

A47 North Tuddenham to Easton Dualling

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6.3 Environmental Statement Appendices **Appendix 8.5 - White-clawed Crayfish Survey** **Report**

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ENVIRONMENTAL STATEMENT APPENDICES
Appendix 8.5 - White-clawed Crayfish Survey Report

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White-Clawed Crayfish Survey along the River Tud, Norfolk

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1 Introduction

Abrehart Ecology was commissioned by Sweco UK Limited (herein referred to as Sweco) to assess the distribution of crayfish species along the River Tud, as part of the proposed A47 North Tuddenham to Easton scheme. The survey acts to highlight any species of conservation interest (particularly the white-clawed crayfish, river lamprey, and the invasive signal crayfish), in the section of the River Tud adjacent to the A47, that may be impacted by pollutants and run-off during construction works or subject to crossings.

The section of River Tud surveyed was from Honingham to North Tuddenham, 6.8 miles west of Norwich in Norfolk. The sample sites were located along the River Tud, within seven pre-defined sections – chosen using previous knowledge of the river channel and accessibility. Survey areas were agreed with Sweco prior to works.

In particular, the survey aimed to identify remnant populations of white-clawed crayfish (*Austropotamobius pallipes*) within the river. White-clawed crayfish are a freshwater species that can be found under submerged cobbles, rocks, logs, tree roots, and amongst fallen leaves in permanent water bodies. It is not tolerant to pollution or hydrological change; however, the most widespread threat are invasive crayfish species (such as the American signal crayfish (*Pacifastacus leniusculus*) and crayfish plague (*Aphanomyces astaci*).

The white-clawed crayfish is widespread across Europe, although populations have declined significantly. Ireland now supports the greatest subpopulation, as the invasive American signal crayfish has not been introduced. White-clawed crayfish are a species protected under Annex II species of the Habitats Directive and Schedule 5 of the Wildlife and Countryside Act (1981 – as amended).

White-clawed crayfish are a local species of interest and have a Norfolk Biodiversity Action Plan dedicated to them. Recently, they have been observed in the River Wissey, River Glaven, and River Wensum.

The aim of the survey detailed in this report was to establish a dataset on the distribution of any crayfish species present. This can then be used to inform mitigation, future monitoring, and assist the effective management of the site. The main survey objectives were to provide information on:

- The presence and extent of any species of conservation interest, such as white-clawed crayfish (*Austropotamobius pallipes*);
- The presence of invasive/non-native crayfish species;
- The presence of any other species of interest (aquatic invertebrate or fish) and any other invasive species (aquatic invertebrate or mollusc);
- Environmental variables and water body characteristics; and
- To provide information to inform planning applications.

2 Methods

Sampling points were distributed along the 7km stretch of the River Tud adjacent to the potential works along the A47 (Figure 2). Sample sites comprised surveying within seven 500m sections with extensive sampling undertaken within each section.

Sampling points were distributed to cover as much of the suitable crayfish habitat as possible. In total, nineteen sample points were used in a variety of habitats, chosen to include suitable foraging and refugia opportunities for crayfish species.

Data and sample collection were undertaken by a pair of experienced surveyors, Toby Abrehart and Alister Killingsworth. The surveyors sampled for crayfish and recorded water body features. All the sampling was undertaken in September 2019.

2.1 Crayfish sampling

Standard crayfish survey methodology was used for this survey. In particular, the water depth, weather conditions, and habitat composition lent itself to hand searching and sweep netting. No traps were set or used during this survey.

Large cobbles and boulders were turned, fine and large roots were investigated, dense submerged and emergent vegetation was netted, woody and urban debris was investigated, and kick samples were taken. Any crayfish burrows were noted and, in areas where signal crayfish had not been identified by other sampling methods, were investigated.

Crayfish and fish species were identified in the field and either released (white-clawed crayfish and fish) or killed (American signal crayfish which are a schedule 9 species of the WCA and were killed using a heavy object and the remains buried). Any aquatic invertebrate species of interest were also identified in the field (where possible without the need for laboratory equipment) and recorded – species noted were those indicative of good water quality, invasive species, or uncommon native species.

2.2 Assessment of habitat characteristics

Within each section, several habitat assessments were undertaken – usually if habitat structure changed significantly. Information recorded included bank angle and composition, water depth, rate of flow, refugia available to crayfish, and channel substrate. A basic flora list was also produced for each location.

2.3 Biosecurity

The surveyors worked down-catchment, to prevent spreading crayfish plague or other pathogens to previously uninfected areas. As an additional precaution, any equipment (nets, trays, and waders) were rinsed with Virkon© disinfectant before entering a new section of the river.

2.4 Limitations

Occasionally, water depth became too great for surveyors to access potential habitats using waders and so very small sections of the river were not sampled.



Figure 1. River Tud sample locations (overview).



Figure 2. Locations of sampling points along the River Tud (west)



Figure 3. Locations of sampling points along the River Tud (east)

3 Results

Crayfish sampling was undertaken in seven 500m sections of the River Tud on the 16th and 17th September 2019. Within these sections, habitat suitable for crayfish was surveyed by hand and using nets.

No white-clawed crayfish were found during the survey. Several factors may have impacted their survival within this section of the River Tud (having been previously recorded here in 2017 and 2018), these are discussed further in Section 4.

The Annex II species *Cottus gobio* (bullhead) and *Lampetra fluviatilis* (river lamprey) were also recorded within samples (locations detailed later in the report).

Three invasive species, the crustacean *Pacifastacus leniusculus*, the mollusc *Potamopyrgus antipodarum*, and the plant *Impatiens glandulifera* were found within the survey area. All three were found to be widespread across the survey area. *P. antipodarum* created a layer of 'gravel' on the riverbed - which was found in nets during kick sampling and netting, *I. glandulifera* was frequently noted along the riverbanks, and *P. leniusculus* was found within all submerged areas of the river channel – within tree roots, beneath undercut banks, within emergent vegetation, beneath large cobbles,

A kingfisher was seen and heard flying along the river channel. This species is listed on Schedule 1 of the Wildlife & Countryside Act 1981 (as amended), affording it greater protection during the breeding season.

Table 1. Notable, and Red-Listed species found during 2017 surveys.

WCA Schedule 1	Local	Annex II
<i>Alcedo atthis</i>	<i>Ilyocoris cimicoides</i>	<i>Cottus gobio</i>
	<i>Notonecta maculata</i>	<i>Lampetra fluviatilis</i>



Figure 4. Rare or notable species recorded at sample points (west).



Figure 5. Rare or notable species recorded at sample points (east).



Figure 6. Non-native species recorded at sample points (west).



Figure 7. Non-native species recorded at sample points (east).

River Sample Points

3.1.1 Sample Point 1

The sample was taken at the most westerly point of the survey area and was a shaded section of the River Tud near to the bridge crossing of Mill Road in Mattishall. This section of the river had a shallow water depth and sandy/gravelly substrate. Along the riverbed were occasional large rocks and boulders. The banks of the channel were steep (>45°) and were predominantly earthen, providing ample opportunity for crayfish to create burrows. Other refugia noted at this location were small cobbles, fine tree roots, and large tree roots. The shading was from abundant bankside trees that had limited woodland/shade tolerant flora growing beneath.

American signal crayfish were observed from the bridge prior to the start of the survey effort. Once sampling began, a total of three signal crayfish were found – two large adults and one juvenile that had missing chelipeds.

The sampling also revealed a moderate-poor aquatic invertebrate fauna, dominated by shrimp – likely *Gammarus pulex*. Also noted within the samples were five bullhead and banded demoiselle larvae (*Calopteryx splendens*).

3.1.2 Sample Point 2

Taken downstream of Sample Point 1, this stretch of the river had similar habitats and shading to Sample Point 1; however, the banks appeared more undercut and there was a greater abundance of crayfish burrows and large tree roots. This section of the River Tud had a consistent surrounding/adjacent habitat, comprising woodland and agricultural fields.

There were no crayfish recorded in this stretch of river, despite the abundance of refugia and presence of large animals upstream.

Bullhead were again recorded, and aquatic invertebrate diversity was slightly increased. This included bivalve species (*Sphaerium corneum*), *Gammarus sp.*, and alderfly (*Sialis lutaria*).

3.1.3 Sample Point 3

Sample 3 was taken downstream of Sample Point 2. The banks had a reduced frequency of trees and shading was much reduced in this area (<30%). This allowed for a greater abundance and variety of aquatic flora, including water forget-me-not (*Myosotis scorpioides*) and fool's water cress (*Apium nodiflorum*). Crayfish refugia was in the form of fine tree roots, submerged vegetation, woody debris, and emergent vegetation. Siltation was also greater in this section of the channel, along with an increased water depth.

A single signal crayfish moult was found mid-channel, resting against woody debris.

Other species of interest recorded within samples included bullhead, banded demoiselle larvae, stickleback (*Gasterosteus aculeatus* and *Pungitius pungitius*), and a *Dytiscus sp.* diving beetle. On the banksides, a potentially Nationally Scarce plant (stingless nettle *Urtica galeopsifolia*) was recorded.

3.1.4 Sample Point 4

This section of the River Tud began at the bridge crossing of Mattishall Lane. The water depth here varied from <10cm to over >50cm and included several areas of fast-flowing riffles. Despite having abundant tree growth along the banks, there was a good amount of watercress growing near to the bridge. Refugia was abundant across the width of the river – within the banks, margins, and mid-channel. These refuges included cobbles, fine tree roots, large tree roots, undercut banks, and crayfish burrows.

Seven American signal crayfish were recorded within this section; four juveniles, two adult males, and a large adult female. Most of these animals were healthy; however, the large female had a missing cheliped. The crayfish were found in dense

fool's watercress within the riffles, beneath tree roots, beneath cobbles, and moving across the riverbed. A moderate sized moult was also found mid-channel.

Despite the abundance of signal crayfish (which are known to impact upon invertebrate and fish diversity), several species of interest were recorded. This included water crickets (*Velia caprai*), bullhead, stickleback and brown trout (*Salmo trutta*).

3.1.5 Sample Point 5

A more shaded area of this section that had fewer large cobbles or boulders and no emergent vegetation. This coincided with a much-reduced aquatic invertebrate fauna. Although crayfish burrows were noted, these were less frequent than in Sample Point 6. Refuges were provided by woody and urban debris, including a particularly large collection of branches that had accumulated against a fallen tree.

One adult American signal crayfish was seen during the sampling. This was not sexed as it moved beneath dense debris and was only observed, not caught.

One bullhead was also found during the sampling.

3.1.6 Sample Point 6

Further downstream the river became deeper and flow much more steady – near to this Sample Point the water was almost static. There was no aquatic vegetation and banksides were dominated by trees and stinging nettle (*Urtica dioica*). The meadows adjacent to the steep-sided banks were cattle grazed, although cattle were not in the fields at the time of survey. Crayfish refugia included undercuts on the banks, large tree roots, and woody debris.

Two male and one female American signal crayfish were found during the sampling effort. The large males were seen moving across the riverbed and the smaller female was found on top of the tree roots. One male had a damaged cheliped and the female had a missing cheliped.

A single bullhead was found during sampling, disturbed from beneath a dense mat of tree roots.

3.1.7 Sample Point 7

Further upstream the river became more open and a sampling effort was taken within an open area between large willow trees – samples were also taken within and beneath submerged tree roots at either end of the sample area. The channel was densely vegetated with branched bur-reed (*Sparganium erectum*), water cress (*Rorippa nasturtium-aquaticum*), and common reed (*Phragmites australis*). Underfoot, the riverbed had a gravel substrate with occasional small cobbles. Refugia/shelter opportunities were abundant within this stretch of river and, including the vegetation features listed above, comprised undercut banks, earth banks, and woody debris.

No crayfish were recorded within this section of river.

Bullhead and stickleback were again found during the sampling. In addition, a kingfisher (*Alcedo atthis*) and green sandpiper (*Tringa ochropus*) were seen flying along the river and over adjacent habitats.

3.1.8 Sample Point 8

More open than Sample Point 7, this stretch had occasional willow trees and branched bur-reed was dominant within the channel. The riverbed had very limited large cobbles (mostly fine sands, gravels, and silt) and so sampling was restricted to net searches.

One juvenile signal crayfish was found during sampling.

Species of interest identified in the sample included bullhead, banded demoiselle, common backswimmers (*Notonecta glauca*), and stickleback.

3.1.9 Sample Point 9

This section covered a 500m stretch of river that is to the south-east of the village of Hockering – near to Riverside Farm Holidays. Adjacent habitats were much changed from Section A; the land adjacent to the River Tud was grazed as pasture or a hay meadow. The banks were more open than Section A and tall emergent vegetation and bankside flora was abundant. This included branched bur-reed, hemp agrimony (*Eupatorium cannabinum*), purple loosestrife (*Lythrum salicaria*), water starwort (*Callitriche* sp.), and river water-crowfoot (*Ranunculus fluitans*). Refugia/shelter opportunities were abundant at this sample point and included emergents, submerged vegetation, woody debris, tree roots, and undercut banks. The river channel had a varied substrate, comprising of gravel, sand, and silt. Occasional cobbles and pebbles were also noted.

There were no crayfish recorded in this stretch of river; however, *Gammarus* sp. and banded demoiselle were again frequently recorded. Several stickleback were also found during sampling.

3.1.10 Sample Point 10

This sampling area was adjacent to a sluice with very fast-flowing water. This water ranged in depth from a few centimetres to over 50cm. Bank composition and angle were also variable within this section of river: bank angle changed from flat (<10°) cobbled areas – where cattle enter the river - to steep-sided earth banks (>45°). The channel itself had a fine gravel sediment with occasional larger pebbles and cobbles. Aquatic vegetation was dominated by two species, water forget-me-not and watercress. Refuges were common across the river channel (including banks, margins, and mid channel) and included undercut banks, burrows, emergent vegetation, and filamentous algae.

There were no crayfish recorded within this stretch of river.

Bullhead and stickleback were frequently found during sampling – beneath pebbles and cobbles, within marginal vegetation, and within undercut banks.

3.1.11 Sample Point 11

Downstream of the sluice gate, the water still had a good flow; however, this area was more consistently deep with steeper earth banks. There was dense Himalayan balsam (*Impatiens glandulifera*) on the banks and branched bur-reed, water parsnip (*Berula erecta*), and watercress in the channel. This section also had fewer cobbles than the sections upstream and downstream, with a finer, siltier substrate. Despite the differences in channel morphology, the river here still provided frequent crayfish refugia: woody debris, burrows, undercut banks, emergents, submerged vegetation, and occasional cobbles.

Two juvenile female American signal crayfish were recorded within this section of river. Both were healthy and were not missing any legs or chelipeds.

A second non-native species was prevalent here; the New Zealand mud snail (*Potamopyrgus antipodarum*), which in places formed a layer of 'gravel' on the riverbed. Bullhead and stickleback were again frequently recorded within samples.

3.1.12 Sample Point 12

Similar in morphology to Sample Point 10, this section of the River Tud had fast-flowing water, varied water depth, and abundant aquatic vegetation. It was noted that the aquatic invertebrate fauna was more diverse at this location – most likely due to habitat heterogeneity and greater niches to exploit. There were several overhanging trees and occasional stands of Himalayan balsam along the riverbanks. Crayfish refugia/habitat was abundant throughout the length and width of this sample point/section: cobbles (various sizes), boulders, filamentous algae, submerged vegetation, emergent vegetation, undercut banks, and burrows.

One male and one female American signal crayfish – both juveniles – were recorded during the sampling.

Bullhead and stickleback were again abundant within samples. Several species of water boatmen and backswimmers were also recorded.

3.1.13 Sample Point 13

This sample was taken from beneath/adjacent to the A47 crossing at the eastern extent of the village of Honingham. There were inflow pipes and large reinforced banks/gabions around the bridge crossing itself. The water had a layer of 'scum' and was one of very few sample locations that had cloudy water. Emergent vegetation was rare and limited to branched bur-reed, with submerged vegetation more prevalent – including water starwort, water mint, and water forget-me-not. The banks were dominated by tall ruderal and scrub species such as hawthorn (*Crataegus monogyna*), bramble (*Rubus fruticosus agg.*), and lesser burdock (*Arctium minus*) – in places this was growing over and into the channel. Himalayan balsam was also established on the banks.

No crayfish were recorded at this location. Although the water quality appeared reduced and urban litter was greater, bullhead and a river lamprey (*Lampetra fluviatilis*) ammocoete were recorded within samples near to the bridge.

3.1.14 Sample Point 14

A stretch of the River Tud that meandered through cattle grazed pasture. Abrehart Ecology Ltd has previously recorded white-clawed crayfish within this section of the River – as part of aquatic invertebrate sampling in 2017. The river had become markedly more choked with branched bur-reed, reed canary grass (*Phalaris arundinacea*), and watercress within the intervening two years – possibly as a result of a pollution event at the beginning of 2019. Banksides were poached due to cattle grazing, as the river ran through cattle grazed fields, and sections of the bank had block formation.

No crayfish were recorded at this location.

Species of interest recorded within samples were bullhead, water boatmen, backswimmers (including the locally important *Notonecta maculata*), and the invasive New Zealand mud snail.

3.1.15 Sample Point 15

Like Sample Point 14 (deep channel meandering through grazed pasture), this location also supported common club-rush (*Schoenoplectus lacustris*). Similarly, there was frequent crayfish habitat throughout the channel, including woody debris, tree roots (from bankside willow (*Salix* spp.) and alder (*Alnus glutinosa*) trees), undercut banks, emergents, and submerged vegetation. Cobbles were generally smaller within this area and boulders (stones bigger than 25cm in diameter) were absent.

No crayfish were recorded, and the only species of interest were bullhead – which were found occasionally within samples.

3.1.16 Sample Point 16

Despite also being choked with marginal and emergent vegetation (dominated by branched bur-reed and reed canary grass), this section of the river had clear water, a steady flow, and abundant crayfish habitat. Other aquatic plants within the channel included reed sweet-grass (*Glyceria maxima*) and water mint (*Mentha aquatica*).

No crayfish were found at this sample point, and it was noted that despite the abundance of habitat the invertebrate fauna was depauperate.

3.1.17 Sample Point 17

A partially shaded section of the River Tud that had good flow and varied water depth. The banks within this section ranged from <10° to steep sided earth banks that were almost vertical. Crayfish habitat was frequent across the channel and included undercut banks, woody debris, submerged vegetation, and tree roots. Cobbles and boulders were very rare/absent from this area – the riverbed substrate was predominantly fine gravel, sand, and silt.

Again, no crayfish were recorded within at this sample point and the only species of interest were bullhead – recorded occasionally within samples.

3.1.18 Sample Point 18

This was more shaded and had banksides dominated by alder. The water was deeper and slower in this location and the invertebrate fauna was noticeably less diverse. Crayfish habitat was reduced here, and although present was not frequent or abundant.

No crayfish were recorded at this sample point.

One bullhead was recorded during the sampling – beneath tree roots.

3.1.19 Sample Point 19

An open stretch of the River Tud that had good flow, clear water, and abundant submerged and emergent vegetation – watercress, floating grasses, and river water-crowfoot. This section of the river ran through grazed pasture, with occasional mature alders along the bank. Again, crayfish habitat was abundant across the width of the channel and comprised tree roots, undercut banks, and vegetation.

No crayfish were recorded at this sample point.

Other notable species recorded within samples included bullhead, water boatmen, backswimmers, and New Zealand mud snails (less prevalent than previous locations).

3.1.20 Rare and notable species

Bullhead *Cottus gobio* (Linnaeus, 1758)

This is a small bottom-living fish that inhabits rivers, streams, and stony lakes – particularly favouring fast-flowing, clear shallow water. It is not found in badly polluted rivers or streams.

National Status

The bullhead is widespread and often common in rivers across Europe.

This is a species protected under Annex II species of the Habitats Directive.

Local Status

The Bullhead has a widespread distribution across Norfolk, with populations found in a number of river systems. This includes a number of records along the River Tud.

River Lamprey *Lampetra fluviatilis* (Linnaeus, 1758)

An elongated eel-like fish that inhabits river channels and estuaries. Ammocoete larvae live in marginal silts within the river channel before metamorphosing and travelling down the river to estuaries, where they live as a parasite on other fish species. The adult lamprey return to fresh water areas of the river to spawn.

National Status

Lamprey are widespread but rare in the UK.

This is a species protected under Annex II species of the Habitats Directive and listed as a Species of Principle Importance in England in Section 49 of the NERC Act 2006.

Local Status

The river lamprey has a widespread distribution across Norfolk, with populations found in a number of river systems. Although known to be within the Tud (anecdotal evidence provided by the Norfolk Rivers Trust), there are no records on NBN.

Ilyocoris cimicoides (Linnaeus, 1758)

Found in still, often muddy-bottomed water, living on or near the bottom, often amongst dense vegetation. Despite having fully formed wings, *I. cimicoides* is not able to fly and disperses by 'nocturnal walking'.

National Status

They are primarily distributed in central, southern, and eastern England, with further records on the England-Wales border and south-west England. There is no conservation status associated with this species.

Notonecta maculata (Fabricius, 1794)

Usually found in still waters, particularly those associated with barren pools or artificial water bodies. Although, they are known to use chalk streams, drainage channels, and quarry ponds.

National Status

Although it is a widespread species across the England and Wales, there is only one record within Scotland. Within Norfolk, existing records are predominantly from Broads and ditches associated with the River Bure and River Thurne. Prior to this survey there were no records from the River Tud.

4 Discussion and Mitigation

The sampling detailed in this report assessed the diversity and distribution of crayfish species along the River Tud. The surveys aimed to highlight locations of remnant populations of the native white-clawed crayfish and map the current distribution of the non-native American signal crayfish. Whilst sampling, the surveyors also took note of any other plant, fish, or invertebrate species of interest. The survey was undertaken to highlight any species of conservation interest that may be impacted by pollutants and run-off during construction works as part of the proposed duelling of the A47.

4.1 Crayfish populations

Previous aquatic invertebrate surveys carried out by Abrehart Ecology Ltd in 2017 identified a small population of white-clawed crayfish at Sample Point 14 – including a large adult female. However, extensive sampling within this area revealed that the population has likely been lost from this stretch of the River Tud.

Anecdotal evidence provided by the Norfolk Rivers Trust indicated that there was a good population of white-clawed crayfish using the area of river near to Sample Point 13. A large number (60+) of crayfish were translocated from this area in October 2018 to a safe Ark Site – a site that does not contain signal crayfish and whose location means invasive species introduction is unlikely. Sampling carried out in September 2019 revealed that white-clawed crayfish are now likely to have also been lost from this stretch of the River Tud. A large-scale translocation (removing much of the potential breeding population), pollution events, and increased presence of American signal crayfish appear to have caused the loss of the native species from this area too.

The Aquatic Invertebrate Baseline Surveys (Abrehart Ecology Ltd, 2017) also revealed a low-density population of American signal crayfish, with several juvenile animals recorded during sampling. The 2019 sampling showed that the signal crayfish population has increased markedly, and large adults were far more common than before – in several areas these were seen crossing the riverbed from the bankside or bridge crossings. The signal crayfish has far-reaching implications for the health of a watercourse, not only impacting the native white-clawed crayfish through disease transmission and direct competition. This species is also known to cause large-scale damage to riverbanks through the creation of burrows and can have significant impacts on invertebrate and fish diversity through active predation (Booy et al., Mathers et al. 2016). The Abrehart Ecology surveyors that carried out the white-clawed crayfish sampling are also experienced aquatic invertebrate surveyors and noted any species of interest within sweep or kick samples. It was noted along much of the length of the River Tud that species representative of the groups Trichoptera (caddisflies), Hirudinea (leeches), Gastropoda (snails and slugs) were uncommon or absent from many of the sample locations. This is consistent with the findings of Mathers et. al (2016). Their study also indicated that this shift in macroinvertebrate communities was permanent, showing no evidence of recovery.

4.2 Other Notable Species

As mentioned above, the surveyors noted any species of interest recorded within the samples (macroinvertebrates and freshwater sponges) and on the riverbanks (plant species). Bullhead fish (an Annex II species) were recorded at 18 of 19 sample locations – often within sweep samples of submerged vegetation, beneath floating tree roots, or amongst/beneath larger cobbles or boulders within the channel. A single river lamprey ammocoete was recorded at Sample Point 13, within a kick sample taken beneath the A47 crossing. This is a Species of Principle Importance in England (NERC Section 41) and care should be taken to avoid disturbing or damaging the habitats within this area or causing pollution events that could impact local populations.

Two further non-native species were identified during the survey; the New Zealand mud snail and Himalayan balsam. The New Zealand mud snail can reproduce rapidly and is now the most common freshwater gastropod in Britain (<http://archive.jncc.gov.uk/default.aspx?page=1713>). Himalayan balsam was noted along the banks at several Sample Points. This is a highly invasive species that can outcompete native species and which can spread up and downstream along a river – through its seed dispersal mechanism. It is possible to eradicate this species through proactive management (before seeds have set) within two or three years.

4.3 Recommendations

Care should be taken to avoid hazardous materials from construction works entering the watercourses, to prevent impact to these important habitats, and spill kits should be kept with each vehicle. Should hazardous materials enter the watercourses, then the area should be re-surveyed to assess the impact to invertebrate fauna.

It is also important to produce guidelines/a dedicated method statement detailing biosecurity measures for working within waters containing non-native species and waterborne pathogens – such as crayfish plague. Any workers or equipment that enters the watercourse should be disinfected or left to air dry for a minimum of 48 hours before it is placed into another watercourse. Workers should also be careful not to spread Himalayan balsam seeds. If possible, management of Himalayan balsam should be carried out prior to the start of works on any riverbanks.

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Appendix A – Photos

Examples of habitats surveyed



Sample area 1 -
To the east of Mill
Lane



Sample area 5 -
A section to the
north of Riverside
Farm Holidays



Sample area 4 -
To the east of
Mattishall Lane



Sample area 6 -
To the east of
Mattishall Lane



Sample area 10 -
To the east of
Berrys Lane



Signal Crayfish
Pacifastacus leiusculus
Found along the entire length of the survey area of the River Tud



Bullhead
Cottus gubio
Found along the entire length of the survey area of the River Tud, the most frequent fish collected in the samples



Himalayan balsam
Impatiens glandifera
Found from section 11 to 12 on both banks



River lamprey
Lampetra fluviatilis
This single ammocoete was collected under the A47 bridge at sample site 13