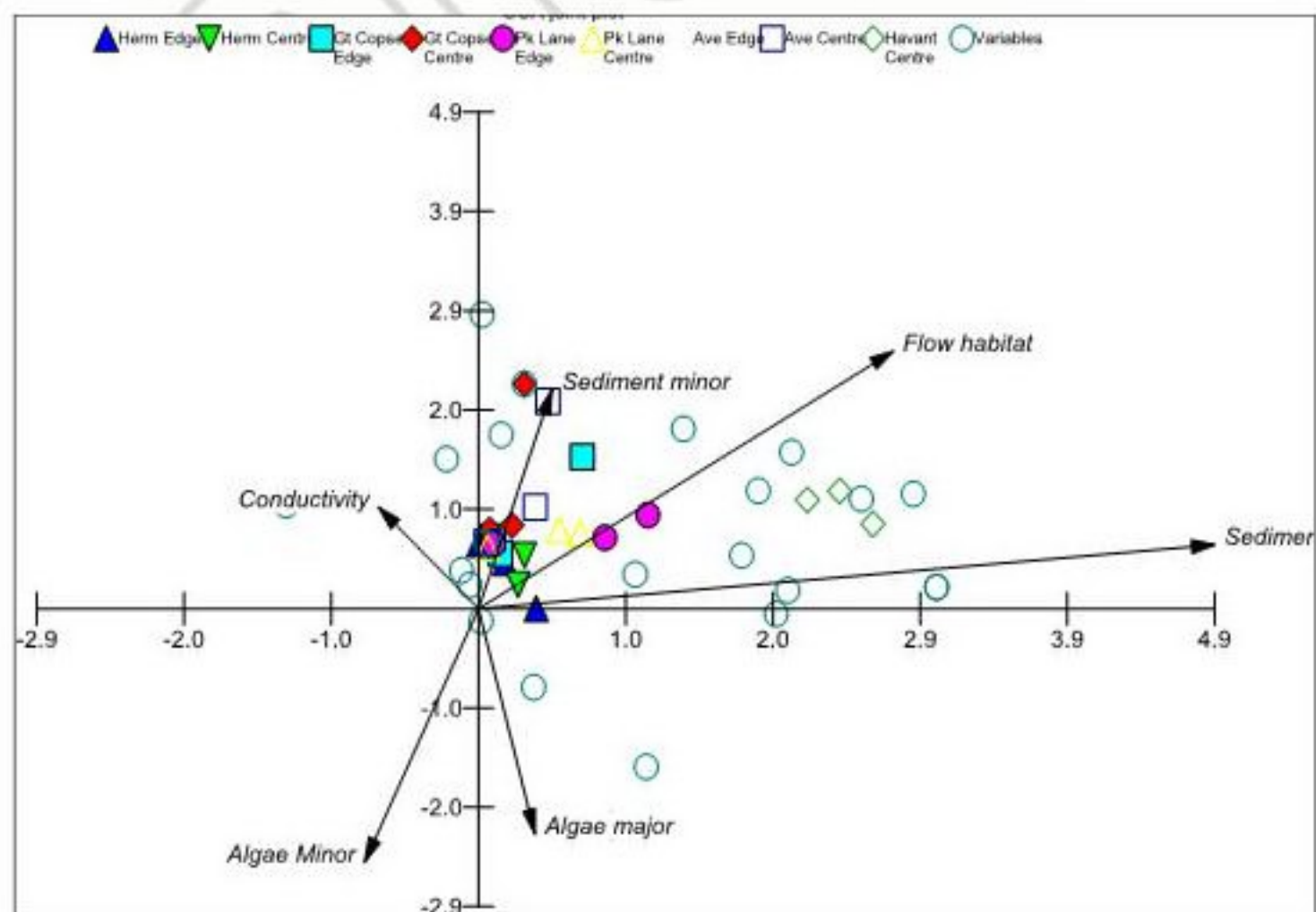


Figure 15: Detrended canonical correspondence analysis invertebrate fauna for sample sites edge and centre locations in relation to environmental variables - October 2008

Further to this, flow and sediment type, possibly relating also to poor water quality determined the impoverished Great Copse community (Figure 15). As with July, other than these sites, clustering was generally centred on all measured variables.

3.7 Discussion – Habitat indications

Results indicate that the communities are relatively poor in overall water quality but that the Avenue and Havant Thicket could be colonised by clean water preferring families/species when flow conditions allowed. Species present, indicated that at least at Havant Thicket, the community had developed in relation to ephemeral flows. Diversity and equitability were variable both within and between sites (giving statistically significant results). Whilst macro-invertebrate communities were relatively unremarkable (apart from sensitive and opportunistic species at Havant Thicket and The Avenue), bullheads were found in streams where they perhaps were unexpected due to water quality.

Sites appear affected by water volume and, to a lesser extent other variables, rather than pollution per se, although where anthropogenic factors were more prevalent, water quality will be an increasing issue. This is not to say, however that all communities would benefit from increased flow, which would enhance flushing. As it appears that, in the case of The Avenue and Havant Thicket, communities consist of families adapted to opportunistic colonisation. For example, Nemouridae were recorded in the Avenue in October 2008. Hynes (1979) noted that Nemouridae may be very dependent on water hardness and that different species within the family will prefer different conditions. For example *Nemoura cinerea* may be particularly associated with temporary streams developing more quickly and robustly in gravel habitat with suitable flow, rather than fines.

The variety of both natural and anthropogenic factors affecting these sites, makes it difficult to draw definitive conclusions as they are dictated by both 'natural' and anthropogenic factors and to clearly elucidate patterns would take a longer research project than is available, or practical, here. Overall, Park Lane may be considered as optimal in terms of general diversity, ASPT and flow consistency resulting in a robust community. However, both The Avenue and Havant Thicket are dependent on the ephemeral flow conditions and good water quality for the family/species matrices recorded. For general diversity, not necessarily a good measure of water quality, the Hermitage came out as being notably high however, the invertebrate community largely consisted of poor-water quality tolerant species.

The ASPT recorded at around 4, has changed little from work undertaken in 1997 (Day, 1997) suggesting that water quality since that time has not notably improved. This being the case, it may be that water quality at other sites investigated has changed little over time (although no earlier data were readily available to compare), as they all flow into the Hermitage (Figure 1).

4 Conclusions

The River Habitat Surveys and Macro Invertebrate surveys were undertaken during the summer and autumn of 2008.

The differences in hydromorphological character between the surveyed rivers were identified and habitat modification and habitat quality were assessed. These can be used to assist in WFD monitoring.

The rivers surveyed have all undergone modifications throughout during the past, both in terms of land use change and plan form change. This has impacted on the geomorphological quality of the rivers as well as on the habitat quality. The flashy and ephemeral nature of the rivers also has an impact. The water quality, especially within the rivers running through residential / urbanised areas, also plays a significant role in the quality of the habitat.

In terms of the macro-invertebrate communities investigated, the overall conclusions were that they are relatively unremarkable and indicative of stress through anthropogenic sources and influence of natural factors, particularly flow.

It should be noted however, that communities at some sites have developed in relation to ephemeral flows. Where this is the case, an increase to permanent flow may result in loss of ephemeral flow dependent families / species, however increased flows may also enhance water quality in other locations through enhanced flushing or change it through increased runoff from agricultural land. This may also have implications for geomorphological characteristics and as a result affect habitats and communities elsewhere.

For any works undertaken, pre and post surveys are recommended. This will elucidate community changes and related habitat change and allow biological monitoring of improvement or decline in water quality.

This study has been a temporal 'snapshot' of stream communities and habitat in the region. Accordingly, the precautionary principle should be adopted in relation to disturbance and where feasible, changes should be predicted and appropriately mitigated.

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Appendix L3 Invertebrate Species Recorded at Proposed Reservoir Site, Access Road and Havant Thicket Woodland in 2018

Order	Family	Scientific Name	English Name	Status	Date
ORTHOPTERA (Grasshoppers and Crickets)		<i>Chorthippus parallelus</i>	Meadow grasshopper	Common, Widespread	26/06/2018, 24/07/2018, 15/08/2018
		<i>Conocephalus discolor</i>	Long-winged Conehead	Common, Widespread	24/07/2018
		<i>Conocephalus dorsalis</i>	Short-winged Conehead	Common, Widespread	24/07/2018
		<i>Leptophyes punctatissima</i>	Speckled Bush Cricket	Common, Widespread	26/06/2018, 24/07/2018
		<i>Metriopectera roeselii</i>	Roesel's Bush Cricket	Common, Widespread	26/06/2018, 24/07/2018
		<i>Pholidoptera griseoaptera</i>	Dark Bush Cricket	Common, Widespread	08/06/2018, 26/06/2018
DICTYOPTERA (Cockroaches)		<i>Ectobius lapponicus</i>	Dusky Cockroach	Nationally Scarce Nb	08/06/2018
HEMIPTERA (True Bugs)	Acanthosomatidae (Shield Bugs)	<i>Elasmotethus interstinctus</i>	Birch Shieldbug	Common, Widespread	24/07/2018
	Coreidae (Squash Bugs)	<i>Coreus marginatus</i>	Squash Bug	Common, Widespread	24/07/2018
	Pentatomidae (Shield Bugs)	<i>Aelia acuminata</i>	Bishop's mitre	Common, Widespread	24/07/2018, 15/08/2018
		<i>Dolycoris baccarum</i>	Sloe bug	Common, Widespread	24/07/2018, 15/08/2018

Order	Family	Scientific Name	English Name	Status	Date
		<i>Palomena prasina</i>	Green shieldbug	Common, Widespread	08/06/2018, 24/07/2018
		<i>Pentatoma rufipes</i>	Forest bug	Common, Widespread	08/06/2018
	Scutelleridae (Tortoise Bugs)	<i>Euygaster testudinaria</i>	Common Tortoise Bug	Common, Widespread	24/07/2018
ODONATA (Dragonflies and Damselflies)	Coenagrionidae (Damselflies)	<i>Pyrhosoma nymphula</i>	Large Red Damselfly	Common, Widespread	26/06/2018
	Agriidae (Demoiselles)	<i>Agriion virgo</i>	Beautiful Demoiselle	Local, Wetland	08/06/2018
	Libellulidae (Skimmers and Darters)	<i>Sympetrum striolatum</i>	Common Darter	Common, Widespread	15/08/2018
LEPIDOPTERA (Butterflies and Moths)	Nymphalidae	<i>Aphantopus hyperantus</i>	Ringlet	Common, Widespread	08/06/2018, 24/07/2018
		<i>Maniola jurtina</i>	Meadow brown	Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018, 15/08/2018
		<i>Coenonympha pamphilus</i>	Small Heath	S41 species	08/06/2018, 26/06/2018, 15/08/2018
		<i>Pararge aegeria</i>	Speckled Wood	Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018, 15/08/2018

Order	Family	Scientific Name	English Name	Status	Date
		<i>Pyronia tithonus</i>	Gatekeeper	Common, Widespread	24/07/2018, 15/08/2018
		<i>Argynnis paphia</i>	Silver - washed Fritillary	HBAP, County of Interest	26/06/2018, 24/07/2018
		<i>Gonepteryx rhamni</i>	Brimstone	Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018
		<i>Inachis io</i>	Peacock	Common, Widespread	24/07/2018
		<i>Vanessa atalanta</i>	Red Admiral	Common, Widespread	26/06/2018
		<i>Polygonia c - album</i>	Comma	Common, Widespread	26/06/2018
		<i>Vanessa cardui</i>	Painted Lady	Common, Widespread	26/06/2018
		<i>Limenitis camilla</i>	White Admiral	S41 species	26/06/2018
		<i>Melanargia galathea</i>	Marbled White	Common, Widespread	26/06/2018
	Lycaenidae (Blues, Coppers and Hairstreaks)	<i>Celastrina argiolus</i>	Holly blue	Common, Widespread	15/08/2018
		<i>Polyommatus icarus</i>	Common blue	Common, Widespread	08/06/2018, 24/07/2018, 15/08/2018
	Hesperiidae (Skippers)	<i>Ochlodes faunus</i>	Large Skipper	Common, Widespread	08/06/2018
		<i>Thymelicus sylvestris</i>	Small skipper	Common, Widespread	26/06/2018, 24/07/2018
	Pieridae (Whites)	<i>Pieris brassicae</i>	Large white	Common, Widespread	26/06/2018, 24/07/2018

Order	Family	Scientific Name	English Name	Status	Date
		<i>Pieris napi</i>	Green-veined white	Common, Widespread	24/07/2018, 15/08/2018
		<i>Pieris rapae</i>	Small white	Common, Widespread	26/06/2018, 24/07/2018
	Erebidae	<i>Tyria jacobaeae</i>	Cinnabar	S41 Species	24/07/2018
		<i>Zygaena filipendulae</i>	6 - spot burnet	Common, Widespread	26/06/2018
DIPTERA (True Flies)	Tipulidae (Craneflies)	<i>Austrolimnophila ocracea</i>		Common, Widespread	08/06/2018
		<i>Molophilus medius</i>		Common, Widespread	08/06/2018
	Stratiomyidae (Soldier flies)	<i>Pachygaster atra</i>		Common, Widespread	26/06/2018
	Rhagionidae (Snipe flies)	<i>Chrysopilus asiliformis</i>		Common, Widespread	08/06/2018
		<i>Chrysopilus cristatus</i>		Common, Widespread	08/06/2018
		<i>Rhagio tringarius</i>		Common, Widespread	08/06/2018
	Tabanidae (Horse flies)	<i>Haematopota pluvialis</i>		Common, Widespread	08/06/2018
		<i>Tabanus sudeticus</i>		Common, Widespread	26/06/2018
	Asilidae (Robberflies)	<i>Dioctria atricapilla</i>		Common, Widespread	08/06/2018
		<i>Dioctria baumhaueri</i>		Common, Widespread	08/06/2018
		<i>Dioctria linearis</i>		Common, Widespread	08/06/2018
		<i>Leptogaster cylindrica</i>		Common, Widespread	08/06/2018, 26/06/2018
	Dolichopodidae	<i>Chrysotus blepharosceles</i>		Common, Widespread	08/06/2018

Order	Family	Scientific Name	English Name	Status	Date
	(Long-headed flies)	<i>Chrysotus gramineus</i>		Common, Widespread	26/06/2018
		<i>Dolichopus festinus</i>		Common, Widespread	08/06/2018, 26/06/2018
		<i>Dolichopus trivialis</i>		Common, Widespread	26/06/2018
		<i>Dolichopus wahlbergi</i>		Common, Widespread	08/06/2018
		<i>Hercostomus nigripennis</i>		Common, Widespread	26/06/2018
		<i>Poecilobothrus nobilitatus</i>		Common, Widespread	08/06/2018
	Syrphidae (Hoverflies)	<i>Cheilosia bergenstammi</i>		Common, Widespread	24/07/2018
		<i>Cheilosia fraterna</i>		Common, Widespread	08/06/2018
		<i>Cheilosia illustrata</i>		Common, Widespread	26/06/2018
		<i>Cheilosia scutellata</i>		Common, Widespread	15/08/2018
		<i>Chrysogaster solstitialis</i>		Common, Widespread	24/07/2018, 15/08/2018
		<i>Chrysotoxum bicinctum</i>		Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018, 15/08/2018
		<i>Chrysotoxum festum</i>		Common, Widespread	24/07/2018
		<i>Dasysyrphus albostriatus</i>		Common, Widespread	08/06/2018

Order	Family	Scientific Name	English Name	Status	Date
		<i>Episyrphus balteatus</i>		Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018, 15/08/2018
		<i>Eristalis arbustorum</i>		Common, Widespread	08/06/2018, 15/08/2018
		<i>Eristalis interruptus</i>		Common, Widespread	08/06/2018, 26/06/2018, 15/08/2018
		<i>Eristalis pertinax</i>		Common, Widespread	26/06/2018
		<i>Eristalis tenax</i>		Common, Widespread	15/08/2018
		<i>Eupeodes corollae</i>		Common, Widespread	24/07/2018, 15/08/2018
		<i>Eupeodes luniger</i>		Common, Widespread	15/08/2018
		<i>Helophilus hybridus</i>		Common, Widespread	08/06/2018
		<i>Helophilus pendulus</i>		Common, Widespread	08/06/2018
		<i>Heringia latitarsis</i>		Nationally Scarce N	15/08/2018
		<i>Meliscaeva auricollis</i>		Common, Widespread	08/06/2018
		<i>Meliscaeva cinctella</i>		Common, Widespread	15/08/2018
		<i>Melanostoma mellinum</i>		Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018

Order	Family	Scientific Name	English Name	Status	Date
		<i>Myathropa florea</i>		Common, Widespread	26/06/2018, 24/07/2018, 15/08/2018
		<i>Paragus haemorrhous</i>		Common, Widespread	26/06/2018
		<i>Platycheirus albimanus</i>		Common, Widespread	08/06/2018, 26/06/2018
		<i>Platycheirus clypeatus</i>		Common, Widespread	08/06/2018
		<i>Scaeva pyrastris</i>		Common, Widespread	24/07/2018
		<i>Sericomyia silentis</i>		Common, Widespread	08/06/2018
		<i>Sphaerophoria scripta</i>		Common, Widespread	08/06/2018, 24/07/2018, 15/08/2018
		<i>Sphaerophoria taeniata</i>		Common, Widespread	24/07/2018, 15/08/2018
		<i>Syrpita pipiens</i>		Common, Widespread	26/06/2018, 24/07/2018, 15/08/2018
		<i>Syrphus ribesii</i>		Common, Widespread	08/06/2018, 15/08/2018
		<i>Syrphus vitripennis</i>		Common, Widespread	08/06/2018, 15/08/2018
		<i>Volucella bombylans</i>		Common, Widespread	08/06/2018, 26/06/2018

Order	Family	Scientific Name	English Name	Status	Date
		<i>Volucella inflata</i>		Local, Widespread	08/06/2018
		<i>Xylota segnis</i>		Common, Widespread	08/06/2018, 24/07/2018, 15/08/2018
		<i>Xylota sylvarum</i>		Common, Widespread	08/06/2018, 24/07/2018
	Conopidae (Thick-headed flies)	<i>Conops ceriaeformis</i>		Common, Widespread	15/08/2018
		<i>Physocephala rufipes</i>		Common, Widespread	24/07/2018
		<i>Sicus ferrugineus</i>		Common, Widespread	08/06/2018
	Tephritidae (Picture-winged flies)	<i>Campiglossa producta</i>		Nationally Scarce N	15/08/2018
		<i>Chaetorellia jaceae</i>		Common, Widespread	24/07/2018, 15/08/2018
		<i>Merzomyia westermanni</i>		Nationally Scarce N	24/07/2018, 15/08/2018
		<i>Myopites inulaedyssentericae</i>		Rare RDB3	24/07/2018, 15/08/2018
		<i>Sphenella marginata</i>		Common, Widespread	24/07/2018, 15/08/2018
		<i>Terellia ruficauda</i>		Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018, 15/08/2018
		<i>Urophora quadrifasciata</i>		Common, Widespread	24/07/2018

Order	Family	Scientific Name	English Name	Status	Date
	Platystomatidae (Platystomatid Flies)	<i>Rivellia syngenisia</i>		Common, Widespread	26/06/2018
	Opomyzidae (Opomyzid Flies)	<i>Opomyza petrei</i>		Common, Widespread	08/06/2018
	Sciomyzidae (Snail – killing flies)	<i>Coramacera marginata</i>		Common, Widespread	15/08/2018
		<i>Limnia unguicornis</i>		Common, Widespread	08/06/2018, 24/07/2018, 15/08/2018
		<i>Tetanocera elata</i>		Common, Widespread	08/06/2018
		<i>Tetanocera silvatica</i>		Common, Widespread	15/08/2018
	Muscidae (Dung Flies)	<i>Mesembrina meridiana</i>		Common, Widespread	08/06/2018, 15/08/2018
	Scathophagidae (Dung Flies)	<i>Scathophaga stercoraria</i>		Common, Widespread	08/06/2018
	Tachinidae (Tachinid flies)	<i>Eriothrix rufomaculatus</i>		Common, Widespread	24/07/2018
		<i>Gymnosoma rotundatum</i>		Rare RDB 3	24/07/2018
		<i>Tachina fera</i>		Common, Widespread	15/08/2018
HYMENOPTERA (Bees, Wasps, Ants and Relatives)	Formicidae (Ants)	<i>Lasius niger</i>		Common, Widespread	24/07/2018
	Eumenidae (Potter and Mason wasps)	<i>Ancistrocerus gazella</i>		Common, Widespread	26/06/2018
		<i>Symmorphus crassicornis</i>		Rare RDB 3	24/07/2018
	Vespidae	<i>Dolichovespula media</i>	Median wasp	Nationally Scarce Na	24/07/2018

Order	Family	Scientific Name	English Name	Status	Date
	(Social Wasps)	<i>Vespa crabro</i>	Hornet	Local, Widespread	08/06/2018, 24/07/2018, 15/08/2018
		<i>Vespula vulgaris</i>	Common wasp	Common, Widespread	24/07/2018, 15/08/2018
	Crabronidae (Digger Wasps)	<i>Lindeniuss albilabris</i>		Common, Widespread	08/06/2018
		<i>Pemphredon inornata</i>		Common, Widespread	24/07/2018
	Colletidae (Mining and Yellow faced bees)	<i>Hylaeus communis</i>		Common, Widespread	24/07/2018
	Andrenidae (Mining Bees)	<i>Andrena flavipes</i>		Common, Widespread	26/06/2018, 24/07/2018
	Halictidae (Mining and Cuckoo Bees)	<i>Lasioglossum leucozonium</i>		Common, Widespread	24/07/2018
		<i>Lasioglossum morio</i>		Common, Widespread	08/06/2018
		<i>Lasioglossum puncticolle</i>		Nationally Scarce Nb	15/08/2018
		<i>Lasioglossum smeathmanellum</i>		Common, Widespread	15/08/2018
		<i>Lasioglossum villosulum</i>		Common, Widespread	26/06/2018
		<i>Lasioglossum zonulum</i>		Common, Widespread	08/06/2018, 15/08/2018
		<i>Sphecodes monilicornis</i>		Common, Widespread	24/07/2018
	Megachilidae (Solitary bees)	<i>Coelioxys inermis</i>		Local, Widespread	24/07/2018

Order	Family	Scientific Name	English Name	Status	Date
	Apidae (Social and Cuckoo Bees)	<i>Apis mellifera</i>	Honey bee	Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018, 15/08/2018
		<i>Bombus hortorum</i>	A garden bumblebee	Common, Widespread	24/07/2018
		<i>Bombus hypnorum</i>	Tree bumblebee	Common, Widespread	08/06/2018
		<i>Bombus lapidarius</i>	Red-tailed bumblebee	Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018
		<i>Bombus lucorum</i>	White-tailed bumblebee	Common, Widespread	24/07/2018, 15/08/2018
		<i>Bombus pascuorum</i>	Common carder bee	Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018, 15/08/2018
		<i>Bombus pratorum</i>	Early bumblebee	Common, Widespread	08/06/2018, 15/08/2018
		<i>Bombus terrestris</i>	Buff - tailed bumblebee	Common, Widespread	24/07/2018, 15/08/2018
		<i>Bombus lucorum/terrestris</i> worker	a bumblebee	Common, Widespread	08/06/2018
COLEOPTERA (Beetles)	Cantharidae (Soldier Beetles)	<i>Cantharis cryptica</i>		Common, Widespread	08/06/2018
		<i>Cantharis figurata</i>		Common, Widespread	08/06/2018

Order	Family	Scientific Name	English Name	Status	Date
		<i>Cantharis nigra</i>		Common, Widespread	08/06/2018, 26/06/2018
		<i>Rhagonycha fulva</i>		Common, Widespread	24/07/2018
	Cerambycidae (Longhorn Beetles)	<i>Grammoptera ruficornis</i>		Common, Widespread	08/06/2018
		<i>Rutpela maculata</i>		Common, Widespread	26/06/2018
	Chrysomelidae (Leaf Beetles)	<i>Agelastica alni</i>		Data deficient DD	08/06/2018, 15/08/2018
		<i>Cassida murea</i>		Local, Widespread	24/07/2018
		<i>Cassida rubiginosa</i>		Common, Widespread	26/06/2018
		<i>Chrysomela populi</i>		Local, Widespread	26/06/2018, 24/07/2018
		<i>Donacia simplex</i>		Common, Widespread	08/06/2018
	Coccinellidae (Ladybirds)	<i>Adalia 10 - punctata</i>	10 Spot Ladybird	Common, Widespread	24/07/2018
		<i>Coccinella 7 - punctata</i>	Seven Spot Ladybird	Common, Widespread	24/07/2018, 15/08/2018
		<i>Harmonia axyridis</i>	Harlequin Ladybird	Common, Widespread	08/06/2018, 24/07/2018
		<i>Propylea 14 - punctata</i>	14 Spot Ladybird	Common, Widespread	08/06/2018
	Elateridae (Click Beetles)	<i>Agriotes acuminatus</i>		Common, Widespread	08/06/2018

Order	Family	Scientific Name	English Name	Status	Date
	Malachiidae (Pollen Beetles)	<i>Malachius bipustulatus</i>		Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018
	Mordellidae (Tumbling Flower Beetles)	<i>Varimorda villosa</i>		Nationally Scarce Nb	24/07/2018
	Oedemeridae (Oedemerid Beetles)	<i>Oedemera nobilis</i>		Common, Widespread	08/06/2018, 26/06/2018, 24/07/2018, 15/08/2018
ARACHNIDA (Spiders)	Argiopidae (Orb-web Spiders)	<i>Argiope bruennichi</i>	Wasp spider	Nationally Scarce Nb	24/07/2018

Appendix L4 Invertebrate Status Category Definitions and Criteria

Table L10: Invertebrate status categories and associated criteria

Category	Criteria
RDB 1 - Endangered	Taxa in danger of extinction and whose survival is unlikely if causal factors continue operating. - Species which are known or believed to occur as only a single population within one 10 kilometre square of the National Grid. - Species which only occur in habitats known to be particularly vulnerable. - Species which have shown a rapid or continuous decline over the last twenty years and are now estimated to exist in five or fewer 10 kilometre squares. - Species which are possibly extinct but have been recorded in the 20th Century and if rediscovered would need protection.
RDB 2 - Vulnerable	Taxa believed likely to move into the endangered category in the near future if the causal factors continue operating. - Species declining throughout their range. - Species in vulnerable habitats.
RDB 3 - Rare	Taxa with small populations that are not at present Endangered or Vulnerable, but are at risk. Species which are estimated to exist in only fifteen or fewer post-1970 10 kilometre squares. This criterion may be relaxed where populations are likely to exist in over fifteen 10 kilometre squares but occupy small areas of especially vulnerable habitat.
RDB K - Data Deficient	Information on the status of the species is lacking or insufficient and therefore a threat status assessment cannot be undertaken. However, in many cases these species are range restricted and rare species, the reasons for which are usually unknown (i.e. genuine rarity, difficulty in identification, under recording etc.)
Nationally Scarce (Na)	Taxa which do not fall within the RDB categories but which are none-the-less uncommon in Great Britain and thought to occur in 30 or fewer 10 kilometre squares of the National Grid.
Nationally Scarce (Nb)	Taxa which do not fall within the RDB categories but which are none-the-less uncommon and thought to occur in between 31 and 100 10 kilometre squares of the national Grid.
Nationally Scarce (N)	Species which are estimated to occur within the range of 16 to 100 10 kilometre squares.
County Scarce (CS)	Within Hampshire local groups have determined the status of some species, notably <i>Lepidoptera</i> (butterflies and moths) within Hampshire. County Scarce species are those which have been recorded in 4% or less tetrads (2x2km²) within the county (Hampshire Biodiversity Information Centre, 1996)

Category	Criteria
Hampshire BAP	Hampshire BAP species were designated as part of the UK BAP process and were last reviewed in 2000. UK BAP species have now been superseded by S41 species (see below) but the Hampshire BAP has not been updated. These species are considered to be particularly important within the local Hampshire context.
S41 Species of Principal Importance	These species have been identified as being of principal importance for the purposes of conserving biodiversity in England (see Appendix L5 for further details).

Appendix L5 Invertebrate Legislation

This Appendix has been replaced with up to date legislation information in the Desk Study Report in Appendix 9.1.

Appendix L6 Moth Species Recorded from Leigh Park and Suitability of the Site for these Species

Moth species recorded from local residents moth trap at Winterslow Drive Leigh Park located south-east of the site (SU 713 089) and suitability of the site for these species is presented in **Table L11: Table L11**. The foodplant, UK and Hampshire distribution and status data presented in **Table L11** was obtained from the Hantsmoth website (Wall, 2018)

Table L11: Moth species recorded from Leigh Park local resident moth trap and an assessment of the suitability of the site for these species

Species	Foodplant(s)	UK Distribution and Status (Wall, 2018)	Hampshire Distribution and Status (Wall, 2018)	Assessment of Status On-site	Suitability of the Site
Dark spectacle	Common nettle <i>Urtica dioica</i> , hop <i>Humulus lupulus</i>	Common in a wide range of habitats, including river-banks, hedgerows and gardens throughout the British Isles.	Relatively widely distributed throughout Hampshire. Maximum records in a single year 96 (2013)	Common nettle infrequent at the site. Therefore, the site is unlikely to support a significant population of this species.	Limited suitable habitat present
Saltern ear	Various grasses	Local on coastal salt-marshes and sand-dunes, on the south and east coasts of England.	Coastal bias to records. Maximum records in a single year 37 (2010).	Habitat on-site is unsuitable for this coastal species.	No suitable habitat present
Reddish light arches	Various grasses	Local on chalk and limestone grassland, sand-dunes and shingle beaches throughout England.	Locally common in areas with chalk substrate, particular known from specific locations on the coast and chalk grassland sites such as Martin Down. Maximum records in a single year 72 (2014) although most years have between 10-30 records.	This species is mainly known from chalk downland within Hampshire and is unlikely to breed within the site.	Limited suitable habitat present
Small clouded brindle	Various grasses such as reed canary-grass <i>Phalaris arundinacea</i> and wavy hair-grass <i>Deschampsia flexuosa</i> .	Common in marshes, river-banks, damp woodland and damp grassland throughout most of Britain.	Widespread and moderately common in Hampshire. Maximum records in a single year 40 (2009).	It is possible that this species is supported by the site and Havant Thicket woodland to the north. Although wavy hair grass is restricted to Havant Thicket Woodland.	Limited suitable habitat present
Festoon	Oak <i>Quercus</i> species and beech <i>Fagus sylvatica</i>	Broad-leaved woodland and hedgerows throughout much of south-eastern England.	Significant increase in recent years, possibly as a result of increase in average summer temperatures. Maximum records in a single year 180 (2006).	The broadleaved woodland within the site is suitable for this increasing species.	Suitable habitat present

Species	Foodplant(s)	UK Distribution and Status (Wall, 2018)	Hampshire Distribution and Status (Wall, 2018)	Assessment of Status On-site	Suitability of the Site
Red-necked footman	Lichens growing on oak, birch <i>Betula</i> species, beech, European larch, Norway spruce and various trees	Local in broad-leaved woodland and plantations throughout much of southern England and Wales.	The species has increased in Hampshire and is now widespread across much of the county. Maximum records in a single year 59 (2013)	The broadleaved woodland within the site is suitable for this increasing species.	Suitable habitat present
Antler moth	Various grasses, including sheep's-fescue <i>Festuca ovina</i> , mat-grass <i>Nardus stricta</i> and purple moor-grass <i>Molinia caerulea</i>	Common in upland grassland, moorland and downland throughout much of the British Isles.	Rather uncommon in Hampshire, a species that has shown a significant decline in the last 20 years. Maximum records in a single year 29 (2013)	The grassland on-site is potentially suitable for this species albeit not similar to typical habitat in Hampshire (downland). Havant Thicket woodland may be more suitable given the species preference for purple moor-grass and sheep's fescue, species which are rare on site but are present within Havant Thicket woodland	Limited suitable habitat present
Lesser-spotted pinion	Elms <i>Ulmus</i> species	Local in woodland and hedgerows throughout much of southern England.	Uncommon due to the loss of elms as a result of Dutch elm disease. Maximum records seven (2008), most years 1-2 individuals recorded.	No elms were recorded within the site and therefore this species is likely to be absent as a breeding species.	No suitable habitat present
Small phoenix	Willowherb <i>Epilobium</i> species and enchanter's-nightshade <i>Circaea lutetiana</i>	Common in woodland rides, gardens, hedgerows, calcareous grassland, heathland and fens, and on allotments and roadside verges throughout the British Isles.	Widespread and common in Hampshire. Maximum records in a single year 312 (2013)	Enchanter's nightshade is frequent in The Avenue and has also been recorded in broadleaved woodland within Havant Thicket woodland. The site and surrounding area are potentially suitable for small phoenix.	Suitable habitat present
Orange footman	Lichens growing on oak, beech and blackthorn <i>Prunus spinosa</i>	Local in deciduous, especially oak and beech, woodland throughout much of southern England.	In Hampshire still common in areas of oak woodland, and may even be extending its range. Maximum recorded in a single year 351 (2010), increasing.	Suitable habitat within The Avenue, Middle Clearing and Round Wood.	Suitable habitat present
Jersey tiger	Herbaceous plants such as common nettle, hemp-agrimony <i>Eupatorium cannabinum</i> , white dead-nettle <i>Lamium</i>	Locally common on sea cliffs, undercliffs, gardens, rough ground and hedgerows, mainly in south-western England.	Now resident in the county after first being recorded in 1987. The species has increased in recent years with 161 recorded in 2013.	The larvae of Jersey tiger have a varied diet including species present within the site and Havant Thicket woodland to the north.	Suitable habitat present

Species	Foodplant(s)	UK Distribution and Status (Wall, 2018)	Hampshire Distribution and Status (Wall, 2018)	Assessment of Status On-site	Suitability of the Site
	<i>album</i> , ribwort plantain <i>Plantago lanceolata</i> , greater plantain <i>Plantago major</i> , ground- ivy <i>Glechoma</i> <i>hederacea</i> and bramble <i>Rubus fruticosus</i> aggregate.				
Poplar kitten	Poplar <i>Populus</i> species and aspen <i>Populus</i> <i>tremula</i>	Local in woodland, plantations and gardens throughout England.	In Hampshire widely distributed, but not particularly common. Maximum recorded in a single year 42 (2008)	Poplars and aspen are rare within the reservoir site being confined to a small number of immature plants adjacent to the southern edge of The Avenue. Aspen is more common along the access track to the north.	Limited suitable habitat present
Tawny shears	Bladder campion <i>Silene</i> <i>vulgaris</i> , white campion <i>Silene latifolia</i> , Nottingham catchfly <i>Silene nutans</i> , sea campion <i>Silene uniflora</i> and rock sea-spurrey <i>Spergularia rupicola</i>	Found in dry open areas throughout much of England.	In Hampshire very local and increasingly coastal in occurrence. Maximum recorded in a single year 10 (2011)	No campions, catchfly or spurreys have been recorded from the site or Havant Thicket woodland and therefore this species is considered to be absent.	No suitable habitat present
Obscure wainscot	Common reed <i>Phragmites australis</i>	Local in reed-beds, and by fens, ponds and other freshwater margins throughout much of southern and eastern England.	In Hampshire local in reed-beds, with only occasional records away from this habitat. Maximum records 59 (2009).	No reedbeds are present within the site and therefore this species is considered to be absent.	No suitable habitat present
Four-spotted footman	Lichens growing on oaks.	Local in broad-leaved woodland in southern England.	In Hampshire resident at low density in the New Forest and an uncommon, presumed, immigrant elsewhere. Maximum records 272 (2013)	Suitable habitat within The Avenue, Middle Clearing and Round Wood.	Suitable habitat present
Yellow pearl	Hedge bedstraw <i>Stachys sylvatica</i> , field woundwort <i>Stachys</i> <i>arvensis</i> , black	Rare on chalk downland and grassy slopes in parts of southern England, predominantly coastal.	In Hampshire and on the Isle of Wight the species has two strongholds where it is common, on Porton, Broughton and Stockbridge Downs. Occasional	Although some of the larval foodplants are present within the site the restricted nature of the yellow pearl	Site unlikely to support this species

Species	Foodplant(s)	UK Distribution and Status (Wall, 2018)	Hampshire Distribution and Status (Wall, 2018)	Assessment of Status On-site	Suitability of the Site
	horehound <i>Ballota nigra</i> , small nettle <i>Urtica urens</i> and mignonette <i>Reseda odorata</i> .		specimens encountered away from these localities suggest that there may be other, perhaps small, colonies still undetected. Maximum recorded in a single year 37 (2013)	indicate that this species is unlikely to be present.	
Beautiful carpet	Bramble, dewberry <i>Rubus caesius</i> , raspberry <i>Rubus idaeus</i> and hazel <i>Corylus avellana</i> .	Common in open broad-leaved woodland and mature hedgerows throughout much of England.	In Hampshire widespread but scarce in deciduous and open coniferous woodland where there is a good growth of bramble. Maximum records in a single year 15 (2014)	Suitable habitat is present within The Avenue, Middle Clearing and Round Wood. Also suitable habitat in Havant Thicket woodland to the north of the site.	Suitable habitat present
Rosy-striped knot-horn	Bird's-foot Trefoil <i>Lotus corniculatus</i> , white clover <i>Trifolium repens</i> and common restharrow <i>Ononis repens</i>	Scarce on chalk downland and limestone cliffs in England, from Kent to Somerset and in Norfolk.	Records in Hampshire mostly likely to result from immigrants from the continent, although a resident population is present on the Isle of Wight. Maximum records in a single year 32 (2014)	No chalk downland or limestone cliffs are present within the site and therefore this species is considered to be absent.	No suitable habitat present
Grass rivulet	Yellow rattle <i>Rhinanthus minor</i>	Local on calcareous grassland, sand-hills and coastal shingle throughout the British Isles.	In Hampshire local on good quality grassland, particularly on the downs. Maximum records in a single year 15 (2009 and 2013)	No yellow rattle has been recorded from the site and therefore this species is considered to be absent.	No suitable habitat present
Barred umber	Hazel, birch, willow species and hawthorn <i>Crataegus monogyna</i>	Local in ancient broad-leaved woodland and on limestone pavements throughout much of the British Isles.	In Hampshire widely distributed but somewhat scarce, in surviving areas of mature deciduous woodland. Maximum recorded in a single year 19 (2010)	Suitable habitat present within The Avenue. Larval foodplant present in Havant Thicket woodland.	Suitable habitat present
Maple prominent	Field maple <i>Acer campestre</i>	Local in broad-leaved woodland, scrub, hedgerows and gardens throughout much of south-eastern England.	Thinly distributed from the south-east of Hampshire up to the north and north-east. Maximum recorded in a single year 20 (2009)	Field maple is rare within The Avenue and absent from Round Wood Middle Clearing and the Corsican Pine Plantation.	Limited suitable habitat present
Shaded broad-bar	White clover, red clover <i>Trifolium pratense</i> , Hare's-foot clover <i>Trifolium arvense</i> and vetch <i>Vicia</i> species	Common in calcareous grassland, acid heathland, woodland rides, roadside verges, sand-dunes and gardens throughout the British Isles.	In Hampshire much less common than in the past, however large colonies still occur locally in dunes and amongst scrub on downland. Maximum recorded in a single year 104 (2012)	Limited suitable habitat is present within the site, mainly comprising the bridleway east of The Avenue which contains clovers and associated scrub.	Limited suitable habitat present

Species	Foodplant(s)	UK Distribution and Status (Wall, 2018)	Hampshire Distribution and Status (Wall, 2018)	Assessment of Status On-site	Suitability of the Site
Dusky brocade	Various grasses, including reed canary-grass and common couch <i>Elymus repens</i>	Common in damp meadows, calcareous grassland, gardens, hedgerows and open woodland throughout the British Isles.	Widespread and still moderately common in Hampshire. Maximum recorded in a single year 113 (2009)	The site is suitable for this species which has a broad habitat tolerance.	Suitable habitat present
Dusky thorn	Ash <i>Fraxinus excelsior</i>	Common in woodland, hedgerows and gardens throughout much of England.	Historic decline in Hampshire although since the end of the 1990's a population 'explosion' has occurred and it is now recorded in higher numbers than at any time in the last four decades. Maximum recorded in a single year 586 (2006)	The Avenue contains ash and is suitable for this species. Round Wood and Middle Clearing are single species pedunculate oak plantations and are therefore unsuitable.	Suitable habitat present
Rosy rustic	Dock <i>Rumex</i> species, hop, Plantain <i>Lanceolata</i> species, woundwort <i>Stachys</i> species and burdock <i>Arctium</i> species	Common in gardens, hedgerows, fens and woodland rides, and on rough ground and at freshwater margins throughout the British Isles.	In Hampshire widespread and locally common. Maximum recorded in a single year 442 (2011)	The larval of this species feeds on a variety of herbaceous species including many that are present within the site. The species has broad habitat preferences including many that are present within the site.	Suitable habitat present
Large wainscot	Common reed	Common in reed-beds throughout much of the British Isles.	In Hampshire widely distributed in drier reed beds. Maximum recorded in a single year 210 (2011)	No reedbeds are present within the site and therefore this species is considered to be absent.	No suitable habitat present
Buff ermine	A wide range of herbaceous plants included honeysuckle <i>Lonicera periclymenum</i> , hop and birch.	Common in a wide range of habitats, including gardens, hedgerows, parkland and woodland throughout England.	Widespread and common in Hampshire. Maximum recorded in a single year 1137 (2010)	This species is likely to be present within the site given that the species is found in most habitat including gardens, hedgerows, parks and woodlands	Suitable habitat present
Brown-spot pinion	Larva feeds on various herbaceous plants, including meadowsweet <i>Filipendula ulmaria</i> , common sorrel <i>Rumex acetosa</i> and bladder campion.	Common in broad-leaved woodland, parkland, heathland, fens, scrub, hedgerows and gardens throughout the British Isles.	Widespread and moderately common in Hampshire. Maximum recorded in a single year 135 (2011)	Suitable habitat within the site in the form of broadleaved woodland and scrub.	Suitable habitat present

Species	Foodplant(s)	UK Distribution and Status (Wall, 2018)	Hampshire Distribution and Status (Wall, 2018)	Assessment of Status On-site	Suitability of the Site
Beaded chestnut	Hawthorn	Common in broad-leaved woodland, scrub, hedgerows, grassland, heathland and gardens throughout England.	Widespread and common in Hampshire.	Suitable habitat within the site in the form of broadleaved woodland, scrub and grassland	Suitable habitat present
Green-brindled crescent	Larva feeds on hawthorn and blackthorn and, less frequently, other broad-leaved trees and shrubs.	Common in broad-leaved woodland, scrub, hedgerows and gardens	In Hampshire widely distributed, but not particularly common	Suitable habitat within the site in the form of broadleaved woodland and scrub.	Suitable habitat present
Ear moth	Various grasses, including annual meadow-grass and tufted hair-grass <i>Deschampsia cespitosa</i> , and herbaceous plants such as butterbur <i>Petasites hybridus</i>	Common in unimproved grassland, woodland rides, marshes, moorland, saltmarshes and gardens	Widespread in Hampshire and found in small numbers across the county	The foodplants are present within the site with tufted hair-grass especially well represented.	Suitable habitat present
Mouse moth	A wide range of herbaceous plants and shrubs.	Common in a wide range of habitats, including gardens, woodland, sand-dunes, moorland and fens.	Widespread and still moderately common in Hampshire.	Suitable habitat within the site in the form of broadleaved woodland.	Suitable habitat present
Garden tiger	Various herbaceous plants, including common nettle, broad-leaved dock <i>Rumex obtusifolius</i> , greater burdock <i>Arctium lappa</i> and lesser burdock <i>Arctium minus</i> .	Reasonably common, but has declined drastically in recent years, in gardens, water meadows, marshes, fens, sand-dunes and open woodland	Widespread in Hampshire, but present only in small numbers.	Suitable habitat within the site in the form of broadleaved woodland and marshy grassland.	Suitable habitat present

Species	Foodplant(s)	UK Distribution and Status (Wall, 2018)	Hampshire Distribution and Status (Wall, 2018)	Assessment of Status On-site	Suitability of the Site
Minor shoulder-knot	Willow species.	Common in damp woodland, marshes, fens and gardens.	Well distributed across much of Hampshire	Suitable habitat within the site in the form of damp woodland and marshy grassland.	Suitable habitat present
Bulrush veneer	Bulrush <i>Typha latifolia</i>	Local in fens, marshes, river-banks and gravel pits in parts of southern England, increasing in recent years	In Hampshire breeding colonies are widespread, and the moth can be quite common in some areas.	A small stand of Bulrush is present in the Upper Lake at the northern end of The Avenue.	Limited suitable habitat present
Mottled rustic	Common nettle, curled dock <i>Rumex crispus</i> , broad-leaved dock, goosefoot <i>Chenopodium album</i> and hedge bedstraw.	Common in a wide range of low-land habitats, including grassland, farmland, heathland, scrub, woodland and gardens	Widespread and common in Hampshire.	This species is likely to be present within the site given that the species is found in most habitat including hedgerow, scrub and woodlands	Suitable habitat present
Sallow	Grey willow <i>Salix cinerea</i> , poplars and aspen	Common in woodland rides and clearings, hedgerows, parks, moorland, heathland and gardens	Widespread and common in Hampshire.	Larval foodplant present widely within the site.	Suitable habitat present
Striped lychnis	Flowers of dark mullein <i>Verbascum nigrum</i>	Found on calcareous grassland and roadside verges.	Hampshire is an important national stronghold for the species.	This species relies on the species dark mullein which is not present within the site.	No suitable habitat present
Small square-spot	Various herbaceous plants, including dandelion <i>Taraxacum officinale</i> aggregate and docks.	Common in damp woodland and grassland, gardens and rough meadows.	Widespread and common in Hampshire.	Rough meadows present throughout the site.	Suitable habitat present
September thorn	Oak, lime <i>Tilia</i> species, birch and beech	Common in woodland, parks and gardens throughout much of England.	Common and widespread in Hampshire.	Suitable habitat within The Avenue, Middle Clearing and Round Wood.	Suitable habitat present
Spinach	Black currant <i>Ribes nigrum</i> and red currant <i>Ribes rubrum</i>	Common in woodland, gardens and allotments throughout lowland Britain	Widespread in Hampshire.	Red currant is rare on-site and was only recorded in The Avenue. No black currant has been recorded from the site.	Limited suitable habitat present

Species	Foodplant(s)	UK Distribution and Status (Wall, 2018)	Hampshire Distribution and Status (Wall, 2018)	Assessment of Status On-site	Suitability of the Site
White-line dart	Various herbaceous plants, including common mouse-ear <i>Cerastium fontanum</i> , common chickweed <i>Myosoton aquaticum</i> , greater stitchwort <i>Stellaria holostea</i> and hedge bedstraw	Common on sand-dunes, sea cliffs, heathland, moorland and downland throughout much of the British Isles	In Hampshire found primarily on the sandy coasts.	In a Hampshire context the site does not provide suitable habitat for this species which is confined to sandy coastal locations.	No suitable habitat present
Crescent	Great fen-sedge <i>Cladium mariscus</i> and Yellow Iris <i>Iris pseudacorus</i> .	Local in fens, reed-beds, marshes, river-banks and other damp areas	In Hampshire mainly confined to the coast, where there is a particularly strong population at Titchfield Haven, with a scattering of inland records, most notably at Winnall Moors, Winchester.	The larval foodplants are not present within the site and the species is confined to the coast.	No suitable habitat present
Small emerald	Traveller's-joy <i>Clematis vitalba</i> and cultivated <i>Clematis</i> .	Local on heathland, downland, open woodland, scrubland and in gardens.	In Hampshire frequent amongst <i>Clematis</i> on the chalk, and occasional elsewhere	The larval foodplant is not present within the site.	No suitable habitat present
Rustic	Various herbaceous plants, including chickweed, dock and plantain	Common in a wide range of habitats, mainly in low-lying areas, including woodland, rough meadows and gardens.	Common and well distributed in Hampshire	This species has broad habitat requirements, including woodland and rough meadows	Suitable habitat present
Dog's tooth	Various herbaceous plants, including common sea-lavender <i>Limonium vulgare</i> and greater plantain	Local in saltmarshes, grassland, moorland and farmland	Local in Hampshire and virtually confined to the coast, with only a thin scattering of records inland.	A coastal species unlikely to be breeding on site	No suitable habitat present
Shoulder-striped wainscot	Various grasses, especially cock's-foot <i>Dactylus glomerata</i>	Common in fens, marshes, grassland, gardens and damp woodland	Widespread and still moderately common in Hampshire	The species habitat requirements include grassland and marshy areas; therefore this species may be present within the site	Suitable habitat present
Rosy minor	Various grasses, including lyme-grass <i>Leymus arenarius</i> ,	Common in calcareous grassland, fens, scrub, gardens, sea cliffs and sand-dunes	In Hampshire found mainly on the coast and on the chalk downs	The species coastal and chalk downland distribution indicates that	Suitable habitat present

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	Marram-grass, Cock's-foot and some cereal crops			rosy minor is unlikely to be resident on-site.	
Brindled beauty	Various broad-leaved trees and shrubs, including birch, hawthorn, alder, willow, oak, elm and lime	Common in broad-leaved woodland, scrub, hedgerows, parks and gardens	In Hampshire is widespread, but only found in numbers in mature oak woodland	Suitable broadleaved woodland is present within the site, especially within The Avenue	Suitable habitat present
Lackey	Various broad-leaved trees and shrubs, including hawthorn, blackthorn, plum, apple and cherry	Common on heaths, gardens and open woodland	In Hampshire is widespread and usually common	A species that has been recorded regularly adjacent to the site. The larval foodplants are mainly present in The Avenue.	Suitable habitat present
Dot moth	Herbaceous plants such as stinging nettle, broad-leaved dock and white clover, and woody plants such as black currant, ivy, hazel and elder	Common in a wide range of habitats, including gardens, hedgerows and woodland	Widespread and common in Hampshire	This species has wide a wide habitat tolerance including woodland.	Suitable habitat present
Marbled green	Various lichens, often on walls	Local in rocky areas and on dry-stone walls	In Hampshire locally common on the south of the county east of Southampton	The site does not contain any walls or rocky areas and therefore this species is unlikely to be resident.	No suitable habitat present
Powdered Quaker	Various woody and herbaceous plants, including eared willow <i>Salix aurita</i> , grey and willow, goat willow <i>Salix caprea</i> , black poplar <i>Populus nigra</i> , blackthorn, bog-myrtle <i>Myrica gale</i> , meadowsweet, purple loosestrife <i>Lythrum</i>	Common in marshes, damp woodland and gardens	Widespread and still fairly common in Hampshire	Many of the foodplants are present within the site, especially along the ditch lines in the west of the site.	Suitable habitat present

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	<i>salicaria</i> and common fleabane <i>Pulicaria</i> <i>dysenterica</i>				
Gold spot	Various sedges, including tufted sedge <i>Carex stricta</i> and glaucous sedge <i>Carex</i> <i>flacca</i> , and other waterside plants.	Common in marshes, fens, woodland rides and upland grassland, and on heathland, moorland and river-banks	In Hampshire an uncommon resident, mainly in coastal marshes and less commonly in the river valleys, occasional wanderers may turn up elsewhere	A variety of sedges are present on-site and woodland rides and marshy grassland. Although the species coastal and river valley distribution in Hampshire would indicate that it may not be resident within the site.	Limited suitable habitat present
Mullein wave	Wild marjoram <i>Origanum vulgare</i> , wood sage <i>Teucrium</i> <i>scorodonia</i> , horseshoe vetch <i>Hippocrepis</i> <i>comosa</i> , yarrow <i>Achillea millefolium</i> and mugwort <i>Artemisia</i> <i>vulgaris</i> .	Local in grassland and saltmarshes	In Hampshire fairly frequent along the coast, although rare inland, where mainly confined to the chalk.	Suitable grassland habitat for this species is present within the site. Although the species has not been recorded since 2003 from the moth trap in Leigh Park indicating it is not resident nearby.	Unlikely to be present
White ermine	Various herbaceous plants, especially stinging nettle and several species of dock	Common in gardens, hedgerows, grassland, heathland, moorland and woodland	Widespread and common in Hampshire	A species with broad habitat tolerance including a number of habitats present within the site.	Suitable habitat present
Hedge rustic	Various grasses, including mat-grass and wavy hair-grass.	Common in rough grassland and gardens	In Hampshire continues to be recorded regularly and in good numbers only at Sandy Point, Hayling Island.	A species with a restricted range in Hampshire. Habitat suitable for this species is present but the species has not been recorded at the regularly used moth trap adjacent to the site since 2013 indicating that it is absent from the site.	Unlikely to be present
Feathered gothic	Various species of grass, including mat- grass and sheep's- fescue	Common on rough grassland, downland, woodland edges, parks and gardens	In Hampshire there has been a substantial decline since the 1950s, when it was abundant on the north-east heaths and in the New Forest	Suitable habitat is present within the site in the form of rough grassland and woodland edges	Suitable habitat present

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Blood-vein	Orache <i>Chenopodiaceae</i> species, common sorrel, sheep's sorrel <i>Rumex acetosella</i> , knotgrass <i>Polygonum</i> species and dock.	Common in marshes, river-banks, water meadows and gardens	Widespread and common in Hampshire	Regularly recorded adjacent to the site, docks and marshy grassland are present within the site.	Suitable habitat present
Oak hook-tip	Pedunculate oak and sessile oak	Common in oak woodland, hedgerows, parks and gardens	Widespread and common in Hampshire	A species with broad habitat tolerance including a number of habitats present within the site.	Suitable habitat present
Dark-barred twin-spot carpet	bedstraws, ground-ivy and docks	Common in gardens, woodland, hedgerows, downs, fens, moors and sand-dunes	Widespread and common in Hampshire	A species with broad habitat tolerance including a number of habitats present within the site.	Suitable habitat present