A358 Taunton to Southfields Dualling Scheme

Ecological Baseline Report - Aquatic Macroinvertebrates and White-clawed Crayfish

HE551508-ARP-EBD-ZZ-RP-LE-000014

24 May 2022

Table of contents

Table of Figures

Table of Tables

Executive summary

The A358 Taunton to Southfields Dualling scheme (hereafter referred to as 'the scheme') would provide a dual carriageway along the length of the A358 between Taunton and Ilminster in Somerset, connecting the M5 motorway to the A303 at Ilminster to the south.

White-clawed crayfish (*Austropotamobius pallipes*) and aquatic macroinvertebrate assemblage surveys (hereafter referred to as macroinvertebrates) were part of the suite of habitat and protected species surveys commissioned in relation to the scheme. This report presents the results of the surveys undertaken throughout 2021 and aims to inform the ecology baseline for the scheme.

The objectives of this report are to present the methodologies used, identify survey limitations, and present the results white-clawed crayfish and macroinvertebrate surveys; the results of which will be used to inform appropriate mitigation and enhancement (if required).

White-clawed crayfish are protected under Schedule 5 of the Wildlife and Countryside Act 1981. White-clawed crayfish, and certain macroinvertebrates, are also designated as a Species of Principal Importance (SPI) in accordance with Section 41 of the Natural Environment and Rural Communities Act 2006.

A desk study undertaken reviewing available third-party data found no records of protected species within the study area.

A total of ten watercourse crossing points were surveyed for white-clawed crayfish using a nationally accepted standardised sampling methodology in August 2021. Sampling was undertaken at nine watercourse crossing points for macroinvertebrates, which included an upstream and downstream sample at each location in both May and September 2021.

Sampling for macroinvertebrates was not undertaken at two sites in spring due to access restrictions, while three sites were not sampled in autumn due to them being either dry or too shallow to collect a sample. This was also the case at one of the white-clawed crayfish sites.

No crayfish of any species were recorded during physical surveys. However, crayfish remains were present in otter (*Lutra lutra*) spraint at three of the sites. Environmental DNA (eDNA) analysis did not detect white-clawed crayfish at any site whilst American signal crayfish (*Pacifastacus leniusculus*) was detected at one site. The fact that white-clawed crayfish was not detected during physical surveys or through eDNA analysis provides sufficient evidence to suggest the likely absence of this species at the ten crossing locations.

There were no protected macroinvertebrate species present at any of the sites sampled and a general decrease in the aquatic macroinvertebrate metric scores was observed between the spring and autumn surveys, likely due to a dry summer, although some seasonal variation in scores were to be expected.

No specific avoidance, mitigation or compensation would be required for white-clawed crayfish and macroinvertebrate species above those employed through standard best practice. However, the presence of American signal crayfish, will require mitigation measures to be included in the Construction Environmental Management Plan (CEMP) to limit the risk of spread during in-river construction phase works.

1 Introduction

1.1 Purpose and scope of this document

1.1.1 The A358 Taunton to Southfields Dualling scheme (hereafter referred to as 'the scheme') would provide a dual carriageway along the length of the A358 between Taunton and Ilminster in Somerset, connecting the M5 motorway to the A303 at Ilminster to the south. Aquatic macroinvertebrate (hereafter referred to as macroinvertebrates) surveys were part of the suite of habitat and protected species surveys commissioned in relation to the scheme.

1.1.2 This report presents the results of the macroinvertebrate surveys, comprising white-clawed crayfish (*Austropotamobius pallipes*) and macroinvertebrate assemblage surveys, and aims to inform the ecology baseline for the scheme.

1.1.3 The objectives of this report are to:

- establish baseline conditions and determine the presence of protected and/or notable macroinvertebrate species within the study area
- establish whether white-clawed crayfish are present within watercourses crossed by the scheme
- use macroinvertebrate data to assess the biological and physical habitat qualities of the watercourses
- provide recommendations, if required, to enable compliance with relevant legislation and planning policy
- identify the need for avoidance, mitigation and compensation (if required)

1.2 Scheme overview

1.2.1 The scheme is part of a programme of improvements planned along the A303/A358 corridor aimed at improving connectivity between London, the south-east and the south-west. The A303, alongside the A30, forms part of the strategic road network (SRN) and together with the A358, provides the link between London, the south-east and the south-west.

1.2.2 The programme of improvements, as set out in the Government's *Road Investment Strategy* [1] made a commitment to, *"…upgrade all remaining sections of the A303 between the M3 and the A358 to dual carriageway standard, together with creating a dual carriageway link from M5 at Taunton to the A303"*.

1.2.3 The scheme directly addresses this long-term commitment and would provide a new rural all-purpose dual carriageway link from the M5 at Taunton to the A303 at Southfields roundabout. The new dual carriageway would comprise new and upgraded stretches of the existing A358 road. Full details of the scheme will be provided in Chapter 2 *The Project* of the Environmental Statement (ES). Please refer to Figure 1-1 for a scheme plan.

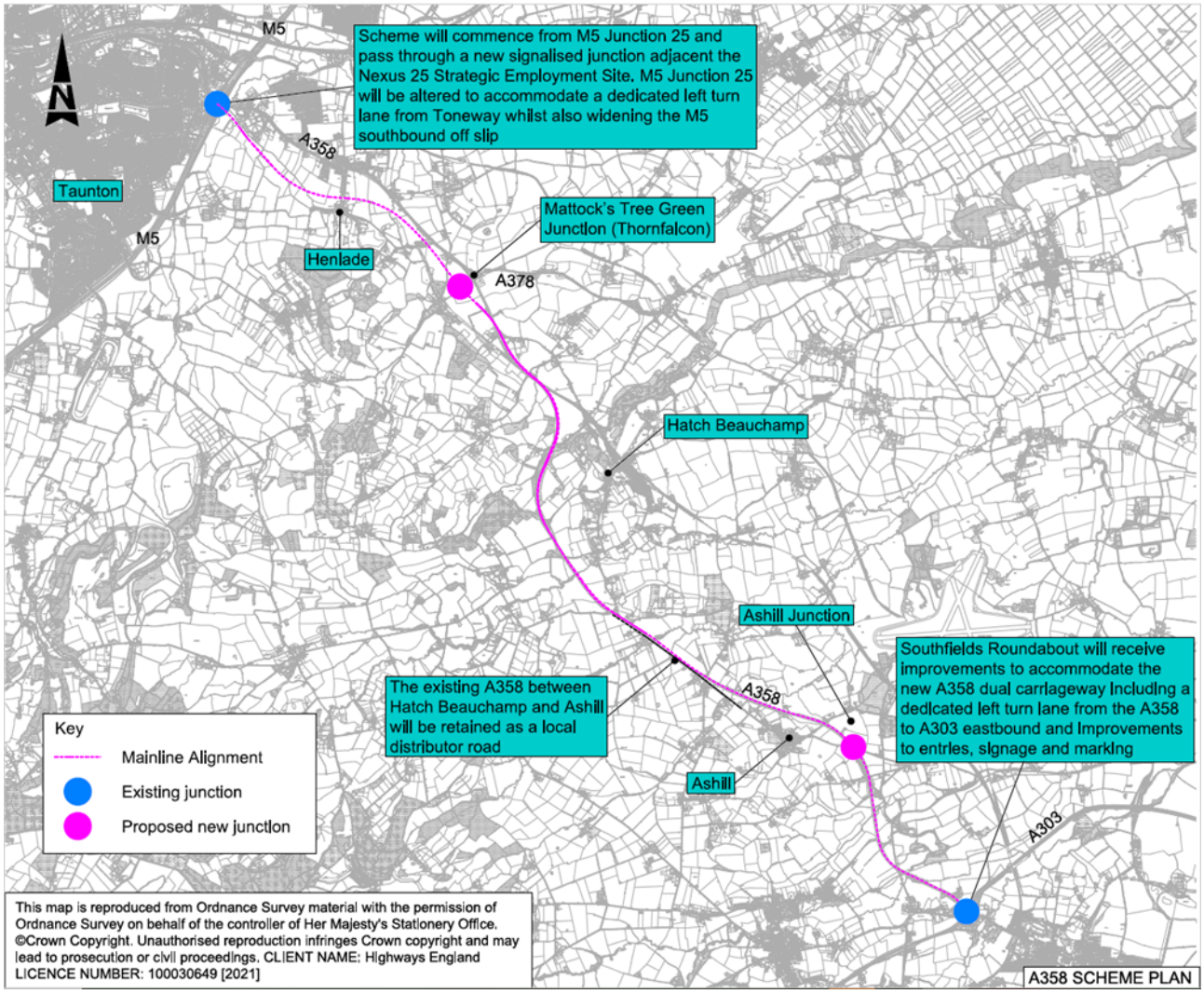


Figure 1-1 Scheme plan

1.3 Study area and zone of influence

1.3.1 The Chartered Institute for Ecology and Environmental Management (CIEEM) *Guidelines for Ecological Impact Assessment* [2] recommend that all potentially important ecological features that occur within the Zone of Influence (ZoI) for a scheme are investigated. The ZoI includes:

- areas to be directly impacted by land take for the scheme resulting in a loss or degradation of existing aquatic species or habitat
- areas that would be temporarily affected during construction
- aquatic species or habitats which could be indirectly affected by the scheme through, for example, overshading or changes in water levels or water quality, including any habitat hydrologically connected to the construction area

1.3.2 The ZoI depends on the ecological features concerned. With regard to the watercourses likely to be affected by the scheme. With regard to white-clawed crayfish and macroinvertebrates the ZoI will vary across different watercourses due to indirect impacts downstream of working extents and hydrologically connected features. For the purposes of the white-clawed crayfish and macroinvertebrate surveys the ZoI is defined as watercourses and associated aquatic and riparian habitat within 250 metres and 100 metres of the ecology survey zone (which

comprises the footprint of the scheme and associated site clearance area) respectively. This ZoI is hereafter referred to as the study area.

1.4 Legislation

1.4.1 A framework of international, European, national and local legislation and planning policy guidance exists to protect and conserve wildlife and habitats in England. This legislation will be listed in full within Chapter 8 *Biodiversity* of the ES. Legislation relevant to and discussed within this report are:

- The Conservation of Habitats and Species Regulations 2017
- Wildlife and Countryside Act 1981
- Natural Environment and Rural Communities (NERC) Act 2006

1.4.2 White-clawed crayfish are protected under Schedule 5 of the Wildlife and Countryside Act 1981 under which it is an offence to take or sell white-clawed crayfish. This legislation does not confer protection of habitat used by white-clawed crayfish.

1.4.3 White-clawed crayfish is listed on Annex II of the EU Habitats Directive, implemented in the UK under the Conservation of Habitats and Species Regulations 2017, which requires the designation of core areas of habitat as Sites of Community importance (SCIs) and included in the National Site Network (previously referred to as Natura 2000 Network). White-clawed crayfish have also been designated as a Species of Principal Importance (SPI) in accordance with Section 41 of the NERC Act 2006.

1.4.4 Other macroinvertebrates receive limited protection from conservation legislation. However, a limited number of species are cited as features of protected areas, listed on the International Union for Conservation of Nature (IUCN) red list and/or designated as SPI for biodiversity in accordance with Section 41 of the NERC Act 2006.

1.4.5 The Water Framework Directive (WFD) (2000/60/EC) is a European directive which aims to protect and improve the water environment. It is transposed into law in England and Wales by The Water Environment (Water Framework Directive) Regulations 2017. There are a number of objectives of the WFD in respect of which the quality of water is protected. The general protection of aquatic ecology is key and ecological protection should apply to all waters.

1.4.6 The overall aims of the WFD relevant to the macroinvertebrates are:

- Enhance the status and prevent further deterioration of surface water bodies, groundwater bodies and their ecosystems.
- Ensure progressive reduction of groundwater pollution.
- Reduce pollution of water, especially by priority substances and certain other pollutants.
- Achieve at least good surface water status for all surface water bodies and good chemical status in groundwater bodies by 2027 (or good ecological potential in the case of artificial or heavily modified water bodies).

1.5 Status of macroinvertebrates and white-clawed crayfish at national level

1.5.1 The white-clawed crayfish is the only species of crayfish native to the UK, it was once common across the country but has suffered a significant decline during the mid to late 20th Century. Populations are now fragmented across England and Wales, meaning the species is nationally very rare.

1.5.2 Despite the decline, populations of white-clawed crayfish are still known to be present in the following areas: Somerset, Gloucestershire, South Wales, Suffolk, East Midlands, Dorset, Exmoor and the North York Moors [3].

1.5.3 White-clawed crayfish are in decline as the result of a range of factors, but chiefly due to the fungal disease crayfish plague (*Aphanomyces astaci*), introduced after the release and spread of invasive non-native crayfish species.

1.5.4 Whilst the introduction of non-native crayfish species is the major threat to white-clawed crayfish, loss of habitat and reduction in water quality also threaten populations throughout the UK.

1.5.5 There are catchments which are free of non-native crayfish species, yet still exhibit rapidly diminishing white-clawed crayfish populations. Susceptibility to pollution occurring from domestic sewage and agricultural run-off also have a negative effect on white-clawed crayfish populations.

1.5.6 Macroinvertebrates receive limited protection from conservation legislation. A very limited group of key species are cited as features of protected areas, listed on the IUCN Red List and/or designated as SPI in accordance with Section 41 of the NERC Act 2006.

1.6 Status of macroinvertebrates and white-clawed crayfish at county level

1.6.1 Within Somerset, watercourses supporting white-clawed crayfish are rare, but the species has been recorded at the following eight locations: River Mells, River Sheppey (culverts through Shepton Mallet), River Alham, Batcombe House Tufa Spring and Cistern, River Brue (Bruton), Lopen Brook, Dairy Field (Chard) and the River Tone (at Tonedale Bridge, Wellington) [4].

1.6.2 White-clawed crayfish are not listed as a Local Biodiversity Action Plan (LBAP) species in any of the Somerset district councils' plans.

1.6.3 No macroinvertebrates are listed as LBAP species in any of the Somerset district councils' local plans.

1.7 White-clawed crayfish and macroinvertebrate ecology

1.7.1 White-clawed crayfish distribution in the UK is largely determined by geology and water quality; areas with relatively hard, mineral-rich waters on calcareous substrates are typical with a pH level between 6.8-8.6 are preferable for this species.

1.7.2 They can inhabit a range of freshwater systems, including small streams, rivers, ditches, lakes, reservoirs and old quarries. Watercourses between 0.75 metres and 1.25 metres deep are more likely to support white-clawed crayfish, although their

presence in very shallow streams and deeper, slow-flowing rivers has also been confirmed [5].

1.7.3 The availability of suitable refuges is also vital to white-clawed populations, which is why it may be more abundant in watercourses which flow north to south where shading is often increased. Refuges may be provided by natural or artificial habitat, typically under rocks, within tree roots or submerged plants or within burrows in riverbanks. These features provide protection from periods of higher flows and refuge opportunities for all white-clawed crayfish life stages against their numerous predators such as European eel (*Anguilla anguilla*), fish, birds and mammals such as mink (*Neovison vison*) and otter.

1.7.4 The species typically favours habitats with an underlying substrate of fine gravel/sand with some pebbles, overlaid with aggregations of boulders and large cobbles. White-clawed crayfish are particularly susceptible after a fresh moult, when their exoskeleton is softer and offers less protection. Due to the large number of potential predators, white-clawed are primarily nocturnal [6].

1.7.5 White-clawed crayfish feed on a variety of live and dead organic matter, such as fallen leaves, vegetation, worms, insect larvae, small fish and other crayfish. Where available, calcified plants are of particular value as they provide a ready source of calcium to build their exoskeleton.

1.7.6 Activity varies by season in response to temperature, river flow and annual cycle of growth, breeding and periods of inactivity. Breeding typically takes place between September and November when water temperatures drop below 10°C for an extended period. During the breeding season different areas within the watercourse may be used for shelter and feeding.

1.7.7 During the winter period, between December and March, they spend most of their time in torpor in refuges until the water temperature increases. Females carry their eggs over the winter period and the juveniles remain on her after hatching at the beginning of the summer. They are usually released from the tail and disperse in June, but this may vary due to location and temperature.

1.7.8 White-clawed crayfish can move along a watercourse for a distance of at least 3 kilometres, maintaining genetic homogeneity within the population. However, even small barriers such as weirs, may limit their movements and isolate populations, limiting connectivity and preventing expansion.

1.7.9 The term macroinvertebrate is the collective name for all benthic aquatic invertebrates visible to the naked eye living on or near the riverbed. They include groups such as freshwater shrimp, aquatic snails, mayflies, beetles, water bugs and caddisflies.

1.7.10 Some species will spend their entire lives in this habitat while others, such as mayfly larvae, only occupy this environment for a distinct life stage. Trophic groups vary with some predating on other invertebrates, while others are grazers, shredders or filter feeders.

1.7.11 Macroinvertebrates vary considerably with regards to sensitivity to water quality. Some species may be tolerant to a certain pollutant but then sensitive to another. They also differ in what flow conditions, water temperature, sediment levels and oxygen levels they prefer. Several indices have been created for macroinvertebrate communities which are commonly used as biological indicators to help determine

water quality, with other indices/metrics specifically designed to assess flow (LIFE) and sediment character (PSI). See section 2.2 for a full list of the metrics used.

2 Methodology

2.1 Desk study

2.1.1 A detailed search for biological records was requested from the Somerset Environmental Records Centre (SERC) in February 2021. This was used to identify records of crayfish and macroinvertebrate species from within a 2 kilometre radius of the scheme.

2.1.2 The Environment Agency's (EA) *Ecology & Fish Data Explorer* [7] was used to search for macroinvertebrate surveys undertaken by the EA within 2 kilometres of the study area in the past 20 years. This data was used primarily to check for the presence of historical records of protected and notable species.

2.1.3 Data from this resource is often not included within county species records. The results from the EA surveys were also used to help determine the presence of white-clawed crayfish.

2.1.4 The *EA's Catchment Data Explorer* [8] was also used to assess the macroinvertebrate Biological Quality Element (BQE) of each of the waterbodies within the scheme area.

2.1.5 A review of the *A358 Taunton to Southfields Dualling Macroinvertebrates Technical Report (May 2021)* [9] was also undertaken to identify any changes at sampling locations in macroinvertebrate assemblages over time.

2.2 Field study

White-clawed crayfish

2.2.1 Surveys were undertaken at crossing points on 10 watercourses and followed the standard methodology set out in Peay (2003) [10]. Locations of the watercourses and survey areas are provided in Appendix A *Site overview map*. Surveys were undertaken on 18 and 19 August 2021, within the optimal survey window.

2.2.2 Surveys involved selecting five 'patches' of suitable habitat for white-clawed crayfish and that could be physically searched, within each watercourse. Within each habitat patch, a search was made of 10 potential refuges. Each refuge was sampled by undertaking a hand-search or, where hand-search was not feasible (e.g. dense marginal macrophytes, tree roots or woody debris), using a kick sampling hand net.

2.2.3 Each patch/refuge was chosen by a suitably qualified and experienced surveyor basing the decision on the availability of optimal refuge habitat.

2.2.4 A standardised field sheet was completed to provide supporting information regarding each sampling location including a detailed description of refuge types as well as habitat suitability and area sampled.

2.2.5 The survey was undertaken by Dave Bartlett (Principal Aquatic Ecologist), a specialist aquatic ecologist with 15 years' relevant experience, supported by Jamie McCready (Aquatic Ecologist) with four years' relevant experience, both of whom have completed CIEEM's Working with Crayfish course. The field team were operating under the CL11 Survey Licence of Seán McGrogan (Principal Aquatic Ecologist).

2.2.6 At sites where evidence of crayfish was present (e.g. in otter spraint) but identification was not possible, environmental DNA (eDNA) surveys were undertaken on 11 October 2021.

2.2.7 This was undertaken at three sites: Site 8, Site 12 and Site 13. Samples were collected using NatureMetrics eDNA sampling kits.

- At each site, five one-litre bottles of river water were filled and poured into a sterile bucket and were thoroughly mixed.
- A sterile 50 millilitre syringe was used to extract water from the bucket and was then pushed through a filter.
- This was repeated until the filter became clogged. The volume of water filtered as well as field measurements were recorded.
- The filter was then preserved and dispatched to NatureMetrics' laboratory for analysis.
- eDNA was extracted from the filters and purified to remove inhibitors. qPCR amplification targeting white-clawed crayfish, American signal crayfish and crayfish plague were carried out in 12 replicates per sample per target, using species-specific primers and probes.
- A score is given out 12 for the number of positive replicates.

Macroinvertebrates

2.2.8 The collection of macroinvertebrate samples was undertaken in spring on 5 and 6 May 2021 and in autumn on 6 and 7 September 2021.

2.2.9 A representative sample site from within the study area (100 metres upstream to 100 metres downstream from where the watercourse crosses the scheme) was chosen by the surveyor as shown in Appendix A *Site overview map*. These sites aligned closely with those surveyed previously in 2017 [9]. Sample locations and dates of sampling are presented in Table 2-1.

2.2.10 All macroinvertebrate surveys were undertaken on Ordinary Watercourses.

2.2.11 Sampling was undertaken using a standardised 3-minute kick sample, using a 1mm mesh net, followed by a 1-minute timed manual search following the EA's operational instruction [11], which conforms to *BS EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters* [12].

2.2.12 Alongside the sample a standardised field sheet (see Table G-1) was completed to provide supporting information regarding each sampling location, including substrate, depths, and riparian land use.

Table 2-1 List of macroinvertebrate survey sites.

Site ID	Watercourse	WFD surface water body	Sample location (NGR), distance and direction from scheme boundary	Spring sample date	Autumn sample date	Reason for no sample being collected
C2	Black Brook Tributary 3	Broughton Brook	ST 26597 23716, 182m downstream	05/05/21	-	Autumn – watercourse too shallow and overgrown to obtain sample within the study area

Site ID	Watercourse	WFD surface water body	Sample location (NGR), distance and direction from scheme boundary	Spring sample date	Autumn sample date	Reason for no sample being collected
C3	Black Brook	Broughton Brook	ST 25649 24737, on scheme boundary	05/05/21	06/09/21	
D1	Thornwater Stream	Tone Ds Taunton Water Body	ST 27614 23383, 174m downstream	05/05/21	06/09/21	
D2	Thornwater Stream	Tone Ds Taunton Water Body	ST27560 23687, 58m upstream	05/05/21	06/09/21	
E1	Meare Stream	West Sedgemoor Main Drain	ST 28847 21045, 696m upstream	-	06/09/21	Spring – access not approved
E1.5	Meare Stream Tributary 1	West Sedgemoor Main Drain	St 29397 20775, 50m downstream	05/05/21	06/09/21	
E2	Meare Stream	West Sedgemoor Main Drain	ST 29462 21824, 16m downstream	-	06/09/21	Spring – access not approved
E2.5	Meare Stream Tributary 1	West Sedgemoor Main Drain	ST 29760 20993, 222m upstream	05/05/21	06/09/21	
F1	Fivehead River main channel 1	Fivehead River	ST 29638 19224, 56m upstream	05/05/21	06/09/21	
F2	Fivehead River main channel 1	Fivehead River	ST29929 19409, on scheme boundary	05/05/21	06/09/21	
G1	Fivehead River main channel 2	Fivehead River	ST 30464 18432, 19m downstream	05/05/21	07/09/21	
G2	Fivehead River main channel 2	Fivehead River Ding	ST 30794 18622, 293m upstream	05/05/21	-	Autumn – watercourse dry within the study area
I1	Cad Brook	Ding	ST 33059 16295, 7m downstream	06/05/21	-	Autumn – watercourse dry within the study area
I2	Cad Brook	Ding	ST 33327 16578, 177 upstream	06/05/21	07/09/21	
J1	River Ding	Ding	ST 33589 15672, 31m downstream	06/05/21	07/09/21	
J2	River Ding	Ding	ST 33751 15884, 6m upstream	06/05/21	07/09/21	
H1	Venner's Water	Fivehead River	ST 31540 17850, 38m downstream	06/05/21	07/09/21	
H2	Venner's Water	Fivehead River	ST 31738 18103, 20m upstream	06/05/21	07/09/21	

2.2.13 Samples were preserved with industrial denatured alcohol on site and transported to the laboratory for sorting and analysis to taxonomic level 5 (TL5) in adherence with the EA's operational instruction [13]. The work was undertaken by a suitably qualified and experienced freshwater taxonomist in an accredited laboratory.

2.2.14 The identification of macroinvertebrates to TL5 species level allows the calculation of specific metrics to determine ecological values of the communities and individual species present at each site.

2.2.15 These can be combined to give an overall picture of the communities within each site, which can be used to support successful implementation of the WFD framework. The macroinvertebrate baseline is focused on the field survey data due to its comprehensive nature.

2.2.16 The metrics used are listed below and are explained in Appendix C *Macroinvertebrate metrics definitions*:

- WHPT (Whalley Hawkes Paisley Trigg) [14]
- WHPT NTAXA (WHPT Number of Taxa) [14]
- WHPT ASPT (WHPT Average Score Per Taxon) [14]
- CCI (Community Conservation Index) [15]
- CS (Conservation Score) [15]
- PSI (Proportion of Sediment-sensitive Invertebrates Index) [16]
- LIFE (Lotic-invertebrate Index for Flow Evaluation) [17]

2.2.17 Indicative WFD classifications of the macroinvertebrate BQE were calculated using the River Invertebrate Classification Tool 2 (RICT) [14]. This used environmental data (Appendix I), collected whilst surveying, and the observed NTAXA and ASPT scores to compare each site to a pristine/reference site with similar environmental conditions.

2.3 Assumptions and limitations

2.3.1 Due to access issues, sites E1 and E2 were not surveyed for macroinvertebrates in spring.

2.3.2 Sample location E1 also sits outside the study area, due access issues and the suitability of sample locations. However, this sample is considered to be representative of macroinvertebrates present along the section of watercourse within the study area.

2.3.3 Sites I1, G2 and C2 were not sampled for macroinvertebrates in autumn due to the sections of these watercourses located within the study area (and where access was permitted) being dry, or the water level being too low to sample which was the case with the latter site. Whilst the baseline is, therefore, incomplete this is not considered a significant constraint.

2.3.4 Cad Brook (Site 11) was not surveyed for white-clawed crayfish as suitable habitat was found not to be present and the watercourse was not surveyable due to dense vegetation cover.

2.3.5 The River Isle (Site 13) was surveyed for white-clawed crayfish only as this watercourse sat outside of the 100 metre study area for macroinvertebrates.

3 Results

3.1 Desk study

3.1.1 The SERC data search and the EA's Ecology & Fish Data Explorer [7] did not return any records of white-clawed crayfish within 2 kilometres of the study area.

3.1.2 The macroinvertebrate desk study showed a number of EA monitoring sites within the 2 kilometres search area (see Appendix B *EA monitoring sites*).

- Species present in the samples with a CCI score ≥ 5 are provided in Appendix D *Macroinvertebrate desk study species list (CCI 5 or higher)*.
- Any species with a CCI ≥ 7 are provided in Table 3-1 below.

3.1.3 No protected macroinvertebrate species were recorded from EA monitoring sites.

3.1.4 WFD macroinvertebrate BQE classifications, obtained from the EA's Catchment Data Explorer [8], for each of the surface waterbodies sampled as part of the scheme, are displayed in Table 3-2.

Table 3-1 Macroinvertebrate species (CCI 7 or above) from EA samples within 2 kilometres of study area

EA site ID/ waterbody	Date	Species	Group	CS	CS Definition	IUCN conservation status	JNCC/ other conservation designation
10532 River Tone	09/05/17	*Libellula fulva*	Odonata	8	RDB3 (Rare)	Near Threatened [18]	N/A
	17/05/16	*Nebrioporus depressus*	Coleoptera	8	RDB3 (Rare)	Near Threatened [19]	Nationally Notable B [20]
	09/05/17	*Nebrioporus depressus*	Coleoptera	8	RDB3 (Rare)	Near Threatened [19]	Nationally Notable B [20]
10534 River Tone	21/09/12	*Nebrioporus depressus*	Coleoptera	8	RDB3 (Rare)	Near Threatened [19]	Nationally Notable B [20]
159877 Dowlish Brook	23/04/18	*Pomatinus substriatus*	Coleoptera	7	Notable (but not RDB status)	Vulnerable [19]	N/A
	23/04/18	*Nebrioporus depressus*	Coleoptera	8	RDB3 (Rare)	Near Threatened [19]	Nationally Notable B [20]

Table 3-2 WFD macroinvertebrate classifications of waterbodies which were surveyed as part of the scheme

Waterbody ID	WFD Surface waterbody	WFD macroinvertebrate classification
GB108052015420	Broughton Brook	**High**
GB108052015482	Tone Ds Taunton Water Body	**High**
GB108052015450	West Sedgemoor Main Drain	**Good**
GB108052015241	Fivehead River	**Good**
GB108052015180	Ding	**Good**

3.1.5 A review of the *A358 Taunton to Southfields Dualling Macroinvertebrates Technical Report (May 2021)* [9] found that sites C3, G1 I1 and J1 each returned 'very good' Biological Monitoring Working Party (BMWP) scores during the spring sampling, which dropped considerably during the autumn sampling, possibly due to observed increases in sedimentation between survey periods.

3.1.6 No protected or nationally significant macroinvertebrate species were recorded during the 2017 sampling, but several species of local conservation value were identified:

- The caddisfly species *Athripsodes bilineatus* – identified at sites C3 and I2
- The caddisfly species *Beraeodes minutus* – identified at site F2
- Beautiful demoiselle *Calopteryx virgo* – identified at sites F2 and J1
- Large spurwing *Procloeon pennulatum* – identified at site F2
- The caddisfly species *Silo nigricornis* – identified at site C3
- The birch-fly species *Simulium reptans* – identified at site J2

3.2 Field study

White-clawed crayfish

3.2.1 No white-clawed crayfish, or crayfish of any species, were recorded in the nine watercourses surveyed and there were no coincidental captures of crayfish during the macroinvertebrate surveys.

3.2.2 Site 11 was unsuitable for survey and no white-clawed crayfish habitat was present, therefore white-clawed crayfish were assumed absent at this site.

3.2.3 Photographs of the survey sites are provided in Appendix E *White-clawed crayfish site photographs*, and site information including habitat suitability is provided in Appendix F *White-clawed crayfish survey information*.

3.2.4 Crayfish remains were found in otter spraint at Sites 8, 12 and 13 (see Appendix G, Table 3-3).

3.2.5 Otters will predate upon crayfish and typically have a large home range where they will rely on various watercourses for foraging and commuting. Therefore, it was important to investigate whether these crayfish had been caught in the watercourses being surveyed. It was not possible to distinguish whether these were native or non-native crayfish and therefore eDNA sampling was subsequently undertaken at these sites to establish if white-clawed crayfish were present in the reach.

3.2.6 eDNA analysis indicated that there were no white-clawed crayfish present at any of the three sites tested, neither was there crayfish plague.

3.2.7 At site 12, however, American signal crayfish DNA was detected (see Table 3-4 below).

Table 3-3 White-clawed crayfish survey sites

Site	Watercourse	Upstream NGR	Downstream NGR	Crayfish remains found	Sample date
Site 4	Black Brook	ST 25894 24434	ST 25835 24492	-	18/08/21
Site 5	Thornwater Stream	ST 27985 22589	ST 27993 22682	-	18/08/21

Site	Watercourse	Upstream NGR	Downstream NGR	Crayfish remains found	Sample date
Site 6	Meare Stream	ST 29259 21450	ST 29233 21549	-	18/08/21
Site 7	Meare Stream Tributary 1	ST 29343 20741	ST 29458 20801	-	18/08/21
Site 8	Fivehead River main channel 1	ST 29809 19335	ST 29934 19405	Yes	18/08/21
Site 9	Fivehead River main channel 2	ST 30492 18456	ST 30633 18516	-	19/08/21
Site 10	Venner's Water	ST 31527 17835	ST 31604 17994	-	19/08/21
Site 11*	Cad Brook	ST 33244 16475	ST 33348 16601	*	*
Site 12	River Ding	ST 33667 15686	ST 33755 15691	Yes	19/08/21
Site 13	River Isle	ST 34501 15127	ST 34617 15279	Yes	19/08/21

*Site 11 (Cad Brook) was not surveyed as there was no suitable habitat present.

Table 3-4 eDNA analysis results for white-clawed crayfish, American signal crayfish and crayfish plague*

Site	White-clawed crayfish	American Signal crayfish	Crayfish plague
Site 8	Negative (0)	Negative (0)	Negative (0)
Site 12	Negative (0)	Positive (1)	Negative (0)
Site 13	Negative (0)	Negative (0)	Negative (0)

* A score is given for the number of positive replicates out of 12 (shown in brackets)

Macroinvertebrates

3.2.8 All macroinvertebrate metrics data are shown in Appendix I, site photographs are given in Appendix J *Macroinvertebrate site photographs* and full taxa lists in Appendix K *Macroinvertebrate taxa lists*.

3.2.9 Table 3-5 and Table 3-6 show species with a CS score of 5 or more and indicative WFD classifications for the macroinvertebrate BQE respectively.

Black Book Tributary 3 (C2) and Black Brook (C3)

3.2.10 Site C2 was only sampled in spring due to the watercourse being too shallow to obtain a sample in autumn. The low WHPT (49.5) and NTAXA (13) scores at this site were indicative of a community of low diversity and a high tolerance to pollution pressure. LIFE score (6.73) showed a community with a high tolerance to flow pressure, while PSI score (22.22) indicated that the watercourse was sedimented. Overall, the CCI (4.91) showed a community of low conservation value.

3.2.11 Site C3 WHPT (109.3 and 105.5). and NTAXA (22) scores showed a community with a relatively high diversity and one which is moderately sensitive to a deterioration in water quality. The community LIFE scores (7.14) suggested the community was likely to be moderately sensitive to any change in flow pressure, while PSI scores (42.88 and 43.48) indicated that the watercourse was sedimented. Conservation scores were higher than C2, giving a community of moderate conservation value. The indicative WFD classification for the macroinvertebrate BQE was classed as high.

Thornwater Stream (D1 and D2)

3.2.12 WHPT (spring: 61.6 and 83.7; autumn: 56.6 and 77.2) and NTAXA (spring: 15 and 17; autumn: 14 and 16) scores at these sites showed a community that was indicative of moderate water quality and diversity, and which would be moderately sensitive to a deterioration in water quality.

3.2.13 In spring, both sites appeared to be sedimented, while in autumn at D1 the watercourse was heavily sedimented and at D2 it was only slightly sedimented. In spring, both sites had communities moderately sensitive to changing flow conditions. In autumn this changed considerably where D1 had a community of high tolerance to changing flow conditions while D2 had a community which was highly sensitive to changing flow conditions.

3.2.14 Conservation values were moderate at D1 and Low at D2 in spring, while in autumn conservation values increased to high at D1 and D2 remained low value. The increase at D1 was due to the presence of the hydraenid *Limnebius papposus.* D1 and D2 had indicative WFD classification for the macroinvertebrate BQE was classed as moderate and good respectively. Between spring and autumn there was a small decline in most metric scores.

Meare Stream (E1 and E2)

3.2.15 Neither E1 nor E2 were sampled in spring due to access issues. Autumn samples showed a community which had a high tolerance to deteriorating water quality and low diversity. The PSI metrics (30.77 and 21.43) indicated an area which was sedimented. E1 was highly sensitive to changing flow conditions while E2 was only moderately sensitive.

3.2.16 Conservation values for E1 and E2 were low and fairly high respectively. The presence of the riffle beetle *Riolus cupreus* at E2 would have been the main reason for the higher score.

Meare Stream Tributary 1 (E1.5 and E2.5)

3.2.17 WHPT scores (86.8 and 86) in spring suggest sites of moderate water quality and diversity. This changed in autumn to a community indicative of bad water quality (32.3 and 61.1). PSI scores (spring: 54.55 and 59.38, autumn: 72.73 and 47.06) showed the sites varied between moderately and slightly sedimented. Macroinvertebrate communities at both sites were shown to have a high sensitivity to changes in flow conditions.

3.2.18 Conservation scores were moderate at E1.5 and fairly high at E2.5 in spring, these declined to low and moderate respectively in autumn. The relatively high score at E2.5 in spring was partially due to the presence of the hydraenid *Hydraena nigrita*. E1.5 and E2.5 was classed as poor and moderate under indicative WFD classification for the macroinvertebrate BQE.

Fivehead River main channel 1 (F1 and F2)

3.2.19 WHPT score (spring: 190.6 and 230.1, autumn: 130.9 and 167.7) and NTAXA (spring: 28 and 33, autumn: 23 and 29) at these sites were indicative of communities of high diversity and were areas subject to low pollution pressure. The community present would be very sensitive to degradation in water quality. PSI (spring: 69.01 and 74.36; autumn: 54.29 and 50.85) showed that the watercourse

was sedimented in spring and only slightly sedimented in autumn, while the communities present were highly sensitive to changes in flow regime.

3.2.20 Conservation scores were relatively high across the two sites, although there was a decline in classifications from spring to autumn.

3.2.21 A number of metric scores also fell between this period. Both sites were classed as high under indicative WFD classification for the macroinvertebrate BQE.

Fivehead River main channel 2 (G1 and G2)

3.2.22 G2 was only sampled in spring, due to the site not being surveyable in autumn. In spring, both sites had communities with moderate conservation values and moderate water quality, meaning that communities would be moderately tolerant to deteriorations in water quality. Communities at G1 in autumn had a decrease in WHPT score (spring: 82.4, autumn: 58.5) indicating a change to a community which would have a relatively high tolerance to deteriorating water quality. Diversity remained similar, however.

3.2.23 This area was subject to sedimented and heavily sedimented environments. LIFE scores (spring: 6.93 and 6.43, autumn: 6.23) showed that both sites had a high tolerance to changes in flow conditions.

3.2.24 Conservation scores at G1 was classed as low value, while G2 it was valued as Moderate. G1 was classed as moderate under indicative WFD classification for the macroinvertebrate BQE.

Venner's Water (H1 and H2)

3.2.25 Both sites were indicative of communities with moderate tolerances to water quality deterioration and high diversity in spring. H1 was similar in autumn, however at H2 the community changed in autumn to represent a site of poor water quality and moderate diversity.

3.2.26 Sedimentation levels at this site varied between sedimented and heavily sediment environments. Both sites appeared to have communities tolerant to changes in flow conditions.

3.2.27 Conservation values at both sites varied seasonally between low and moderate. Both sites were classed as moderate under indicative WFD classification for the macroinvertebrate BQE.

Cad Brook (I1 and 12)

3.2.28 I1 was only surveyed in spring as it was not possible to survey the area in autumn. Both sites were indicative of moderate water quality and diversity in spring. However, in autumn I2 changed from a community of macroinvertebrates which had a moderate tolerance to deterioration of water quality to one with a high tolerance.

3.2.29 PSI metrics (spring: 19.35 and 17.65, autumn: 0.0) showed both sites to be heavily sedimented and that communities were tolerant to changes in flow conditions.

3.2.30 Conservation scores were valued as Moderate or less. I2 was classed as moderate under indicative WFD classification for the macroinvertebrate BQE.

River Ding (J1 and J2)

3.2.31 WHPT scores (spring: 112.7 and 134.6, autumn: 91.4 and 128.1) at both sites revealed communities where water quality was good, with high diversity, while the sites were generally heavily sedimented. On the whole communities had a low sensitivity to flow conditions.

3.2.32 Conservation values were moderate at both sites in spring, this fell to Low in autumn at J1 but remained constant at J2. J1 was classified as moderate and J2 good under indicative WFD classification for the macroinvertebrate BQE.

Table 3-5 Species present with CS score of 5 or more

Location	Date sampled	Species present	Group	CS score	CS definition	IUCN conservation status	JNCC/ other conservation designation
C3	06/09/21	*Aquarius najas*	Hemiptera	5	Local	Least concern [21] N/A	Nationally scarce [21]
C3	06/09/21	*Silo nigricornis*	Trichoptera	5	Local	Least concern [22]N/A	N/A
D1	05/05/21	*Simulium costatum*	Diptera	5	Local	N/A	N/A
D1	06/09/21	*Helochares lividus*	Coleoptera	5	Local	N/A	N/A
D1	06/09/21	*Limnebius papposus*	Coleoptera	8	Notable (but not RDB Status)	Near threatened [19]	N/A
E2	07/09/21	*Riolus cupreus*	Coleoptera	7	Notable (but not RDB Status)	Nationally scarce [19]	N/A
E2.5	06/05/21	*Hydraena nigrita*	Coleoptera	7	Notable (but not RDB status)	N/A	N/A
F1	07/09/21	*Aquarius najas*	Hemiptera	5	Local	Least concern [21] N/A	Nationally scarce [21]
H1	07/09/21	*Acilius sulcatus*	Coleoptera	5	Local	N/A	N/A
H1	07/09/21	*Hydraena testacea*	Coleoptera	6	Regionally notable	N/A	N/A
I2	07/09/21	*Notonecta maculata*	Hemiptera	5	Local	N/A	N/A
J2	07/09/21	*Calopteryx virgo*	Odonata	5	Local	N/A	N/A

Table 3-6 Indicative WFD classification for the macroinvertebrate Biological Quality Element for each site*

Site	NTAXA	ASPT	Overall classification
F1	H	H	H
F2	H	H	H
G1	G	M	M
J1	H	M	M
J2	H	G	G
H1	H	M	M

Site	NTAXA	ASPT	Overall classification
H2	H	M	M
I2	G	M	M
C3	H	G	G
D1	M	M	M
D2	G	G	G
E2.5	M	G	M
E1.5	P	G	P

* H: High, G: Good, M: Moderate, P: Poor

4 Conclusions

White-clawed crayfish

4.1.1 The desk study has shown that there were no reports of white-clawed crayfish within a 2-kilometre area of the scheme. No crayfish of any species were found in the physical surveys despite the presence of suitable habitat at all but one site and conditions being ideal for hand searching. White-clawed crayfish are often present in low densities in fragmented areas of optimal habitat and a negative survey result for the survey section does not necessarily equate to absence of the species from that watercourse or catchment.

4.1.2 Crayfish remains were found in otter spraint at three of the sites, however, it was not possible to conclude if these were white-clawed crayfish or non-native crayfish remains. The crayfish remains were present at the three largest sites containing the most optimal habitat of the survey sites. eDNA monitoring was therefore undertaken to investigate potential presence of white-clawed crayfish.

4.1.3 Whilst eDNA is not a method approved by the regulator for establishing presence or absence of white-clawed crayfish in isolation, it has the benefit in this instance of allowing a relatively fast confirmation of presence of either white-clawed crayfish, American signal crayfish or presence of crayfish plague (which can be taken as a proxy for white-clawed crayfish absence).

4.1.4 eDNA analysis of water samples taken at the three sites did not detect white-clawed crayfish or crayfish plague. American signal crayfish DNA was only detected at one site, Site 12.

4.1.5 The fact that white-clawed crayfish were not detected during physical surveys or through eDNA analysis at three sites with evidence of crayfish provides sufficient evidence to suggest likely absence of this species at the ten crossing locations surveyed. Therefore, no avoidance, mitigation or compensation is required for white-clawed crayfish.

4.1.6 However, the presence of American signal crayfish, a non-native invasive species covered under the Wildlife and Countryside Act 1981 [23] will require mitigation measures to be included in the Construction Environmental Management Plan (CEMP) to limit the risk of spread during in-river construction phase works.

Macroinvertebrates

4.1.7 The desk study found that no macroinvertebrate species present would require specific avoidance, mitigation, or compensation above those implemented through standard best practice.

4.1.8 The WHPT metrics indicated that water quality was moderate across most of the watercourses and the macroinvertebrate communities exhibited moderate diversity. This suggests that the communities present have a moderate tolerance to deterioration of water quality.

4.1.9 A single watercourse, Fivehead River main channel 1, had high WHPT and NTAXA scores, showing a community of high diversity and one highly susceptible to deteriorations in water quality.

4.1.10 Most of the sites were assessed as achieving ‘Moderate’ based on the indicative WFD classification for the macroinvertebrate BQE. Eight of the 13 sites which had

both spring and autumn samples taken would be assessed as failing in accordance with the WFD.

4.1.11 Interestingly, this is quite a contradiction to the desk-based studies where the EA had classified the waterbodies, within each of the areas surveyed as part of the scheme, as Good or High.

4.1.12 The metrics for macroinvertebrates showed a general decrease in community diversity, flow sensitivity, sediment sensitivity and community conservation scores from spring to autumn.

4.1.13 It was expected that metric scores from spring to autumn would be slightly different due to seasonal variation. However, the changes across seasons appeared to be more significant than just that.

4.1.14 Surveyors noted that water levels were considerably lower across most sites, while levels of siltation were higher due to a period of dry weather in autumn. Stonefly (Plecoptera) communities which are a sensitive taxonomic group were noticeably absent in the autumn samples replaced by more lentic adapted families; beetles (Coleoptera).

4.1.15 Conservation scores were relatively low across all sites with only D1 (autumn), E2 (autumn), F2 (spring and autumn), F1 (spring) and E2.5 (spring) obtaining a classification of Fairly High or higher. Only three species had CCI scores of 7 or more, which were found at E2.5, E2 and D1.

4.1.16 As there were no protected species present at any of the sites sampled. No specific avoidance, mitigation or compensation would be required for any macroinvertebrate species present above those employed through standard best practice.

Abbreviations List

Please refer to ES Chapter 17 Abbreviations.

Glossary

Please refer to ES Chapter 18 Glossary.

References

[1] Department for Transport, “Road investment strategy: 2015 to 2020,” March 2015. [Online]. Available: https://www.gov.uk/government/publications/road-investment-strategy-for-the-2010-to-2020-road-period. [Accessed January 2021].

[2] CIEEM, “Guidelines for Ecological Impact Assessement in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1,” Chartered Institute for Ecology and Environmental Management, Winchester, 2018.

[3] Buglife, “Crayfish Identification, Distribution and Legislation,” [Online]. Available: https://cdn.buglife.org.uk/2019/07/Final-Crayfish-ID-distribution-and-Legislation-23-06-15_JG.pdf. [Accessed October 2021].

[4] Somerset Highways, “Biodiversity Manual 2015-2020:,” Part of the Somerset County Council Highways Network Management Plan, version 2.2, 2015.

[5] D. Holdich, “Ecology of the White-clawed Crayfish,” Conserving Natura 2000 Rivers Ecology Series No. 1. English Nature, Peterborough, 2003.

[6] Natural England, “Standing Advice Species Sheet: White clawed crayfish,” 2013. [Online]. Available: http://witham3idb.gov.uk/wp-content/uploads/2013/03/White-Clawed-Crayfish.pdf. [Accessed October 2021].

[7] Environment Agency, “Ecology & Fish Data Explorer,” 2021. [Online]. Available: https://environment.data.gov.uk/ecology/explorer/. [Accessed September 2021].

[8] Environment Agency, “Catchment Data Explorer. [Online]. Available at: https://environment.data.gov.uk/catchment-planning/WaterBody/GB106039030380?cycle=2”.

[9] Highways England, “A358 Taunton to Southfields Dualling Scheme Preliminary Environmental Information Report, Chapter 8: Appendix 8.22,” Highways England, 2021.

[10] S. Peay, “Monitoring the White-clawed crayfish Austropotamobius pallipes. Conserving Natura 200 Rivers Monitoring Series No 1.,” English Nature, Peterborough, 2003.

[11] Environment Agency, “Freshwater macroinvertebrate sampling in rivers: Operational Instruction 018 08. Issued 01/03/17,” Environment Agency, Bristol, 2017.

[12] BSI, “BS EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters,” 2012.

[13] Environment Agency, “Freshwater macroinvertebrate analysis of riverine samples: Operational Instruction 024-08. Issued 28/01/14,” Environment Agency, Bristol, 2014.

[14] Environment Agency, “Walley Hawkes Paisley Trigg (WHPT) index of river invertebrate quality and its use in assessing ecological status. Brief Guide Version 8.,” 2016.

[15] R. Chadd and C. Extence, “The conservation of freshwater macroinvertebrate populations: a community-based classification scheme,” *Aquatic Conservation: Marine and Freshwater Ecosystems,* vol. 14, pp. 597-624, 2004.

[16] C. A. Extence, R. P. Chadd, J. England, M. J. Dunbar, P. J. Wood and E. D. Taylor, “The assessment of fine sediment accumulation in rivers using macro-invertebrate community response,” *River Research and Applications,* vol. 29, no. 1, pp. 17-55, 2013.

[17] C. A. Extence, D. M. Balbi and R. P. Chadd, “River flow indexing using British benthic macroinvertebrates: a framework for setting hydroecological objectives.,” *Regulated Rivers: Research & Management:,* vol. 15, no. 6, pp. 545-574, 1999.

[18] JNCC, “The Odonata Red Data List for Great Britain (Species Status No. 11),” 2008. [Online]. Available: https://hub.jncc.gov.uk/assets/8e18c30d-794e-4b0c-8d1c-378c3faf0e7c. [Accessed March 2022].

[19] G. N. Foster, “A review of the scarce and threatened Coleoptera of Great Britain Part (3): Water beetles of Great Britain. Species Status 1.,” Joint Nature Conservation Committee, Peterborough, 2010.

[20] P. S. Hyman and M. S. Parsons, “Review of the scarce and threatened Coleoptera of Great Britain. Part 1,” *Joint Nature Conservation Committee (UK Nature Conservation 3),* 1992.

[21] A. A. Cook, “A review of the Hemiptera of Great Britain: The Aquatic and Semi-aquatic Bugs (Dipsocoromorpha, Gerromorpha, Leptopodomorpha & Nepomorpha).,” *Natural England Commissioned Report NECR188.,* 2015.

[22] I. D. Wallace, “A review of the status of the caddis flies (Trichoptera) Great Britain. Species Status No.27.,” *Natural England Comissioned Reports, Number 191.,* 2016.

[23] “Wildlife and Countryside Act 1998, c. 14,” [Online]. Available: https://www.legislation.gov.uk/ukpga/1981/69/contents. [Accessed November 2021].

[24] M. B. Seddon, I. J. Killeen and A. P. Fowles, “A Review of the Non-Marine Mollusca of Great Britain: Species Status No.17,” *NRW Evidence Report,* 2014.

[25] C. R. Macadam, “A review of the status of the mayflies (Ephemeroptera) of Great Britain - Species Status No.28,” *Natural England Commissioned Report, Number 193.*

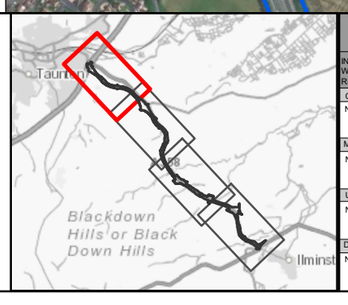
[26] Department of Transport, “Road investment strategy: 2015 to 2020,” March 2015. [Online]. Available: https://www.gov.uk/government/publications/road-investment-strategy-for-the-2015-to-2020-road-period. [Accessed January 2021].

Appendices

Appendix A Site overview map

LEGEND

- ECOLOGY SURVEY ZONE
- ECOLOGY SURVEY ZONE BUFFER - 250M
- WATERCOURSES
- WHITE-CLAWED CRAYFISH SURVEY EXTENT
- WHITE-CLAWED CRAYFISH SAMPLE LOCATIONS
- *SITE 11 WAS NOT SURVEYED AS THERE WAS NO SUITABLE HABITAT PRESENT
- WHITE-CLAWED CRAYFISH REMAINS
- MACROINVERTEBRATE SAMPLE LOCATIONS



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS (REFERENCE SHALL ALSO BE MADE IN THE DESIGN HAZARD LOG)

CONSTRUCTION
NONE

MAINTENANCE / CLEANING
NONE

USE
NONE

DECOMMISSIONING / DEMOLITION
NONE

Rev.	Date	Description	By	Chk'd	App'd	Auth'd
P02	05/05/22	ISSUE FOR INFORMATION	LL	MA	JS	SV

Suitability: S2 — Drawing Status: SUITABLE FOR INFORMATION

TAYLOR WOODROW together @ VINCI | ARUP | RAMBOLL

Client: national highways

Project Title: A358 TAUNTON TO SOUTHFIELDS DUALLING SCHEME

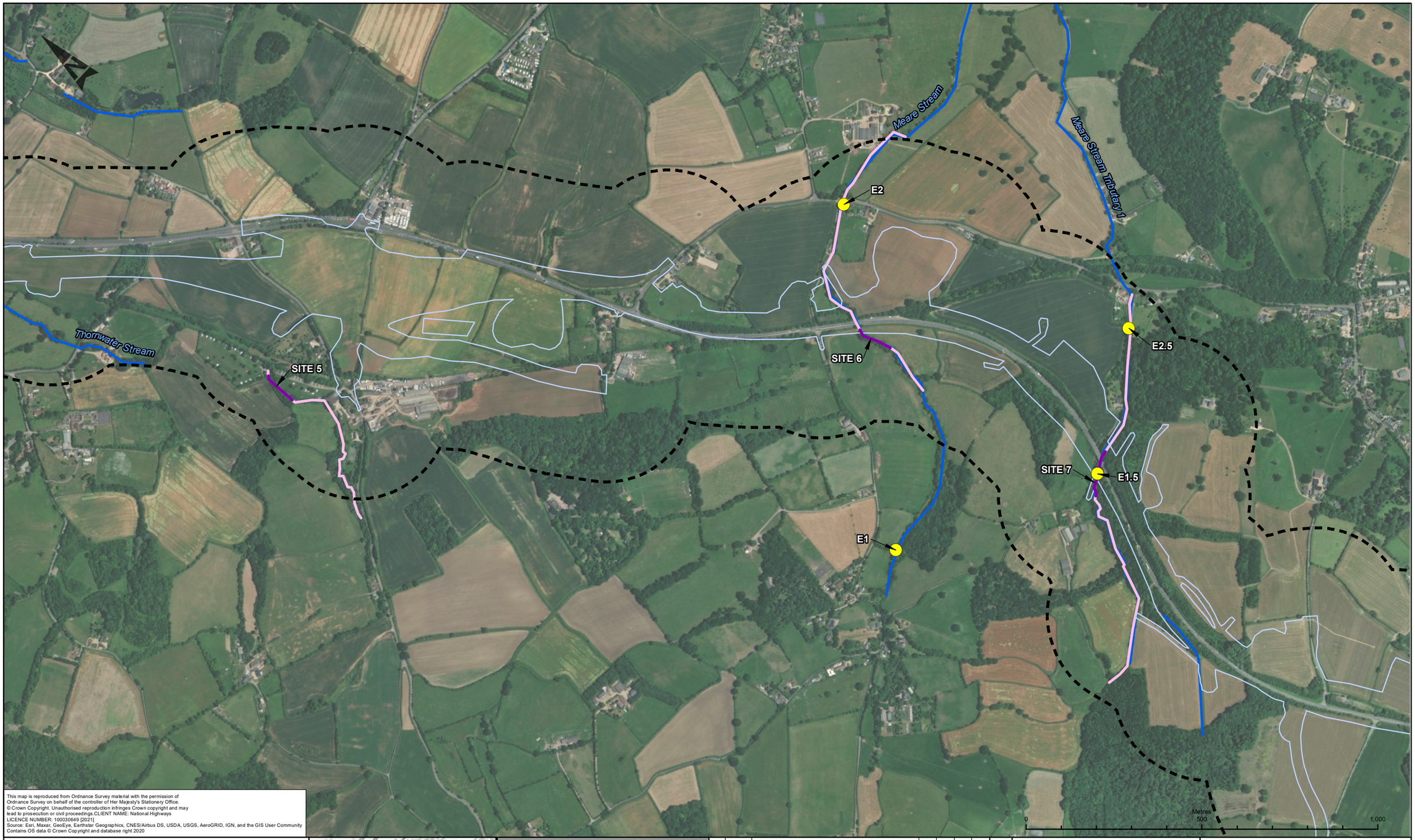
Drawing Title: WHITE CLAWED-CRAYFISH AND MACROINVERTEBRATE SITE OVERVIEW SHEET 1 OF 4

Scale	By	Checked	Approved	Authorised
1:10,000	LL	MA	JS	SV

Original Size	Date	Date	Date	Date
A3	05/05/22	05/05/22	05/05/22	05/05/22

Drawing Number: HE551508 (HE P/N) - ZZ (Location) | ARP (Originator) - VES (Volume) - DR - LE - 000262 (Type | Role | Number)

Revision: P02

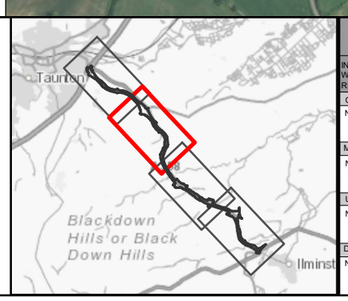


LEGEND

- ECOLOGY SURVEY ZONE
- ECOLOGY SURVEY ZONE BUFFER - 250M
- WATERCOURSES
- WHITE-CLAWED CRAYFISH SURVEY EXTENT
- WHITE-CLAWED CRAYFISH SAMPLE LOCATIONS

*SITE 11 WAS NOT SURVEYED AS THERE WAS NO SUITABLE HABITAT PRESENT

- WHITE-CLAWED CRAYFISH REMAINS
- MACROINVERTEBRATE SAMPLE LOCATIONS



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS (REFERENCE SHALL ALSO BE MADE IN THE DESIGN HAZARD LOG)

CONSTRUCTION
NONE

MAINTENANCE / CLEANING
NONE

USE
NONE

DECOMMISSIONING / DEMOLITION
NONE

Rev.	Date	Description	By	Chk'd	App'd	Auth'd
P02	05/05/22	ISSUE FOR INFORMATION	LL	MA	JS	SV

Suitability: S2 — SUITABLE FOR INFORMATION

Drawing Status

TAYLOR WOODROW together @ VINCI
ARUP RAMBOLL

Client: national highways

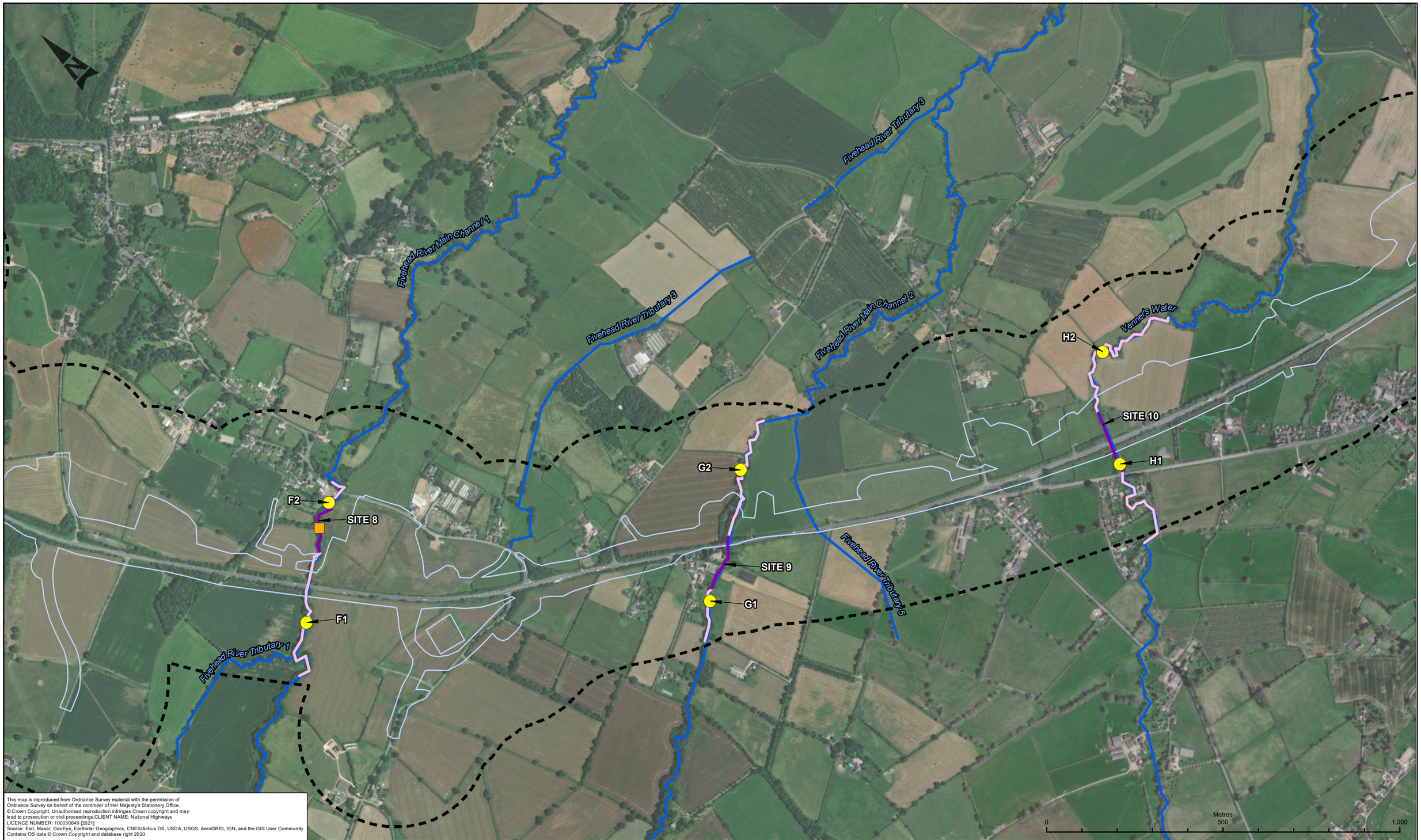
Project Title: A358 TAUNTON TO SOUTHFIELDS DUALLING SCHEME

Drawing Title: WHITE CLAWED-CRAYFISH AND MACROINVERTEBRATE SITE OVERVIEW SHEET 2 OF 4

Scale	By	Checked	Approved	Authorised
1:10,000	LL	MA	JS	SV
Original Size	**Date**	**Date**	**Date**	**Date**
A3	05/05/22	05/05/22	05/05/22	05/05/22

Drawing Number: HE551508 - ZZ | Originator: ARP | Volume: VES | Location: ZZ | Type: DR | Role: LE | Number: 000263

Revision: P02

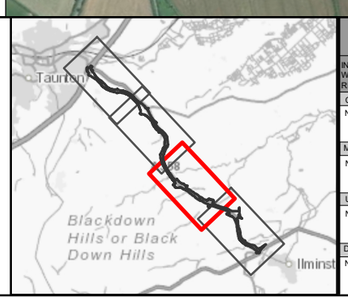


LEGEND

- ECOLOGY SURVEY ZONE
- ECOLOGY SURVEY ZONE BUFFER - 250M
- WATERCOURSES
- WHITE-CLAWED CRAYFISH SURVEY EXTENT
- WHITE-CLAWED CRAYFISH SAMPLE LOCATIONS

*SITE 11 WAS NOT SURVEYED AS THERE WAS NO SUITABLE HABITAT PRESENT

- WHITE-CLAWED CRAYFISH REMAINS
- MACROINVERTEBRATE SAMPLE LOCATIONS



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS (REFERENCE SHALL ALSO BE MADE IN THE DESIGN HAZARD LOG)

CONSTRUCTION
NONE

MAINTENANCE / CLEANING
NONE

USE
NONE

DECOMMISSIONING / DEMOLITION
NONE

Rev.	Date	Description	By	Chk'd	App'd	Auth'd
P02	05/05/22	ISSUE FOR INFORMATION	LL	MA	JS	SV

Suitability: S2 — SUITABLE FOR INFORMATION

Drawing Status

Client: national highways

Project Title: A358 TAUNTON TO SOUTHFIELDS DUALLING SCHEME

Drawing Title: WHITE CLAWED-CRAYFISH AND MACROINVERTEBRATE SITE OVERVIEW SHEET 3 OF 4

Scale	By	Checked	Approved	Authorised
1:10,000	LL	MA	JS	SV
Original Size	**Date**	**Date**	**Date**	**Date**
A3	05/05/22	05/05/22	05/05/22	05/05/22

Drawing Number: HE551508 - ZZ - ARP - DR - LE - VES - 000264 (Location | Originator | Volume | Type | Role | Number)

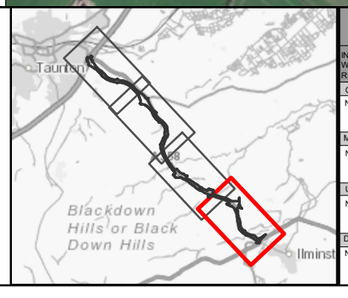
Revision: P02

LEGEND

- ECOLOGY SURVEY ZONE
- ECOLOGY SURVEY ZONE BUFFER - 250M
- WATERCOURSES
- WHITE-CLAWED CRAYFISH SURVEY EXTENT
- WHITE-CLAWED CRAYFISH SAMPLE LOCATIONS

*SITE 11 WAS NOT SURVEYED AS THERE WAS NO SUITABLE HABITAT PRESENT

- WHITE-CLAWED CRAYFISH REMAINS
- MACROINVERTEBRATE SAMPLE LOCATIONS



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS (REFERENCE SHALL ALSO BE MADE IN THE DESIGN HAZARD LOG)

CONSTRUCTION
NONE

MAINTENANCE / CLEANING
NONE

USE
NONE

DECOMMISSIONING / DEMOLITION
NONE

Rev.	Date	Description	By	Chk'd	App'd	Auth'd
P02	05/05/22	ISSUE FOR INFORMATION	LL	MA	JS	SV

Suitability: S2 — Drawing Status: SUITABLE FOR INFORMATION

TAYLOR WOODROW together @ VINCI | ARUP | RAMBOLL

Client: national highways

Project Title: A358 TAUNTON TO SOUTHFIELDS DUALLING SCHEME

Drawing Title: WHITE CLAWED-CRAYFISH AND MACROINVERTEBRATE SITE OVERVIEW SHEET 4 OF 4

Scale	By	Checked	Approved	Authorised
1:10,000	LL	MA	JS	SV

Original Size	Date	Date	Date	Date
A3	05/05/22	05/05/22	05/05/22	05/05/22

Drawing Number: HE PIN | Originator | Volume | Location | Type | Role | Number
HE551508 - ARP - VES - ZZ - DR - LE - 000265

Revision: P02

Appendix B EA monitoring sites

LEGEND

- ECOLOGY SURVEY ZONE
- ECOLOGY SURVEY ZONE BUFFER - 100M
- EA MONITORING SITES

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS (REFERENCE SHALL ALSO BE MADE IN THE DESIGN HAZARD LOG)

CONSTRUCTION
NONE

MAINTENANCE / CLEANING
NONE

USE
NONE

DECOMMISSIONING / DEMOLITION
NONE

Rev.	Date	Description	By	Chk'd	App'd	Auth'd
P01	06/05/22	ISSUE FOR INFORMATION	LL	MA	JS	SV

Suitability: S2 — Drawing Status: SUITABLE FOR INFORMATION

TAYLOR WOODROW together @ VINCI | ARUP | RAMBOLL

Client: national highways

Project Title: A358 TAUNTON TO SOUTHFIELDS DUALLING SCHEME

Drawing Title: EA MONITORING SITES

Scale	By	Checked	Approved	Authorised
1:60,000	LL	MA	JS	SV

Original Size	Date	Date	Date	Date
A3	06/05/22	06/05/22	06/05/22	06/05/22

Drawing Number: HE551508 - ZZ (Location) | ARP (Originator) | VES (Volume) | DR - LE - 000342 (Type | Role | Number)

Revision: P01

Appendix C Macroinvertebrate metrics definitions

C.1.1 Whalley Hawkes Paisley Trigg (WHPT), WHPT ASPT (Average Score Per Taxon) & WHPT Number of Taxa (NTAXA) [14]

C.1.1.1 WHPT is a metric used in the assessment of macroinvertebrate populations which looks at individual species tolerance to general degradation including organic pollution. The WHPT replaced the Biological Monitoring Working Party (BMWP) scoring system Biological Monitoring Working Party (BMWP) is used mainly to assess general water quality and macroinvertebrates tolerance to pollution especially organic waste. This metric uses family level taxa and is scored from 1 to 10. With 1 scoring species most tolerant to pollution and 10 least. The main difference between these two metrics is that BMWP doesn't account for abundances of individuals present.

C.1.1.2 NTAXA (Number of TAXA) is a metric is used to help determine the diversity of taxa at family level. It counts the total number of family present within a sample, with the higher the score the higher the diversity. WHPT TAXA is a follow on from this which takes into account abundances of each family present.

C.1.1.3 WHPT ASPT is calculated by dividing the WHPT score by WHPT NTAXA to give an average score per taxon. While WHPT and WHPT ASPT scores are used as a measure of water quality, WHPT NTAXA is used as a measure of diversity or species richness.

C.1.2 Water Framework Directive (WFD) Classification

C.1.2.1 WFD classifications are used by the Environment Agency to assess waterbody status. WFD classifications use morphological, chemical and biological quality elements to assess overall waterbody status. Waterbodies are compared to near pristine reference sites and are given a classification ranging between Bad, Poor, Moderate, Good and High. Only classifications of Good and High are considered acceptable with regards to the Directive.

C.1.3 Community Conservation Index (CCI) & Conservation Score (CS) [15]

C.1.3.1 The Community Conservation Index (CCI) represents the national rarity and diversity of species within a site and gives a total conservation score to the whole community. Table G-1 shows a guide to specific scores of from the metric.

Table C-1 CCI values

CCI score	Conservation value
<5	Low
5-<10	Moderate
10-<15	Fairly High
15-<20	High
>20	Very High

C.1.3.2 Conservation Scores (CS) looks at individual species rareness and is graded from 0 to 10, with definitions of each score shown in Table C-2.

Table C-2 Conservation score values

Conservation score	Classification
10	RDB1 (Endangered)
9	RDB2 (Vulnerable)
8	RDB3 (Rare)
7	Notable (no RDB status)
6	Regionally Notable
5	Local
4	Occasional
3	Frequent
2	Common
1	Very Common

C.1.4 Lotic-invertebrate Index for Flow Evaluation (LIFE) [17]

C.1.4.1 LIFE Score is derived from the relationship between the sensitivity of different macroinvertebrates species to flow conditions. The metric is also weighted by abundances of each species with more sensitive communities of macroinvertebrates obtaining a higher score. It is therefore useful for assessing the impact of variable flows on benthic populations.

Table C-3 LIFE classifications

Score	Classification
7.26 and above	High sensitivity
6.51 – 7.25	Moderately sensitive
6.5 and below	Low sensitivity

C.1.5 Proportion of Sediment-sensitive Invertebrates (PSI) [16]

C.1.5.1 PSI is used as a metric to assess the ability of macroinvertebrate ability of the macroinvertebrate community to provide a proxy measure for the quantity of inert fine sediment present at a site and in particular fine sediment accumulation and/or erosion over time.

Table C-4 PSI classifications

Score	Classification
0 - 20	Heavily sedimented
21 - 40	Sedimented
41 - 60	Moderately sedimented
61 - 80	Slightly sedimented
81 - 100	Minimally sedimented

Appendix D Macroinvertebrate desk study species list (CCI 5 or higher)

Table D-1 Macroinvertebrate species list (CS 5 or higher)

EA site ID/waterbody	Counts & date sampled	Species present	Group	CS	CS definition	IUCN conservation status	JNCC/ other conservation designation
10309 River Isle	1 (16/09/14)	*Athripsodes bilineatus*	Trichoptera	5	Local	Least Concern [22]	N/A
	1 (27/03/14)	*Brachycentrus subnubilus*	Trichoptera	5	Local	Least Concern [22]	N/A
	5 (27/03/14)	*Calopteryx virgo*	Odonata	5	Local	Least Concern [18]	N/A
	4 (16/09/14)	*Gerris najas*	Hemiptera	5	Local	N/A	N/A
10532 River Tone	120 (17/05/16)	*Caenis macrura*	Ephemeroptera	5	Local	N/A	N/A
	1 (08/09/16)	*Caenis macrura*	Ephemeroptera	5	Local	N/A	N/A
	50 (09/05/17)	*Caenis macrura*	Ephemeroptera	5	Local	N/A	N/A
	10 (19/10/17)	*Caenis macrura*	Ephemeroptera	5	Local	N/A	N/A
	1 (09/05/17)	*Calopteryx virgo*	Odonata	5	Local	Least Concern [18]	N/A
	1 (09/05/17)	*Enochrus affinis*	Coleoptera	6	Regionally notable	N/A	N/A
	1 (09/05/17)	*Libellula fulva*	Odonata	8	RDB3 (Rare)	Near Threatened [18]	N/A
	1 (17/05/16)	*Nebrioporus depressus*	Coleoptera	8	RDB3 (Rare)	Near Threatened [19]	Nationally Notable B [20]
	2 (09/05/17)	*Nebrioporus depressus*	Coleoptera	8	RDB3 (Rare)	Near Threatened [19]	Nationally Notable B [20]
	7 (09/05/17)	*Nebrioporus depressus*	Coleoptera	8	RDB3 (Rare)	Near Threatened [19]	Nationally Notable B [20]
	1 (17/05/16)	*Platycnemis pennipes*	Odonata	5	Local	Least Concern [18]	N/A
10534 River Tone	1 (16/03/12)	*Bithynia leachii*	Mollusca	5	Local	Least Concern [24]	N/A
	1 (16/03/12)	*Brachycentrus subnubilus*	Trichoptera	5	Local	Least concern [22]	N/A
	50 (07/09/17)	*Caenis macrura*	Ephemeroptera	5	Local	N/A	N/A
	1 (15/10/15)	*Calopteryx virgo*	Odonata	5	Local	Least concern [18]	N/A
	1 (10/05/17)	*Calopteryx virgo*	Odonata	5	Local	Least concern [18]	N/A
	1 (21/09/12)	*Nebrioporus depressus*	Coleoptera	8	RDB3 (Rare)	Near Threatened [19]	Nationally Notable B [20]
	5 (22/04/10)	*Polycentropus kingi*	Trichoptera	5	Local	Least Concern [22]	N/A

EA site ID/waterbody	Counts & date sampled	Species present	Group	CS	CS definition	IUCN conservation status	JNCC/ other conservation designation
	30 (04/09/13)	*Polycentropus kingi*	Trichoptera	5	Local	Least Concern [22]	N/A
	20 (16/09/14)	*Polycentropus kingi*	Trichoptera	5	Local	Least Concern [22]	N/A
10542 Broughton Brook	4 (24/03/14)	*Athripsodes bilineatus*	Trichoptera	5	Local	Least Concern [22]	N/A
	2 (04/09/13) 3 (03/09/14)	*Aquarius najas*	Hemiptera	5	Local	N/A	N/A
	3 (03/09/14)	*Aquarius najas*	Hemiptera	5	Local	N/A	N/A
	2 (07/03/13)	*Lepidostoma basale*	Trichoptera	6	Regionally notable	Least Concern [22]	N/A
153896 Dowlish Brook	1 (14/05/14)	*Brachycentrus subnubilus*	Trichoptera	5	Local	Least Concern [22]	N/A
	40 (14/05/14)	*Caenis macrura*	Ephemeroptera	5	Local	N/A	N/A
159877 Dowlish Brook	1 (23/04/18)	*Baetis buceratus*	Ephemeroptera	6	Regionally notable	N/A	N/A
	1 (29/05/15)	*Brachycentrus subnubilus*	Trichoptera	5	Local	Least Concern [22]	N/A
	30 (10/10/17)	*Caenis macrura*	Ephemeroptera	5	Local	Least Concern [25]	N/A
	4 (17/09/19)	*Calopteryx virgo*	Odonata	5	Local	N/A	N/A
	1 (14/10/21)	*Aquarius najas*	Hemiptera	5	Local	N/A	N/A
	13 (12/08/20)	*Aquarius najas*	Hemiptera	5	Local	N/A	N/A
	2 (23/04/18)	*Pomatinus substriatus*	Coleoptera	7	Notable (but not RDB status)	Vulnerable [19]	N/A
	5 (23/04/18)	*Nebrioporus depressus*	Coleoptera	8	RDB3 (Rare)	Near Threatened [19]	Nationally Notable B [20]
160521 Allen's Brook	1 (25/03/14)	*Riolus subviolaceus*	Coleoptera	6	Regionally notable	N/A	Nationally Scarce [19]

Appendix E White-clawed crayfish site photographs

Site 4 (18 August 2021)

Site 5 (18 August 2021)

Site 6 (18 August 2021)

Site 7 (18 August 2021)

Site 8 (18 August 2021)

Site 9 (19 August 2021)

Site 10 (19 August 2021)

Site 11 (19 August 2021) — not surveyable

Site 12 (19 Augsut 2021)

Site 13 (19 August 2021)

Figure E-1 White-clawed crayfish survey site photographs

Appendix F White-clawed crayfish survey information

Table F-1 White-clawed crayfish survey information

Site	Total search area (m^2)	Refuge types Present/Searched (Bold=Primary Refuge)	Habitat (None / Present / Frequent / Abundant)	Crayfish habitat Score (0=None, 1=Present, 2=Frequent, 3=Abundant)	Description
Site 4	61	Small Cobble (65 - 150mm) **Undercut bank** **Tree roots (fine)** **Woody Debris** Submerged vegetation	Present	2	Very silted, overshaded and shallow channel with clay and earth banks through scrub next to the Park and Ride. Three-spined stickleback present. Cover predominantly from undercut banks, with additional from woody debris and some macrophytes (*Berula sp.*). Frequent crayfish habitat.
Site 5	95	Small Cobble (65 - 150mm) Boulder (256 - 400mm) Undercut Bank **Calcium Waterfall** Tree Roots (fine) **Woody Debris** Urban Debris **Emergent Vegetation**	Present	1	Steep gradient channel through campsite. Heavily shaded and silted with calcium deposits covering everything in the channel and forming small cascades. Habitat is present but fairly poor quality.
Site 6	135	**Small Cobble (65 - 150mm)** **Large Cobble (150 - 256mm)** Boulder (256 - 400mm) Undercut Bank Tree Roots (Fine) Woody Debris Submerged vegetation Moss Filamentous Algae Tree Roots (large)	Present	2	Nice channel with lots of suitable habitat present, however, there is very low flow. The channel is incised and heavily shaded. Three-spined stickleback present.
Site 7	54.5	**Small Cobble (65 - 150mm)** **Large Cobble (150 - 256mm)** Undercut Bank Tree Roots (Fine) Tree Roots (Large) Woody Debris Tree Roots (large)	Present	2	Shaded incised channel with almost no flow. Most cover and available habitat out of the water. Stream pooled in places. No fish and few invertebrates.
Site 8	235.5	**Small Cobble (65 - 150mm)** **Large Cobble (150 - 256mm)** Undercut Bank **Tree Roots (Fine)** Tree Roots (Large) **Woody Debris** Tree Roots (large) Filamentous Algae	Present	2	Open channel in the lower section consisting of gravel/pebble/cobble. Good cover from cobbles, woody debris and tree roots throughout. Water level low with a heavy growth of filamentous algae. Heavily shaded in the upper section. Otter spraint with crayfish shell identified within survey section. Minnow, three-spined stickleback and brown trout present.

	Total		Habitat	Crayfish habitat Score	
Site 9	119.5	**Small Cobble (65 - 150mm)** **Large Cobble (150 - 256mm)** Boulder (256 - 400mm) Rubble Urban Debris Undercut Bank **Tree Roots (Fine)** Moss Filamentous Algae Submerged vegetation Emergents Tree Roots (Large) Woody Debris Tree Roots (large) Filamentous Algae Other Reinforced Wall	Present	1	Channel survey length U/S of A358 as the D/S was impenetrable. Very low flow which was mostly pooled along the site length and was largely dry at the U/S end. Habitat is present under higher flows but not really viable under current conditions. Lots of large cover from cobbles/ boulder debris. Rubble present was comprised of bricks, tiles, blocks, concrete rubble and posts. Stoneloach present.
Site 10	147	**Small Cobble (65 - 150mm)** Rubble Urban Debris Undercut Bank **Tree Roots (Fine)** Tree Roots (Large) Moss **Filamentous Algae** Submerged vegetation Emergents Woody Debris Tree Roots (large) Filamentous Algae	Present	2	Section from Kenny road bridge, down under the A358 and into the fields D/S. Very low flow, with water almost pooled. Good habitat available. Mosaic of sheltered and open channel. Lots of macrophytes and overhanging vegetation in open sections. Very silted in pooled sections. Three-spined stickleback present.
Site 11	N/A	-	Present	0	Small ditch with no flow and stagnant water. Shallow dredged channel thick with silt and stagnant water present. Channel full of macrophytes and overhanging vegetation. No suitable habitat and not surveyable. Channel width mostly <0.5m. Similar conditions U/S of A358.
Site 12	271	**Small Cobble (65 - 150mm)** Large Cobble (150 - 256mm) Urban Debris Undercut Bank **Tree Roots (Fine)** Tree Roots (Large) Moss Filamentous Algae Submerged vegetation Tree Roots (Large) Woody Debris Filamentous Algae	Present	2	Section of the channel between A358 bridge and near where it joins another channel. Low flow but good habitat present. Shorter section surveyed as lots of good habitat present and impounded above the weir at the U/S NGR. Old otter spraint with crayfish leg present found on gravel bar at the U/S end.
Site 13	558	**Small Cobble (65 - 150mm)** Large Cobble (150 - 256mm) Urban Debris Undercut Bank Tree Roots (Fine) Tree Roots (Large)	Present	2	Surveyed a total length of 100m U/S and 50m D/S of the road bridge and weir. Lots of otter spraint on gabions under the road bridge including crayfish remains. Some of the spraint was fresh. Lovely natural channel D/S of bridge with lots of cover, clean gravel/cobbles and instream macrophytes. U/S of bridge channel impounded and habitat is less good.

	Total		Habitat	Crayfish habitat Score	
		Moss Filamentous Algae Submerged vegetation **Emergents** Tree Roots (Large) Woody Debris Filamentous Algae Other Reinforced Wall			

Appendix G Otter spraint photographs

Site 8 (18 August 2021)

Site 12 (19 August 2021)

Site 13 (19 August 2021)

Figure G-1 Photographs showing otter spraints with crayfish remains

Appendix H Macroinvertebrate site details

Table H-1 Macroinvertebrate site details

Site	Season	Dominant Substrates	Depth (cm)	Width (m)	Flow (m/s)	Habitat type	Riparian land use	Temperature	Conductivity	Dissolved oxygen (%)	pH
C2	Spring	Silt	3	0.5	0.05	Trickle	Arable/tall herbs	8.9	817	75.3	8.29
	Autumn	Dry									
C3	Spring	Silt	15	1.5	0.16	Glide	Rough pasture/road	7.4	1282	9.2	8.17
	Autumn	Silt/pebble	10	1	0.03	Run/glide	Tall herb/improved pasture/road and railways	14.7	1645	61	8.13
D1	Spring	Silt	10	0.6	0.1	Run/glide	Rough pasture	9	1005	44	8.03
	Autumn	Silt	10	1.5	0.01	Glide/slack	Tall herb/rough pasture	14.9	1089	10.5	7.91
D2	Spring	Silt/gravel	5	0.5	0.2	Run	Rough pasture	8.6	935	69	8.08
	Autumn	Silt/pebble/gravel	5	1	0.03	Run/glide	Tall herb/arable land/ rough pasture/road and railways	14.5	988	46.6	8.05
E1	Spring	No Access									
	Autumn	Cobble/pebble	5	1	0.1	Run/glide	Broadleaved woodland/tall herbs/improved pasture	15.4	714	70.4	8.17
E1.5	Spring	Pebble/gravel	30	0.5	0.06	Trickle/run	Broadleaved woodland	8.6	1337	94.1	8.05
	Autumn	Cobble/pebble	4	1	<0.01	Glide/slack	Broadleaved woodland/tall herbs/ roads and railways	15.9	1620	65	8.06
E2	Spring	No Access									
	Autumn	Silt	10	1	<0.01	Glide/slack	Parks/tall herbs/road	15.1	802	12.7	7.82
E2.5	Spring	Gravel/silt	8	0.65	0.02	Trickle/pool	Broadleaved woodland/road	8.1	1257	83.3	8.16
	Autumn	Cobble/pebble	3	1	0.01	Run/glide	Broadleaved woodland/tall herbs/ roads and railways	15.2	1308	48.7	8.18
F1	Spring	Pebble	10	1.5	0.02	Pool/run/glide	Arable/rough pasture	8.9	468	100	8.46

Site	Season	Dominant Substrates	Depth (cm)	Width (m)	Flow (m/s)	Habitat type	Riparian land use	Temperature	Conductivity	Dissolved oxygen (%)	pH
	Autumn	Cobble/pebble	15	1	0.11	Run/glide	Tall herbs/arable	15.6	583	69.3	8.09
F2	Spring	Pebbles	5	1.2	0.25	Riffle/pool/glide	Rough pasture/farm buildings	9.1	474.8	113	8.55
	Autumn	Cobble/pebble	15	1	0.06	Run/glide	Tall herbs/arable	18	578	93.8	8.31
G1	Spring	Silt	30	1.3	0.01	Glide	Rough pasture/farm buildings	9.4	613	100.9	8.34
	Autumn	Gravel	30	2	0.01	Slack	Broadleaved woodland/improved pasture	14.7	1026	20.7	7.9
G2	Spring	Silt	3	0.5	0.1	Trickle/pool	Tall herb/rough pasture	9	687	77.1	7.82
	Autumn	Dry									
H1	Spring	Gravel	10	1.2	0.1	Run/glide	Rough pasture	8.2	724	84.9	8.16
	Autumn	Cobble/pebble	10	1.5	0.03	Trickle/slack/ditch	Arable/road	15.2	651	39.8	7.93
H2	Spring	Clay/silt	20	1	0.1	Pool/glide	Improved pasture/ rough pasture	7.1	745	71	8.02
	Autumn	Silt/clay	20	1	0.01	Slack/ditch	Broadleaved woodland/arable	14.5	654	27.7	7.76
I1	Spring	Pebbles/gravel	5	0.5	0.01	Trickle/pool	Arable	5.8	610.3	80	8.03
	Autumn	Silt	10	1	<0.01	Trickle/ditch	Improved pasture/rough pasture	16.1	591	16.8	7.71
I2	Spring	Gravel/pebble	5	0.4	0.01	Trickle/pool	Rough pasture	6.8	585.2	102.1	7.85
	Autumn	Dry									
J1	Spring	Gravel/pebble	30	4	0.1	Glide	Arable/rough pasture	7.8	447.8	81.1	8.12
	Autumn	Pebble	45	3	0.01	Pool/glide/slack	Broadleaved woodland/arable	16.7	473.9	62.9	7.86
J2	Spring	Silt	30	0.5	0.1	Glide	Rough pasture/ broadleaved woodland	8.3	520	69.5	7.83
	Autumn	Silt	20	1	0.01	Slack/ditch	Broadleaved woodland/arable	16.5	531.9	58.1	7.72

Appendix I Macroinvertebrate scores and RICT input

Table I-1 Macroinvertebrate metrics spring data

Sample location	Sample date	LIFE (TL5)	PSI (TL5)	CCI (TL5)	Conservation classification	WHPT (TL2)	NTAXA (TL2)	ASPT (TL2)
C2	05/05/21	6.73	22.22	4.91	Low	49.5	13	3.81
C3	05/05/21	7.14	42.86	8.16	Moderate	109.3	22	4.97
D1	05/05/21	7	44.44	7.86	Moderate	61.6	15	4.11
D2	05/05/21	7.07	46.88	4.62	Low	83.7	17	4.92
E1.5	05/05/21	7.5	54.55	5	Moderate	86.8	16	5.43
E2.5	05/05/21	7.64	59.38	12.38	Fairly High	86	16	5.38
F1	05/05/21	8.09	69.01	11.52	Fairly High	190.6	28	6.81
F2	05/05/21	8.11	74.36	18.38	High	230.1	33	6.97
G1	05/05/21	6.93	26.09	4.75	Low	82.4	17	4.85
G2	05/05/21	6.43	18.42	5.25	Moderate	78	17	4.59
H1	06/05/21	6.71	30.43	4.2	Low	89.6	20	4.48
H2	06/05/21	6.5	21.74	7.27	Moderate	112.8	24	4.7
I1	06/05/21	6.31	19.35	6.5	Moderate	71.4	14	5.1
I2	06/05/21	5.93	17.65	4.85	Low	91.7	18	5.09
J1	06/05/21	7	35.9	6.74	Moderate	112.7	22	5.12
J2	06/05/21	6.67	20	7.08	Moderate	134.6	26	5.18
Keys to cell shading (see Appendix C for value ranges)								
PSI	Heavily sedimented	Sedimented	Moderately sedimented	Slightly sedimented	Minimally sedimented			
CCI	Low conservation value	Moderate conservation value	Fairly high conservation value	High conservation value	Very high conservation value			

Table I-2 Macroinvertebrate metrics autumn data*

Sample location	Sample date	LIFE (TL5)	PSI (TL5)	CCI (TL5)	Conservation classification	WHPT (TL2)	NTAXA (TL2)	ASPT (TL2)
C3	06/09/21	7.14	43.48	8.75	Moderate	105.5	22	4.80
D1	06/09/21	5.62	16.00	16.15	High	56.6	14	4.04
D2	06/09/21	7.58	65.22	3.55	Low	77.2	16	4.83
E1	06/09/21	7.43	30.77	1.00	Low	44.8	10	4.48
E1.5	06/09/21	8.00	72.73	1.40	Low	32.2	7	4.60
E2	07/09/21	6.86	21.43	12.38	Fairly High	56.5	14	4.04
E2.5	06/09/21	7.43	47.06	5.25	Moderate	61.1	13	4.70
F1	07/09/21	7.52	54.29	7.37	Moderate	130.9	23	5.69
F2	07/09/21	7.55	50.85	11.04	Fairly High	167.7	29	5.78
G1	07/09/21	6.23	12.12	4.09	Low	58.5	16	3.66
H1	07/09/21	6.36	24.49	8.41	Moderate	101.1	24	4.21
H2	07/09/21	6.23	20.69	4.00	Low	61.7	16	3.86
I2	07/09/21	5.67	0.00	7.50	Moderate	66.8	17	3.93
J1	07/09/21	6.00	9.09	4.95	Low	91.4	21	4.35
J2	07/09/21	6.64	18.00	7.40	Moderate	128.1	25	5.12
Keys to cell shading (see Appendix C for value ranges)								
PSI	Heavily sedimented	Sedimented	Moderately sedimented	Slightly sedimented	Minimally sedimented			
CCI	Low conservation value	Moderate conservation value	Fairly high conservation value	High conservation value	Very high conservation value			

*Note C2, G2 and I1 were dry within the study area during the autumn survey visit.

Table I-3 RICT environmental data input

Site	Season	Log altitude	Log distance from source (km)	Log width (m)	Log depth(cm)	Mean substratum	Discharge category	Alkalinity (mg.l-1 CaCO3)	Log alkalinity (mg.l-1 CaCO3)	Log slope (m.km-1)	Mean air temperature (°C)	Air temperature (°C)
C3	Autumn	1.02119	0.39094	0.09691	1.09691	4.52375	1	460.4	2.66314	0.40824	10.4463	11.762
C3	Spring	1.02119	0.39094	0.17609	1.17609	7.4375	1	402.3	2.60455	0.40824	10.4463	11.762
D1	Autumn	1.31597	0.24797	0.19033	1	7.4	1	327.05	2.51461	1.09691	10.4307	11.7451
D1	Spring	1.31597	0.24797	-0.2218	1	7.1375	1	313.6	2.49638	1.09691	10.4307	11.7451
D2	Autumn	1.23805	0.34044	-0.1249	0.69897	2.675	1	263.69	2.42109	0.90634	10.4315	11.7459
D2	Spring	1.23805	0.34044	-0.301	0.69897	4.025	1	291.2	2.46419	0.90634	10.4315	11.7459
E1.5	Autumn	1.55509	0.12385	-0.1249	1.23045	-3.685	1	465.2	2.66764	1.19312	10.423	11.7169
E1.5	Spring	1.55509	0.12385	-0.301	1.47712	-2.6575	1	419.9	2.62315	1.19312	10.423	11.7169
E2.5	Autumn	1.41497	0.24551	-0.0835	0.74036	-2.0313	1	402.45	2.60471	1.35641	10.4224	11.7206
E2.5	Spring	1.41497	0.24551	-0.1871	0.90309	0.5375	1	394.3	2.59583	1.35641	10.4224	11.7206
F1	Autumn	1.6826	0.82217	0.09691	1.09691	-3.1488	1	160.15	2.20453	0.7495	10.4193	11.6915
F1	Spring	1.6826	0.82217	0.17609	1	-2.05	1	141.7	2.15137	0.7495	10.4193	11.6915
F2	Autumn	1.66134	0.84323	0.04139	1	-4.1125	1	160.4	2.2052	0.75435	10.419	11.697
F2	Spring	1.66134	0.84323	0.07918	0.69897	-3.625	1	143.9	2.15806	0.75435	10.419	11.697
G1	Autumn	1.61909	0.64147	0.21748	1.47712	0.425	1	254.3	2.40535	1.10789	10.4161	11.6875
G1	Spring	1.61909	0.64147	0.11394	1.47712	1.625	1	188.2	2.27462	1.10789	10.4161	11.6875
H1	Autumn	1.62542	0.6464	0.13033	1	-0.865	1	212	2.32634	0.98272	10.4115	11.683
H1	Spring	1.62542	0.6464	0.07918	1	1.8125	1	223.7	2.34967	0.98272	10.4115	11.683
H2	Autumn	1.5955	0.6637	0	1.30103	8	1	215.7	2.33385	0.69461	10.4114	11.6835
H2	Spring	1.5955	0.6637	0	1.30103	8	1	230.4	2.36248	0.69461	10.4114	11.6835
I2	Autumn	1.58995	0.5966	-0.1549	0.87506	3.36875	1	180.21	2.25578	1	10.4143	11.6763
I2	Spring	1.58995	0.5966	-0.3979	0.69897	-1.2625	1	179.3	2.25358	1	10.4147	11.6762
J1	Autumn	1.61278	0.85794	0.54407	1.57403	-1.825	1	139.45	2.14442	0.83569	10.4226	11.6639
J1	Spring	1.61278	0.85794	0.60206	1.47712	-1.45	1	135.3	2.1313	0.83569	10.4226	11.6639
J2	Autumn	1.57864	0.87157	-0.1249	1.39794	8	1	160.3	2.20493	0.81757	10.4213	11.6682
J2	Spring	1.57864	0.87157	-0.301	1.47712	8	1	158.4	2.19976	0.81757	10.4213	11.6682

Appendix J Macroinvertebrate site photographs

Site C2 (05/05/21)

Site C2 (5 September 2021) - Insufficient water depth to sample.

Site C3 (05/05/21)

Site C3 (5 September 2021)

Site D1 (05/05/21)

Site D1 (06/09/21)

Site D2 (05/05/21)

Site D2 (06/09/21)

E1 - No Spring sample collected

Site E1 (06/09/21)

E2- No Spring sample collected

Site E2 (06/09/21)

Site E1.5 (05/05/21)

Site E1.5 (06/09/21)

Site E2.5 (05/05/21)

Site E2.5 (06/09/21)

Site F1 (05/05/21)

Site F1 (06/09/21)

Site F2 (05/05/21)

Site F2 (06/09/21)

Site G1 (05/05/21)

Site G1 (07/09/21)

Site G2 (05/05/21)

Site G2 (07/09/21)

Site H1 (06/05/21)

Site H1 (07/09/21)

Site H2 (06/05/21)

Site H2 (07/09/21)

Site I1 (06/05/21)

Site I1 (07/09/21)

Site I2 (06/05/21)

Site I2 (07/09/21)

Site J1 (06/05/21)

Site J1 (07/09/21)

Site J2 (06/05/21)

Site J2 (07/09/21)

Figure J-1 Spring and autumn macroinvertebrate site photographs

Appendix K Macroinvertebrate taxa lists

Table K-1 Macroinvertebrate taxa list and abundance from spring samples

Taxa name	Site name															
	C2	C3	D1	D2	E1.5	E2.5	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
	Abundance															
Acroloxus lacustris											3	1			2	
Agapetus fuscipes		1				12		2								
Agapetus sp.						5										
Amphinemura sp.												1				
Amphinemura sulcicollis								1								
Ampullaceana balthica		3					1		2		108	22				
Anabolia nervosa									2		4		1			12
Ancylus fluviatilis							3	1	1	2	1				1	
Asellus aquaticus	87	84	1328	387	19	108	10	1	92	341	110	98	90	385	27	231
Athripsodes bilineatus		3														
Athripsodes cinereus							3									
Athripsodes sp.		1					3	4								
Baetis muticus							25	32								
Baetis rhodani/atlanticus agg.		5	7	16	6	2	40	615			65	5				
Baetis sp.								233			7					
Brachyptera risi							1	5								
Caenis luctuosa															1	
Caenis rivulorum								1								
Centroptilum luteolum	1	1										1	1			
Ceratopogonidae	15	15	1		10	12					4	2		3		33
Chaetopteryx villosa		9			1		2						1		2	5
Chelifera sp.											1					1
Chironomidae	710	659	400	48	39	98	208	385	152	102	288	185	2350	950	789	3450
Chironomini	32					13							125			
Cloeon simile										1						
Crangonyx pseudogracilis/floridanus agg.		1	1				1		3	84		17	25	68		1

Taxa name	Site name															
	C2	C3	D1	D2	E1.5	E2.5	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
	Abundance															
Cyrnus trimaculatus								1								1
Dendrocoelum lacteum											1					
Dicranota sp.		17	2	6												
Dixa sp.													1			
Drusus annulatus															1	
Dytiscidae													4			
Ecdyonurus dispar							2									
Ecdyonurus sp.								8								
Ecdyonurus torrentis							30	7								
Elmis aenea		5		99	2	77	62	27			1	1			3	2
Elodes sp.			15	6		3						1		2		
Eloeophila sp.			1													
Ephemera danica							3	1							2	36
Eristalis sp.														1		
Erpobdella octoculata															3	7
Galba truncatula											1		1			
Gammarus pulex	27	41	59	588	221	378	28	9	1	1	15	95		2		
Gammarus pulex/fossarum agg.	15	47	613	126	129	264	14	39			6	9				8
Girardia tigrina		1		2											3	1
Glossiphonia complanata	3					1				1	7	3				2
Gyraulus albus															1	
Gyraulus crista												1			1	
Gyrinus substriatus														1		
Habrophlebia fusca				1	255	910	168	122	475	471	99	219	171	330	21	41
Halesus digitatus							1	2	1	3						
Halesus radiatus								2			7				1	
Haliplus lineatocollis		1							1			1		4		
Helobdella stagnalis											3	1			1	
Helophorus aequalis					1											
Helophorus brevipalpis			1	1									1			
Helophorus grandis													3	3		

Taxa name	Site name															
	C2	C3	D1	D2	E1.5	E2.5	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
	Abundance															
Helophorus sp.									1	1		1				1
Hemerodromia sp.								1								
Heptagenia sulphurea							2	1								
Hippeutis complanatus								1				1				
Hydracarina	3							1								
Hydraena gracilis							16	6								
Hydraena nigrita						2										
Hydroporus palustris													1			
Hydroporus planus														2		
Hydroporus sp.													5			
Hydropsyche angustipennis		1														
Hydropsyche siltalai							7	8							1	
Isoperla grammatica					1		87	51	1	51	49	7	43	7		
Lepidostoma hirtum								2							3	1
Leptophlebiidae		3						33	45					40		
Leuctra geniculata							12	4							1	3
Leuctra sp.								1								
Limnephilidae	12			28		5				6	15	36	1	25	15	2
Limnephilus lunatus	86	4	5	9						24	10	96		53	1	47
Limnius volckmari		6					44	54	2						2	
Limoniidae												1				
Lype reducta	1															
Micropterna sequax						4										
Mystacides longicornis																5
Nemoura cinerea					1	1			1	9			1	3		
Nephrotoma sp.									1							
Oligochaeta	18	51	78	36	15	69	48	64	110	91	112	51	93	81	56	144
Orectochilus villosus							10	2								
Oribatei					1					1						
Ostracoda	1												1	44		
Oulimnius tuberculatus		1					16					1				1

Taxa name	Site name															
	C2	C3	D1	D2	E1.5	E2.5	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
	Abundance															
Paraleptophlebia submarginata								1								
Pericoma sp.	1		3								1					
Physa fontinalis	1															
Physella acuta										68						
Pisidium amnicum																29
Pisidium milium	5											1				
Pisidium personatum				1		1	1	1		19				2		
Pisidium sp.	49	45				6	4	1		212	18	15		4	4	77
Pisidium subtruncatum		3		2							5	1			1	4
Planorbis carinatus											1	3				1
Plectrocnemia conspersa				1	9	39					1					
Polycelis felina								2								
Polycelis nigra/tenuis	59	12		5			1					2		51	1	5
Polycentropus flavomaculatus							11	4								
Potamophylax latipennis							3									
Potamopyrgus antipodarum		392	1				74	90	70	1053	24	6			28	45
Proasellus meridianus	2													91		
Prodiamesinae									63	17		11				
Psychoda sp.											1					
Ptychoptera lacustris			1													
Rhithrogena semicolorata								4								
Rhyacophila dorsalis								2								1
Sericostoma personatum		2					7	15							2	3
Serratella ignita							184	432								
Sialis lutaria												1				2
Sialis sp.																1
Simulium angustipes/velutinum		3						3								
Simulium costatum			1													
Simulium sp.		6	3	75	1		2	60								
Siphonoperla torrentium							1	1								
Sphaerium corneum																3

Nemoura avicularis									1					1	
Nepa cinerea													2		
Notonecta maculata													15		
Notonecta sp.										1					
Oligochaeta	27	40	23	21		50	11	2	32	7	66	60	1	13	33
Orectochilus villosus									2						
Oulimnius sp.									45						
Oulimnius tuberculatus	9					1		2	32		5	2	1	30	12
Pericoma sp.						1	1								
Physella acuta/heterostropha										3					
Pisidium milium						9									
Pisidium personatum										1					
Pisidium sp.	38			38		408	1	3	1	1	257	36		15	23
Planorbis carinatus											3		22		39
Planorbis planorbis						1									
Platambus maculatus	4						2		32		7				
Platambus sp.								5			6				
Plea minutissima		1													
Plectrocnemia conspersa			2		3										
Plectrocnemia sp.					1										
Polycelis nigra/tenuis			1								1		9		5
Polycentropus flavomaculatus								12	39					6	1
Potamopyrgus antipodarum	143		2	12		323		180	162	148				48	46
Prodiamesinae	122	65	22	5								20			33
Riolus cupreus						1									
Sericostoma personatum				1				3	16						2
Serratella ignita									1						
Sialis lutaria	24			1				4	1		3	16		42	57
Sialis sp.															1
Sigara nigrolineata										1					
Silo nigricornis	2														
Simulium angustipes/velutinum							1								
Simulium sp.			1												
Sphaeridium scarabaeoides															1
Sphaerium corneum															8

Taxa name	Site name														
	C2	C3	D1	D2	E1.5	E2.5	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
	Abundance															
Succinea sp.														1		
Tanypodinae	22	47	35	41			65	78	145	35	57	56		66		215
Tanytarsini	85	125	9	295		15		77		16			27	35	60	331
Trocheta subviridis				1	1			1	1	1			4			
Valvata piscinalis															2	1
Velia sp.					1											

Table K-2 Macroinvertebrate taxa list and abundance from autumn samples

Taxa name	Site name														
	C3	D1	D2	E1	E1.5	E2	E2.5	F1	F2	G1	H1	H2	I2	J1	J2
	Abundance														
Acari			1	1	5		9				3				
Acilius sulcatus											1				
Acroloxus lacustris											10	1		19	
Agabus bipustulatus		4									1	1	14		
Agabus sp.						2				2	2	2			
Agapetus fuscipes	1														
Ampullaceana balthica		1							10	101	35	3		3	1
Anacaena globulus		1	1										2		
Ancylus fluviatilis						1		6	2	1	1				
Aquarius najas	1							29							
Asellus aquaticus	192	155	140	2	30	55	55	4	83	24	156	902	57	203	10
Athripsodes sp.												1			
Atrichopogon sp.				1	1										
Baetidae									11						
Baetis muticus									2						
Baetis rhodani/atlanticus agg.			3	1				2	87		5				
Baetis sp.											2				
Caenis luctuosa	3														
Calopteryx sp.								1							4

Calopteryx virgo															3
Centroptilum luteolum									1					2	
Chaetopteryx villosa	1						1		1					3	2
Chelifera sp.											1				
Chironomidae	18	35	42		12	150		7	61	15	76		202	105	41
Chironomini			15			435	9			32		95	425	61	25
Collembola					1										
Cordulegaster boltonii															1
Crangonyx pseudogracilis/floridanus agg.	1								2	1		8	2	1	
Culicidae		1													
Dendrocoelum lacteum								1							
Dicranota sp.	15	3	1												
Dixa sp.	1		11				1				1				1
Dryops luridus													1		
Dytiscidae															1
Dytiscus marginalis													2		
Ecdyonurus sp.								6	1						
Ecdyonurus torrentis								1	1						
Elmis aenea	21	1	2	10		3	6	10	33		3			1	1
Elodes sp.		2	1				2				1				
Ephemera danica								1						2	6
Ephemera sp.															2
Erpobdella octoculata														2	1
Erpobdella sp.														1	7
Erpobdella testacea	1														
Galba truncatula		1													
Gammarus pulex	102		382		74		36	1	3	1	85	21			1
Gammarus pulex/fossarum agg.	78	1	153		115	2	8	6	1	1	59	47			1
Gerridae								13							
Girardia tigrina													1		
Glossiphonia complanata	12					1		2	3	8	93	25		13	4
Goera pilosa	1														
Gyraulus albus														23	1
Gyraulus crista														3	
Gyrinus substriatus						1					2	1	6		5

Halesus digitatus											1				
Haliplus lineatocollis	1									1			3		
Haliplus sp.									2		1				
Helobdella stagnalis											22		1	30	
Helochares lividus		1													
Helophorus brevipalpis										1					
Helophorus grandis		1													
Helophorus minutus		1											1		
Helophorus minutus/griseus		30													
Helophorus sp.		45													
Hesperocorixa sahlbergi										15	2		4		
Hippeutis complanatus						1						2		6	1
Hydracarina											1	1			
Hydraena gracilis								1							
Hydraena testacea											1				
Hydrobius fuscipes		6											1		
Hydroporus angustatus													1		
Hydropsyche angustipennis	9														
Hydropsyche siltalai									3						
Hydroptila sp.									1						
Ilybius fuliginosus													2		1
Ilybius sp.														1	3
Lepidostoma hirtum									1						
Leptophlebiidae									1						
Leuctra hippopus								11	3						
Limnebius papposus		1													
Limnephilidae					2			2							
Limnius volckmari	22		1	5		1		7	47					1	2
Limnophora sp.									1		1				
Lype reducta			2			2						1			
Micropterna sequax			2												
Musculium lacustre											1				
Mystacides longicornis	51						1	2	1					133	2
Nebrioporus elegans	1								12						
Nebrioporus sp.									3						

Succinea sp.	1														17
Syrphidae		1													
Tanypodinae	36	128	12	16	9	250	15	3	155	12	35	17			
Tanytarsini					17	125	6	4			145				42
Tonnoiriella sp.											1				
Valvata piscinalis														12	1
Velia caprai					1										

If you need help accessing this or any other National Highways information, please call **0300 123 5000** and we will help you.

This document is also available on our website at **www.nationalhighways.co.uk**

For an accessible version of this publication please call **0300 123 5000** and we will help you.

If you have any enquiries about this publication email **info@nationalhighways.co.uk**
or call **0300 123 5000***. Please quote the Natioanl Highways publications code **PR91/22**.

*Calls to 03 numbers cost no more than a national rate call to an 01 or 02 number and must count towards any inclusive minutes in the same way as 01 and 02 calls.

These rules apply to calls from any type of line including mobile, BT, other fixed line or payphone. Calls may be recorded or monitored.

Printed on paper from well-managed forests and other controlled sources when issued directly by National Highways.

Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ

National Highways Company Limited registered in England and Wales number 09346363