

A303 Amesbury to Berwick Down

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6.3 Environmental Statement Appendices

Appendix 8.10 White clawed crayfish survey report

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed
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October 2018



**A303 Stonehenge
Amesbury to Berwick Down**

Crayfish Survey Report 2017

Arup Atkins Joint Venture

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November 2017

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Foreword

The A303/A358 corridor is a vital connection between the South West and London and the South East. While the majority of the road has been dualled, there are still over 35 miles of single carriageway. These sections act as bottlenecks for users of the route resulting in congestion, particularly in the summer months and at weekends, delays to traffic travelling between the M3 and the South West and an increased risk of accidents. The A303 passes through the Stonehenge, Avebury and Associated Sites World Heritage Site, separating the stones from other scheduled monuments and severely limiting the enjoyment of the wider site.

The A303 Stonehenge (Amesbury to Berwick Down) scheme is part of the wider package of proposals for the A303/A358 corridor designed to transform the connectivity to and from the South West by creating an expressway. This would comprise of consistently good dual carriageway roads with grade-separated junctions, giving most users a motorway-quality journey. The A303/A358 package was identified in the 2014 National Infrastructure Plan as one of the country's Top 40 priority infrastructure projects.

The proposals by Highways England to upgrade the A303 past Stonehenge consist of an eight mile (13 kilometre) stretch from Amesbury in the east, through the Stonehenge World Heritage Site (WHS) and the village of Winterbourne Stoke, to Berwick Down in the west. Proposals include a 1.8 mile (2.9 kilometre) tunnel with approach roads inside the WHS, a new bypass for Winterbourne Stoke (passing either north or south of the village) and improvements to existing junctions with the A345 and A360.

Highways England (HE) commissioned the Arup-Atkins Joint Venture (AAJV) to undertake the Options Phase for the scheme starting in January 2016. The AAJV was also commissioned by HE to undertake crayfish surveys of the River Till and the River Avon, in order to de-risk the next stages of the project, due to the fast-tracked nature of the scheme. This report presents the findings of the crayfish surveys, which were led by Dr Ben Rushbrook of Arcadian Ecology on behalf of the AAJV. The AAJV and Arcadian Ecology would like to thank the landowners as well as the local fishing clubs for their help and consideration during the course of the surveys.

Executive Summary

The AAJV were commissioned by Highways England in 2016 to undertake surveys to investigate the (potential) presence of white-clawed crayfish as part of a programme of ecological surveys to inform the design of the proposed A303 Stonehenge (Amesbury to Berwick Down) Scheme.

This report presents the baseline survey results recorded during the crayfish surveys undertaken between May and October 2017 at two sites; the River Avon associated with the A303 road bridge near Amesbury, and the River Till near Berwick St James, both locations which would be affected by each of the three route options proposed at the time (1Na, 1Sa and 1Nd). It is intended that the information in this report will be used to identify and assess the potential implications of the Scheme and inform mitigation and compensation for the species.

A framework of European and national legislation, and planning policy guidance exists to protect and conserve white-clawed crayfish.

Following a detailed habitat appraisal, both sites were investigated in further detail using a combination of the four survey techniques across five survey visits: Artificial Refuge Traps (River Avon and River Till survey sites); Funnel traps (River Avon survey site only); Hand-searching (River Avon and River Till survey sites); and Torch survey (River Avon survey site only).

Nine signal crayfish were recorded across the five survey visits conducted at the River Avon survey site. Although only a small number of signal crayfish were recorded relative to the level of survey effort, it is considered that the River Avon survey site is likely to support at least a moderately high density of signal crayfish. No signal crayfish were found at the River Till site. No white-clawed crayfish were found at either sites.

The findings of these surveys have been used to assess the (potential) presence, distribution and relative abundance of native and non-native crayfish species at the two survey sites. A complete assessment of potential impacts to crayfish will be undertaken within the Environmental Impact Assessment (EIA) for the preferred route option, along with details of mitigation and compensation measures as appropriate.

1 Introduction

1.1 Project Background

- 1.1.1 The A303 Stonehenge (Amesbury to Berwick Down) Scheme forms part of the A303/A30 trunk route, which provides vital east-west connectivity between London and the South West and is also part of the Trans-European Network-Transport (TEN-T). The A303, which runs for approximately 150 kilometres from Junction 8 of the M3 near Basingstoke towards Taunton and Exeter, serves not only long distance traffic but also intermediate regional destinations via connecting major north-south route options as well as local small and medium sized settlements along the route.
- 1.1.2 Recognising the importance of the A303/A358 Corridor and the problems along it, the Government has committed in its Road Investment Strategy (RIS) to create an 'Expressway' to the South West via the A303/A358 route by 2029. The A303 Stonehenge scheme, involving dualling the A303 between Amesbury and Berwick Down, including the construction of a tunnel at least 1.8 miles (2.9 kilometres) long as the road passes Stonehenge, has been prioritised within the first RIS period (2015/16 to 2019/20).
- 1.1.3 Following public consultation in January 2017, three routes were recommended for detailed assessment during 2017, Route Options 1Na, 1Sa and 1Nd. Maps 1 to 3 in the Crayfish Survey Report 2017 prepared by Arcadian Ecology in Annex 1 show the sites selected for crayfish presence/assumed absence surveys.

1.1 Scope of the Document

- 1.1.1 This report presents the baseline survey results recorded during the 2017 crayfish surveys. It is intended that the information in this report will be used with the results of other ecological surveys to identify and assess the potential implications of the scheme and inform mitigation and compensation for impacts to crayfish.
- 1.1.2 This baseline report can be used to accompany any future Development Consent Order (DCO) and associated Environmental Impact Assessment (EIA) for the Scheme.
- 1.1.3 Dr Ben Rushbrook of Arcadian Ecology was commissioned to undertake these surveys on behalf of the AAJV. The full survey report which details the methodology used and describes the results of the 2017 crayfish surveys can be found in Annex 1 of this report.

Annexes

Annex 1 - Crayfish Survey Report 2017 prepared by Arcadian Ecology

Crayfish Survey Report

A303 Stonehenge Amesbury to Berwick Down



Dr Ben Rushbrook
November 2017

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Front Cover: Adult signal crayfish recorded during surveys on the River Avon.

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Executive Summary

Arcadian Ecology & Consulting Ltd (hereafter 'Arcadian Ecology') was appointed by the Arup Atkins Joint Venture, on behalf of Highways England, to conduct a programme of surveys for white-clawed crayfish *Austropotamobius pallipes* at two sites associated with the proposed A303 Stonehenge Amesbury to Berwick Down scheme options.

Surveys to investigate the (potential) presence of white-clawed crayfish were conducted at two sites; the River Avon associated with the A303 road bridge near Amesbury, and the River Till near Berwick St James. This report presents the findings of these surveys.

The findings of this survey programme have been used to assess the (potential) presence, distribution and relative abundance of native and non-native crayfish species at the two survey sites. However, it is emphasised that it was outside the remit of this report to provide an assessment of any potential effects of the proposed A303 Stonehenge Amesbury to Berwick Down scheme on crayfish, or potential implications of crayfish on the delivery of the proposed scheme.

An initial visit was undertaken at each site on 17th May 2017 and a general assessment made of the potential suitability of the habitats present within the survey sections to support crayfish. This included a walk-over of the section of the River Avon downstream of the A303 road bridge, and 'spot checks' of sections of the River Till near Berwick St James.

A detailed habitat appraisal was conducted of the main and side channels of the River Avon downstream of the A303 road bridge on 3rd August 2017, and of the main river channel upstream of the road bridge on 14th August 2017. A detailed habitat appraisal was conducted of the River Till near Berwick St James on 3rd August 2017.

These reaches were investigated in further detail using a combination of the four survey techniques:

- Artificial Refuge Traps (River Avon and River Till survey sites);
- Funnel traps (River Avon survey site only);
- Hand-searching (River Avon and River Till survey sites);
- Torch survey (River Avon survey site only).

No white-clawed crayfish were recorded across the five survey visits conducted on the sections of channel included within the River Avon survey site. However, nine signal crayfish (plus one additional adult observed during a bat survey in June 2017) encompassing a range of sizes / ages were recorded across the five survey visits. It is therefore considered unlikely that white-clawed crayfish are present at the River Avon survey site.

Furthermore, although only a small number of signal crayfish were recorded relative to the level of survey effort, it is considered that the River Avon survey site is likely to support at least a moderately high density of signal crayfish given the:

- range of sizes / ages of crayfish recorded;
- evidence of recent recruitment;
- the presence of a number of burrows associated with the true left bank;
- the presence of optimal to sub-optimal habitat along the majority of the length of the survey site; and
- the dense marginal vegetation (in particular in the reaches nearest the road bridge) which limited the visibility for torching and may have reduced trapping success.

No white-clawed crayfish were recorded across the five survey visits conducted at the River Till survey site. It is therefore considered unlikely that white-clawed crayfish are present at the River Till survey site. Furthermore, no signal crayfish were recorded across the five survey visits conducted at the River Till survey site. It is therefore considered unlikely that signal crayfish are present at the River Till survey site.

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1. INTRODUCTION

1.1 Background

Arcadian Ecology & Consulting Ltd (hereafter 'Arcadian Ecology') was appointed by the Arup Atkins Joint Venture, on behalf of Highways England, to conduct a programme of surveys for white-clawed crayfish *Austropotamobius pallipes* at two sites associated with the proposed A303 Stonehenge Amesbury to Berwick Down scheme options.

1.2 Site Descriptions

Surveys to investigate the (potential) presence of white-clawed crayfish were conducted at two sites; the River Avon associated with the A303 road bridge near Amesbury, and the River Till near Berwick St James (Map 1).

The River Avon survey site is located to the north-west of the town of Amesbury and includes sections of the main river channel both upstream and downstream of the A303 road bridge near Amesbury, and a small number of side channels associated with the downstream section (Map 2). The main river channel upstream (north) of the road bridge is predominately deep, relatively wide, and dominated by a silt substrate. Downstream of the road bridge the channel characteristics are similar, although the channel becomes shallower with a coarser substrate in the lower reaches of the survey section (Photograph 1). A public footpath is present on the true left bank top from the downstream extent of the survey section (i.e. the road bridge at Countess Road) to the upstream limit of the A303 road bridge, and a number of river restoration and protection features are present along this length.

A number of side channels are present to the north of the downstream section of the main river. The majority of these were considered either sub-optimal for crayfish and / or difficult to survey due to the limited depth of water they supported and / or the dominance of silt across the channel bed. However, a single channel (Map 2) did provide suitable habitat. Furthermore, a small side channel to the east and south (Map 2), which reconnects to the main river channel at a number of locations, supported a range of habitats with the potential to provide refuge opportunities for crayfish.

The River Till survey site is located to the north-east of Berwick St James (Map 1) and is set within a largely rural landscape. The majority of the survey section is characterised by a shallow, relatively wide bowl-shaped channel that extends approximately 160m and 220m upstream and downstream of a wooden footbridge respectively (Map 3). The channel here is enclosed within predominately willow trees and scrub (Photograph 2), with the channel bed comprised of a mixture of sections dominated by accumulated silt, and sections characterised by gravels and small cobbles.

A 65m section of channel downstream of this (tree and scrub-lined) reach was also included within surveys. The channel here was generally narrower, with a broad fringe of emergent marginal vegetation at both banks, and characterised by a substrate of large stones, small cobbles and occasional flints (Photograph 3). However, a cattle crossing point is located immediately downstream of the tree-lined section resulting in a short section of channel that is notably wider and very shallow.

1.3 Remit and Scope of the Report

This report presents the findings of surveys for white-clawed crayfish conducted at two locations associated with the proposed A303 Stonehenge Amesbury to Berwick Down scheme.

The findings of this survey have been used to assess the (potential) presence, distribution and relative abundance of native and non-native crayfish species at the two survey sites. However, it is emphasised that it was outside the remit of this report to provide an assessment of any potential effects of the proposed A303 Stonehenge Amesbury to Berwick Down scheme on crayfish, or potential implications of crayfish on the delivery of the proposed scheme.

2. ECOLOGY AND LEGISLATION

2.1 Ecology

The white-clawed crayfish *Austropotamobius pallipes* (Figure 1) is a decapod crustacean of the family Astacidae. This species of crayfish is distributed throughout Europe and is at the most north-western limit of its range in Britain (Holdich, 2003). It is the only species of crayfish which is native to Britain and was formerly widespread where conditions were suitable, although populations in western Wales and Scotland are a result of subsequent introductions (Holdich, 2003; Holdich & Sibley, 2009; Holdich *et al.*, 2009).



Figure 1. A white-clawed crayfish in a chalk stream in southern England.

In Britain, white-clawed crayfish occur in many types of water body including rivers, streams, slow moving canals and still waters such as lakes, reservoirs and water-filled quarries (Pöckl *et al.*, 2006). White-clawed crayfish distribution is largely determined by geology and water quality, with crayfish occurring in areas with relatively hard, mineral-rich waters (Holdich, 2003). White-clawed crayfish typically favour habitats with an underlying substrate of fine gravel / sand with some pebbles and overlaid with aggregations of boulders and large cobbles / stones (>25cm diameter), areas of undercut bank and overhanging trees, and in-channel vegetation (Peay, 2003). Within these, white-clawed crayfish will occupy cryptic micro-habitats under rocks and submerged logs, among tree roots, algae and macrophytes, and are also able to burrow into suitable substrate (Holdich, 2003). However, it is important to recognise that white-clawed crayfish are also found to be abundant in streams, rivers, canals and millraces with deep, anoxic mud, with very little aquatic vegetation, where they utilise submerged tree roots, woody debris and anthropogenic structures for refuge (Holdich *et al.*, 2006).

As with all crustaceans, crayfish undergo a series of moults to grow, the frequency of these moults decreasing with age. White-clawed crayfish usually reach sexual maturity after three to four years and, although the exact timing of breeding will depend on latitude and altitude, breeding takes place between September and November when water temperatures drop below 10°C for an extended period (Holdich, 2003). Eggs are fertilised externally and held beneath the abdomen by the female

over winter. The eggs hatch in late spring and the juveniles initially remain associated with the female's abdomen before becoming independent at the second stage of development (when they are extremely prone to predation), around June in southern England.

The white-clawed crayfish is omnivorous, but primarily carnivorous, eating macroinvertebrates (including worms, insect larvae and snails), some small fish and carrion when available (Holdich, 2003). Macrophytes, algae and detritus are other key components of the white-clawed crayfish diet, and calcified plants are particularly attractive to crayfish as they provide a ready source of calcium during the moulting process (Holdich, 2003).

2.2 Status

White-clawed crayfish were once widespread across Europe and Britain but, following a dramatic decline during the mid to late 1900's, are now considered to be internationally and nationally rare (Holdich & Sibley, 2009; Füreder *et al.*, 2010). This decline has been due to habitat loss and degradation, pollution, abstraction, but most significantly the introduction of non-native crayfish species, and the disease 'crayfish plague' carried by species from North America, which results in up to 100% mortality in populations of our native species (Holdich *et al.*, 1995; Holdich & Sibley, 2009).

Britain historically supported a significant proportion of white-clawed crayfish in Europe (Füreder *et al.*, 2010). However, following the introduction of the North American signal crayfish *Pacifastacus leniusculus* in the 1970's and associated outbreaks of crayfish plague, a large number of white-clawed crayfish populations have been eliminated, and most existing populations are concentrated in northern and central England (Holdich *et al.*, 2009).

The dramatic decline of white-clawed crayfish in Britain has occurred in parallel to the introduction and rapid spread of the North American signal crayfish, the most abundant species of non-native crayfish in Britain (Holdich & Sibley, 2009; Holdich *et al.*, 2014). It is therefore considered that the dramatic decline of white-clawed crayfish in southern England is a direct result of the introduction and spread of signal crayfish. Specifically, the loss of most white-clawed crayfish populations is considered to be a result of a series of suspected outbreaks of crayfish plague associated with these introductions.

2.3 Legislation

As a consequence of this global and national decline, white-clawed crayfish are protected under European and National legislation. They are listed under Annexes II and V of the European Council Directive 92/43/EEC the Habitats Directive 1992, transposed into UK Legislation through the Conservation of Habitats and Species Regulations 2010 that requires:

- *The identification and designation of important sites for white-clawed crayfish as Special Areas of Conservation (SACs); or*
- *The taking in the wild and exploitation of white-clawed crayfish to be subject to management measures.*

However, the white-clawed crayfish is not noted as an Annex II species present as a qualifying feature for selection of the River Avon as a SAC.

White-clawed crayfish are provided additional partial protection through their inclusion on Schedule 5 [section 9.1(taking) and 9.5]] of the Wildlife and Countryside Act 1981 (as amended) that makes it an offence to:

- *Intentionally take [capture] a wild white-clawed crayfish; or*
- *Sell, offer or expose for sale, or have in one's possession or transport for the purpose for sale, any live or dead wild white-clawed crayfish, or any part derived from it.*

Any surveys or the removal of white-clawed crayfish during works must therefore be carried out under licence from Natural England. In addition, the trapping of any species of crayfish requires consent from the Environment Agency.

White-clawed crayfish are also of material consideration in the planning process. Under Section 41 of the Natural Environment and Rural Communities Act 2006, all public bodies have a duty to conserve

biodiversity, with specific attention paid to species included on the Governments list of species of principal importance, which includes the white-clawed crayfish.

The introduction of new or established non-native species can have severe and enduring adverse impacts on our native fauna, flora and habitats. As a consequence, under section 14(1) of the Wildlife and Countryside Act 1981 (as amended), it is an offence to release or allow to escape into the wild any animal which:

- *Is of a kind which is not ordinarily resident in and is not a regular visitor to Great Britain in a wild state; or*
- *Is included in Part 1 of Schedule 9.*

Although already established in the wild, the North American signal crayfish is highly invasive, has well documented significant adverse impacts on our native wildlife and habitats (Sibley, 2000; Peay, 2001 and references therein; Crawford *et al.*, 2006; Holdich *et al.*, 2014), and is therefore included on Schedule 9 of the aforementioned legislation.

In essence, it is therefore not only an offence to release signal crayfish either intentionally or through a lack of due diligence, but any individuals trapped or captured from a watercourse should not be re-released and must be disposed of in an appropriate manner (Peay, 2001).

3. METHODOLOGY

3.1 Background Data Search

Background data searches of the two survey sites had previously been conducted by the Arup Atkins Joint Venture and, based on the results of these and of the previous site assessments conducted by Atkins Limited and Arup, the potential presence of white-clawed crayfish had been identified.

3.2 Field Survey

All surveys were undertaken by Dr Ben Rushbrook (MCIEEM) and supervised co-workers under Natural England Class Survey Licence WML-CL11 (White-clawed Crayfish: Registration Number 2016-19682-CLS-CLS). All surveys were undertaken within the approved survey period for white-clawed crayfish (Peay, 2003), and under the relevant permits from the Environment Agency (i.e. EP/EW032-J-301/9766/01 and EP/EW024-F-315/9765/01).

Appropriate biosecurity measures were implemented prior to, during and after each survey visit to minimise the risk of 'crayfish plague' transmission.

Any crayfish captured were transferred to a secure container and processed on the bank top. The following information was recorded: species, sex, carapace length, presence of physical damage, evidence of disease, breeding condition, moult stage, location and method of capture.

Any individuals with a carapace length (CL) less than 25mm for white-clawed (Peay, 2003), and less than 35mm for signal crayfish (Smith & Wright, 2000), were recorded as juveniles. It is acknowledged that the exact size and age at maturity varies with location (Guan & Wiles, 1996), but it is considered that these size ranges are appropriate to provide an approximate assessment of juvenile status.

Any white-clawed crayfish found would be handled for the minimum time feasible before being carefully returned to the location of capture. Any non-native crayfish captured would permanently be removed from the watercourse, dispatched humanely, and the carcasses disposed of at a secure location away from any watercourses.

The River Avon associated with the A303 road bridge near Amesbury, and the River Till near Berwick St James, were each visited on five occasions between 3rd August 2017 and 2nd October 2017 inclusive. Overviews of the specific sections / areas included within the surveys are shown in Maps 2 and 3 for the River Avon and River Till sites respectively.

Survey sections extended above and below the areas to be directly affected by the proposed scheme options to maximise the likelihood of recording crayfish should they be present, and therefore the level confidence in the survey results returned.

3.2.1 Habitat appraisal

An initial visit was undertaken at each site on 17th May 2017 and a general assessment made of the potential suitability of the habitats present within the survey sections to support crayfish. This included a walk-over of the section of the River Avon downstream of the A303 road bridge, and 'spot checks' of sections of the River Till near Berwick St James.

A detailed habitat appraisal was conducted of the main and side channels of the River Avon downstream of the A303 road bridge on 3rd August 2017, and of the main river channel upstream of the road bridge on 30th August 2017. A detailed habitat appraisal was conducted of the River Till near Berwick St James on 3rd August 2017.

These reaches were investigated in further detail using a combination of the four survey techniques detailed below. It is considered that using a combination of survey techniques would further increase the probability of recording any crayfish present (Peay, 2000).

3.2.2 Artificial Refuge Trap

Artificial Refuge Traps (ARTs) are a series of tubes of varying diameter set on a metal base (Photograph 4). The ARTs are utilised by crayfish for refuge in the same way they use natural

features such as crevices beneath rocks and burrows in the bank. Unlike conventional traps, animals are able to enter and exit the tubes at their will between checks, which eliminates the risk of adverse impacts on non-target species such as water vole *Arvicola amphibius*, young otter *Lutra lutra* and water fowl.

The ARTs were deployed within locations along the survey section that supported suitable habitat features including gravel substrate overlain by large cobbles and flints, marginal vegetation, and submerged tree root systems. Areas of deep water and locations supporting unsuitable habitat features were avoided, including those characterised by deep or accumulated silt, or where vegetation had completely choked the channel.

A total of ten and 25 ARTs were deployed at the River Avon and River Till survey sites respectively (Maps 4 and 5), and the location of each ART was recorded using a GPS device. The majority of the survey length of the main channel of the River Avon was deep and in places dominated by a thick layer of silt substrate, particularly with increasing proximity to the A303 road bridge. As a consequence, ARTs were focused downstream of the A303 road bridge, on a single side channel supporting suitable habitat for crayfish that flowed into the main river channel from the north-west (Map 4).

ARTs at each site were checked for the presence of crayfish approximately fortnightly during a nine week period (i.e. during a further four survey visits).

3.2.3 Funnel trapping

Funnel trapping was conducted on the main channel of the River Avon only, since its depth and the extensive sections of deep silt rendered it unsuitable for surveying with ARTs.

Cylindrical, collapsible mesh-traps, with funnelled entrances at either end (Photograph 5) and baited with an attractant, were deployed overnight when crayfish most actively forage. Funnel traps were deployed within areas of the survey sections where they could be fully submersed and associated with suitable refuge habitat (e.g. alder *Alnus glutinosa* root plates, dense marginal vegetation beds, etc.), or where there was evidence of possible crayfish activity (i.e. burrows in the bank side). Care was taken to avoid the areas of greatest flow rates, minimising the risk of trap loss, and appropriate measures were taken to minimise the risk of capturing non-target species.

Funnel traps were deployed on three separate occasions. The specific number and location of funnel traps varied between surveys, and is summarised in Table 1 and on Maps 6 - 8.

Table 1: Description of number and locations of funnel traps deployed on the River Avon.

Survey Dates	Comments
14/08/2017 – 15/08/2017	Fifteen funnel traps deployed downstream of the A303 road bridge only (Map 6).
30/08/2017 – 31/08/2017	Ten funnel traps deployed downstream and upstream of the A303 road bridge respectively (Map 7).
13/09/2017 – 14/09/2017	Eighteen funnel traps deployed downstream and two immediately upstream of the A303 road bridge respectively (Map 8).

3.2.4 Hand-searching

Working in an upstream direction, areas of suitable habitat were identified and manually searched for the presence of crayfish. A purpose built survey viewer allowed surveyors to see the river / stream bed more clearly (Photograph 6).

Cobbles / large stones, bricks, woody debris and other potential natural refugia were lifted or turned, the bed beneath allowed to clear and the area inspected for crayfish. Where necessary, any stones

beneath were lifted too until the gravel, sand or soft substrate beneath was encountered and this was examined for crayfish and their burrows. Where practicable, all material was returned to its original position and arrangement.

Only those sections supporting suitable habitat features and that were safe and practicable to were surveyed using this technique. Hand-searching was undertaken for 20 minutes survey effort (e.g. equivalent to one surveyor searching for 20 minutes) at each location per occasion. Any crayfish that were located but avoided capture (escapee) were only included where confident species identification was made, with juvenile or adult status also estimated.

Two areas were hand-searched at both the River Avon and the River Till survey sites (Maps 9 and 10), with surveys of the former only covering a short length of channel due to the width of the channel (area 1) or as a result of the density of cobbles in that section (area 2).

3.2.5 Night viewing (torching)

Torching was conducted on the main channel of the River Avon survey site only, since its depth and the extensive sections of deep silt rendered the majority of its length unsuitable for surveying by hand-searching.

Torching was undertaken from the true left bank of the main channel of the River Avon and was conducted along the length from beneath the A303 road bridge, downstream to Countess Road (Map 11). Specifically, the channel was surveyed where the channel was visible from the bank top and sufficiently shallow to allow the channel bed to be illuminated using a high powered torch. This allowed for proactive investigation for crayfish when they are at their most active.

3.3 Survey Limitations

It was noted that two (20%) and a single (10%) ART was lifted or dislodged, and therefore considered temporarily ineffective, during the second and third checks respectively at the River Avon survey site (Table 2). Furthermore, two (8%) and four (16%) ARTs were considered to be temporarily ineffective during the third and fourth checks respectively at the River Till site, with a further one (4%) considered sub-optimal on the latter survey (Table 6). However, since the majority of ARTs provided suitable refuge opportunities during all visits (i.e. 92.5% and 93% at the River Avon and River Till survey sites respectively), it is considered that this did not impact the surveyor's ability to conduct a robust assessment of the potential presence and abundance of crayfish within the survey sections.

The majority of survey effort on the River Avon was focused downstream of the A303 road bridge. This was largely a consequence of the downstream section providing a greater accessibility and therefore opportunities to conduct hand-searching and torching survey, and side channels suitable for the deployment of ARTs. It is considered however that, since suitable habitat for crayfish is present both down- and upstream of the A303 road bridge, and given that crayfish would be able to move throughout the total reach included within the survey, the results of the survey can be considered to be representative of the potential presence and abundance of crayfish throughout.

Furthermore, it is acknowledged that the dense marginal vegetation at the River Avon survey site, in particular in association with the reaches upstream and downstream on the A303 road bridge, limited visibility during torch surveys of that section. In addition, approximately ten minutes of very light rain was experienced during torching on the lower reaches of the River Avon. However, given this section of the channel was lined with trees, this was neither sufficiently heavy to obscure the channel bed nor prolonged to influence the surveyor's ability to assess the potential presence and abundance of crayfish within the survey section.

It is therefore considered that, given the range of survey techniques used, and based on the findings of the habitat assessment, the level and range of survey effort employed allowed for a comprehensive and robust assessment of the potential presence and abundance of crayfish within the survey sections.

4. RESULTS

4.1 River Avon

4.1.1 Summary

No white-clawed crayfish were recorded across the five survey visits conducted on sections of the River Avon associated with the A303 road bridge near Amesbury (Tables 2 – 5).

Nine signal crayfish were recorded across the five survey visits conducted at the River Avon survey site. This included five individuals recorded within the main river channel downstream (south / west) of the A303 road bridge (Map 12). Individuals collected comprised a wide range of size / ages with a large (>70mm CL) adult male recorded during the night viewing survey (Table 5), and four small / juvenile signal crayfish (all less <21 mm CL) collected during hand-searching (Table 4) of the main river channel (Photographs 7 and 8).

Four signal crayfish were recorded within the Artificial Refuge Traps on the side channel that enters the downstream reach on the main river channel from the north-west (Maps 4 & 12). Individuals collected ranged in size from 11mm to 42mm carapace length.

No signal crayfish were recorded upstream (north) of the A303, though it is emphasised that the majority of the survey effort was focused to the south of the A303 road bridge (Maps 4, 6– 9 and 11).

Finally, it is noted that a signal crayfish was observed directly beneath the A303 road bridge (Map 12) by Gareth Harris during a bat activity survey on 14/06/2017.

4.1.2 Habitat appraisal

The majority of the main channel of the River Avon supported cryptic microhabitats that provided optimal to sub-optimal habitat for crayfish including dense marginal vegetation, submerged tree roots and woven willow hurdles. Furthermore, the lower reaches of the survey area supported areas of coarse gravels overlain with cobbles, flints, brick and concrete slabs, and imported cobbles used for bank reinforcement (Photograph 9). Finally, an extensive section of the main channel downstream of the A303 road bridge was characterised by a steep bank profile, provide abundant burrowing opportunities for signal crayfish.

Furthermore, a single side channel flowing into the lower reaches of the main channel from the north-west provided optimal habitat for crayfish. Specifically, this channel supported a gravel and cobble dominated substrate, and bankside alders *Alnus glutinosa* and willows that provided refuge opportunities through complex root systems and large woody debris dams. Finally, a small side channel, which reconnects to the main river channel from the east and south at a number of locations, supported a range of habitats including sections with silt and dense vegetation, areas of bankside trees and associated submerged root systems, and sections dominated by gravels and cobbles.

4.1.3 Artificial Refuge Traps

Four signal crayfish of varying size / age were recorded across the four checks of the ARTs deployed in the side channel of the River Avon (Table 2; Map 12).

4.1.4 Funnel trapping

No crayfish were recorded during funnel trapping across three survey visits (Table 3).

4.1.5 Hand-searching

Four small / juvenile signal crayfish were recorded during hand-searching across two survey visits (Table 4). All individuals were recorded within the main river channel downstream (south / west) of the A303 road bridge (Map 12).

4.1.6 Night viewing (torching)

A single, large male signal crayfish was recorded during a single torching survey (Table 5; Map 12).

Table 2: Results of Artificial Refuge Trap checks on a side channel of the River Avon.

Date	Number of Crayfish Recorded		Comments
	White-clawed	Signal	
15/08/2017	0	2	Three bullhead <i>Cottus gobio</i> recorded across two ARTs.
31/08/2017	0	1	One ART dislodged and tube entrances lifted out of water; one ART with back end lifted but tube entrances still submerged; six bullhead recorded across five ARTs.
14/09/2017	0	1	One ART dislodged and tube entrances lifted out of water; five bullhead recorded across four ARTs.
02/10/2017	0	0	Two bullhead recorded across two ARTs

Table 3: Results of funnel trapping on the River Avon down- and upstream of the A303 road bridge.

Date Retrieved	Number of Crayfish Recorded		Comments
	White-clawed	Signal	
15/08/2017	0	0	One funnel trap displaced with one end exposed; one brown trout <i>Salmo trutta</i> and one stone loach <i>Barbatula barbatula</i> recorded.
31/08/2017	0	0	One brown trout recorded.
14/09/2017	0	0	One minnow <i>Phoxinus phoxinus</i> and one stone loach recorded.

Table 4: Results of hand-searching on the River Avon downstream of the A303 road bridge.

Date	Number of Crayfish Recorded		Comments
	White-clawed	Signal	
31/08/2017	0	3	Area 1 surveyed for 20 minutes survey effort; numerous bullhead and a single stone loach recorded.
02/10/2017	0	1	Areas 1 and 2 surveyed 20 minutes survey effort respectively.

Table 5: Results of torching on the River Avon downstream of the A303 road bridge.

Date	Number of Crayfish Recorded		Comments
	White-clawed	Signal	
13/09/2017	0	1	Approx. 650m surveyed in 1 hour 43 minutes.

4.2 River Till

4.2.1 Summary

No crayfish were recorded during the five survey visits conducted on the River Till near Berwick St James.

4.2.2 Habitat appraisal

The upper reaches of the River Till survey site (i.e. upstream of the wooden footbridge) provided abundant suitable refuge features, primarily in the form of multiple submerged willow root plates and overhanging / emerging limbs present at both the margins and within the centre of the channel. In addition, large woody debris dams and short sections of dense emergent marginal vegetation provided further refuge opportunities.

Similar habitat features were present downstream of the wooden footbridge, but were less frequent and less well established than above. Furthermore, downstream of this tree and scrub-lined reach, the channel supported alternative suitable cryptic microhabitat features including dense fringes of emergent marginal vegetation and interstitial spaces between large stones and small cobbles.

4.2.3 Artificial Refuge Traps

No crayfish were recorded across the four checks of the ARTs deployed in the River Till (Table 6).

Table 6: Results of Artificial Refuge Trap checks on the River Till near Berwick St James.

Date	Number of Crayfish Recorded		Comments
	White-clawed	Signal	
14/08/2017	0	0	Sixty-five bullhead recorded across 19 ARTs; two brown trout across two ARTs.
30/08/2017	0	0	Fifty-two bullhead recorded across 20 ARTs; two threespine stickleback <i>Gasterosteus aculeatus</i> recorded across two ARTs.
13/09/2017	0	0	Two ARTs dislodged and tube entrances lifted out of water; 45 bullhead recorded across 21 ARTs; one threespine stickleback recorded.
02/10/2017	0	0	One ART dislodged and tube entrances lifted out of water; one ART partially and another one ART fully exposed due to reduced water levels; one ART heavily silted; one ART displaced but still submerged; forty-three bullhead recorded across 19 ARTs.

4.2.4 Hand-searching

No crayfish were recorded during hand-searching of the River Till across two survey visits (Table 7).

Table 7: Results of hand-searching on the River Till near Berwick St James.

Date	Number of Crayfish Recorded		Comments
	White-clawed	Signal	
30/08/2017	0	0	Area 1 surveyed for 20 minutes survey effort; numerous bullhead recorded.
13/09/2017	0	0	Area 2 surveyed for 20 minutes survey effort; numerous bullhead recorded covering a wide range of sizes / ages.

5. CONCLUSION

5.1 River Avon

No white-clawed crayfish were recorded across the five survey visits conducted on sections of the River Avon associated with the A303 road bridge near Amesbury. However, nine signal crayfish (plus one adult observed during a bat survey in June 2017) encompassing a range of sizes / ages were recorded across the five survey visits. It is therefore considered unlikely that white-clawed crayfish are present at the River Avon survey site.

Furthermore, although only a small number of signal crayfish were recorded relative to the level of survey effort, it is considered that the River Avon survey site is likely to support at least a moderately high density of signal crayfish given the:

- range of sizes / ages of crayfish recorded;
- evidence of recent recruitment;
- the presence of a number of burrows associated with the true left bank;
- the presence of optimal to sub-optimal habitat along the majority of the length of the survey site; and
- the dense marginal vegetation (in particular in the reaches nearest the road bridge) which limited the visibility for torching and may have reduced trapping success.

It is considered that, given the presence of signal crayfish at this site, any measures included within the proposed scheme options that directly contact / effect the beds' or banks' of these watercourses, will require the implementation of stringent biosecurity safeguards. This will minimise the risk of transferring signal crayfish, or the disease crayfish plague (which they are carriers of), from the site.

Furthermore, it is important to note that it is an offence under the Wildlife and Countryside Act 1981 (as amended) to 'release or allow to escape' signal crayfish into the wild. It is therefore considered that the implementation of the biosecurity safeguards / mitigation measures recommended below will minimise the risk of such an offence being committed.

Particular risks include the movement of personnel, equipment and machinery to and from the site, and the disposal of spoil or in-channel / bankside vegetation that may harbour signal crayfish or crayfish plague.

It is strongly recommended that a stringent biosecurity protocol is agreed between all the relevant statutory bodies and stakeholders as early in the pre-works planning process as is possible. It is recommended that measures to be discussed / implemented should include, but not necessarily be limited to:

- All site staff must be briefed with regards to the presence of signal crayfish on the site and must be familiar with the recommendations set out within this section.
- No crayfish, either live or dead, should be removed from the site; emphasise to all staff that it is illegal to trap any species of crayfish without a licence from the Environment Agency, and it is illegal to move any species of crayfish to a new site without written permission from Natural England.
- It is highly likely that any bank side / bed material removed as part of the proposed scheme options will contain (potentially a large number of) signal crayfish, and therefore careful consideration must be given to the control and disposal of this material.
- Furthermore, guidance should be sought from the statutory bodies with regards to -
 - (Natural England / Environment Agency) the necessity and recommended measures required to dispose of potentially a large number of signal crayfish; and
 - (Environment Agency) where relevant the proximity to the watercourse that the material can be deposited to ensure that any undetected signal crayfish may return to the existing population (rather than spread outwards), whilst adhering to any other regulatory conditions (e.g. through the Environment Permitting process).

- Where practicable staff should not move between sites; if this is not feasible, staff must thoroughly clean, disinfect / treat with hot water and where feasible dry their equipment (e.g. waders, wellington boots, etc.) both before entering the site and before moving to a new site.
- All large equipment and machinery should be cleaned with hot water / disinfected where feasible, and allowed to dry both prior to arriving on site and before being transferred to a new site.
- If stocking with aquatic plants or incorporating inorganic material, do not use material or stockists from watercourses that are known to support non-native crayfish.

5.2 River Till

No white-clawed crayfish were recorded across the five survey visits conducted on the River Till near Berwick St James. It is therefore considered unlikely that white-clawed crayfish are present at the River Till survey site.

Furthermore, no signal crayfish were recorded across the five survey visits conducted at the River Till survey site. It is therefore considered unlikely that signal crayfish are present at the River Till survey site.

Finally, although it is considered unlikely that signal crayfish are present at the River Till survey site, it would be considered 'best practice' for a biosecurity protocol (as developed for the River Avon site) to be included within the delivery of any proposed scheme options here.

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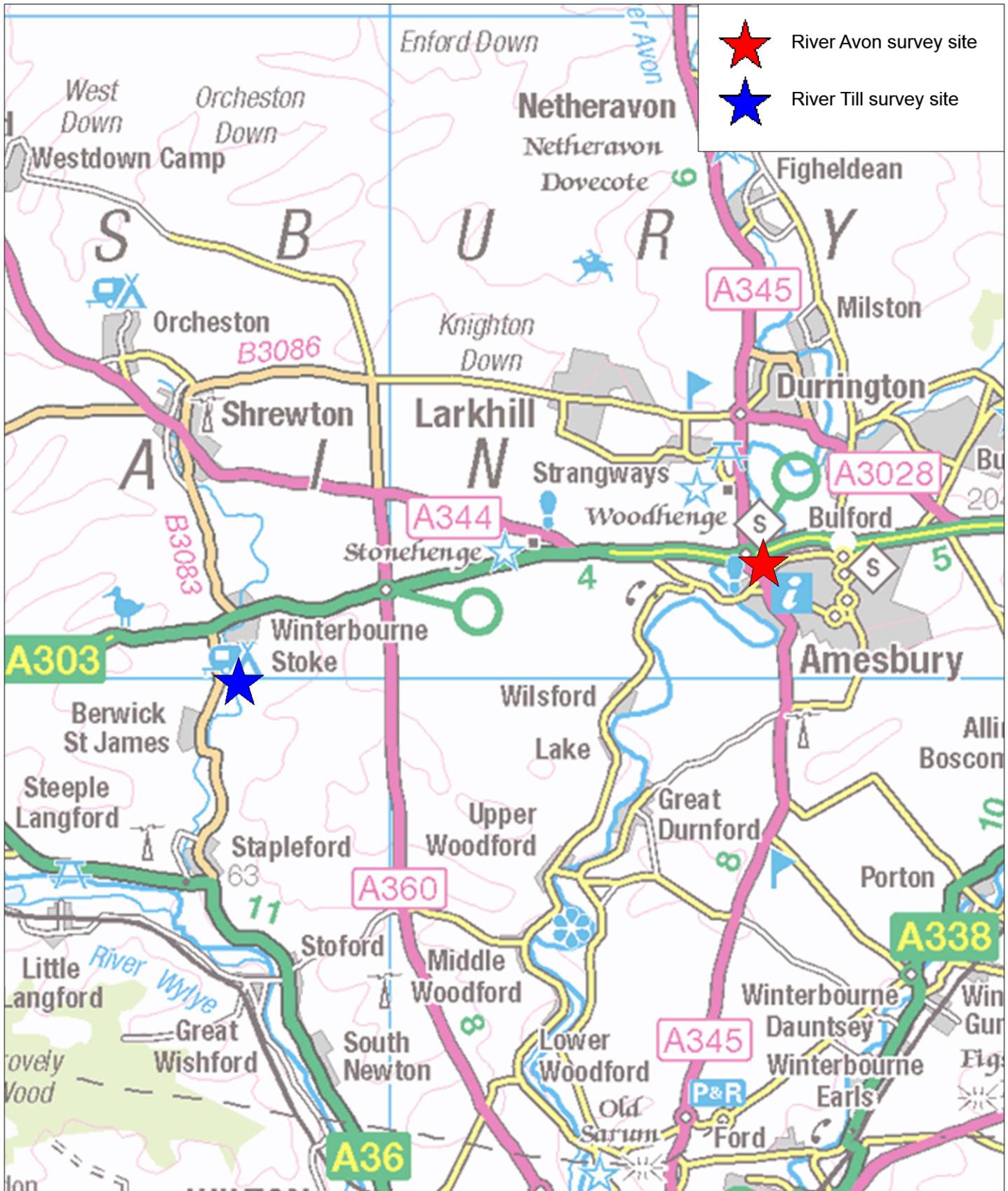
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MAPS

Map 1. Location of survey sites

A303 Stonehenge Amesbury to Berwick Down

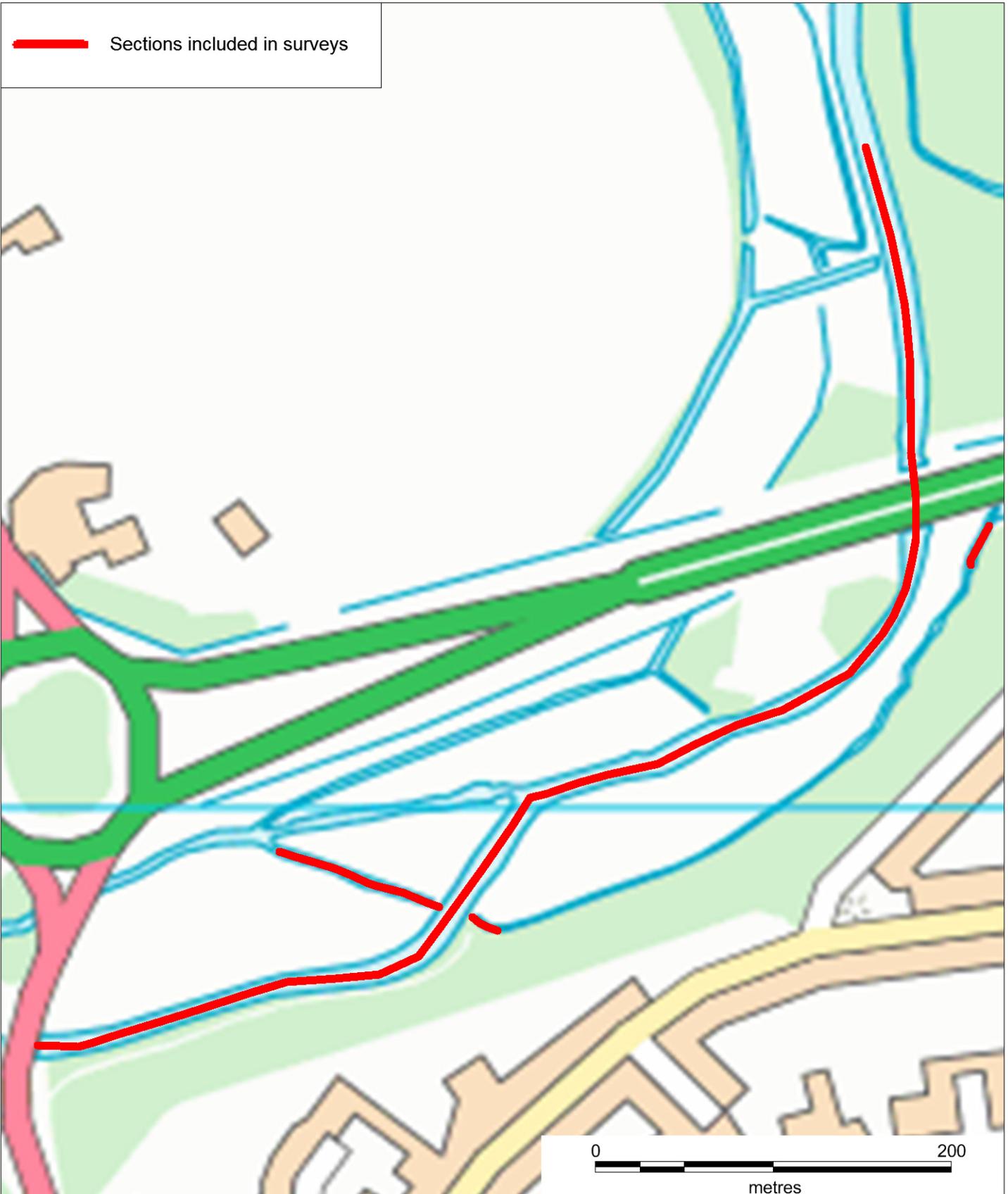
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Map 2. River Avon survey site

A303 Stonehenge Amesbury to Berwick Down



Map 3. River Till survey site

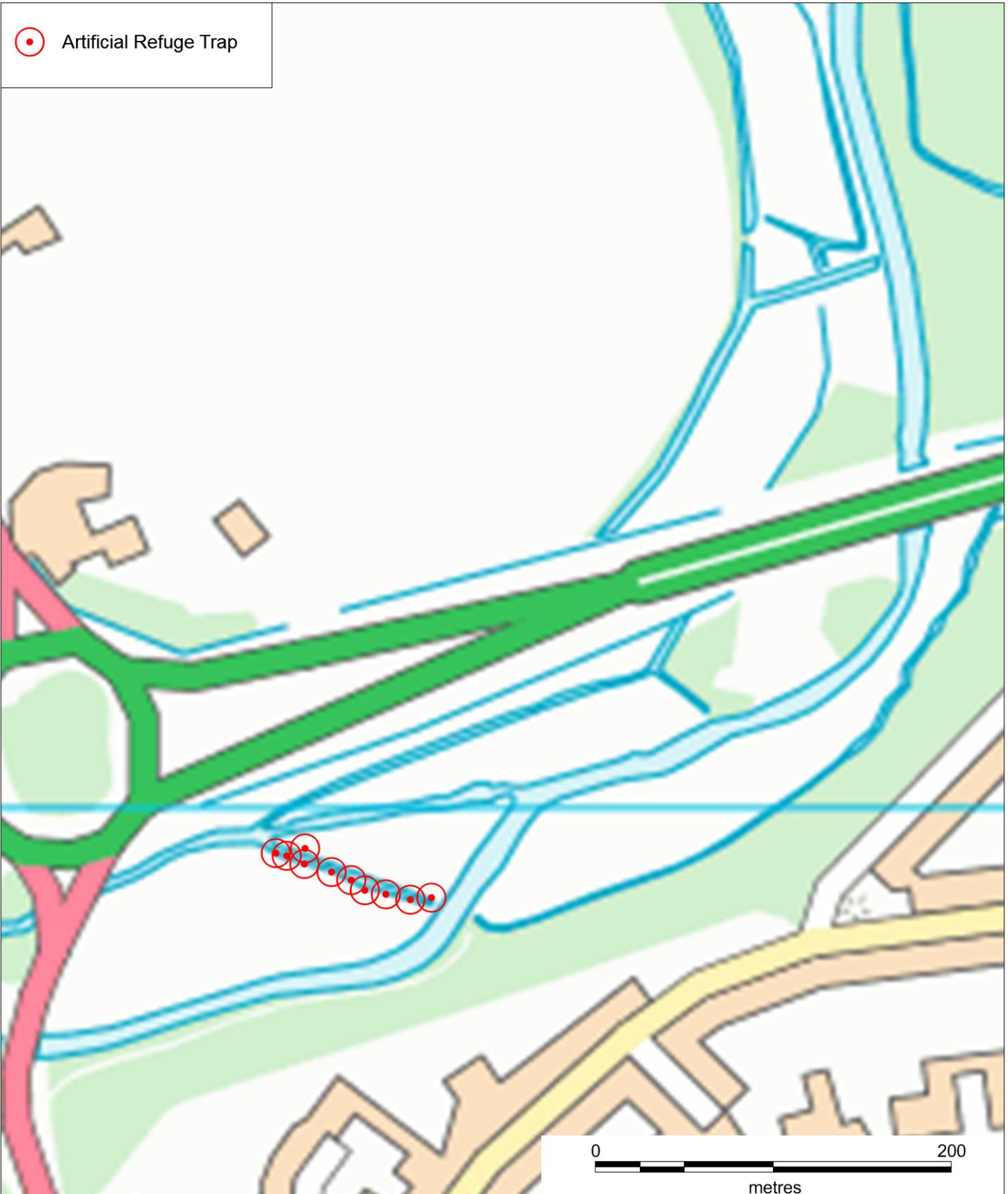
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Map 4. Location of Artificial Refuge Traps at the River Avon survey site

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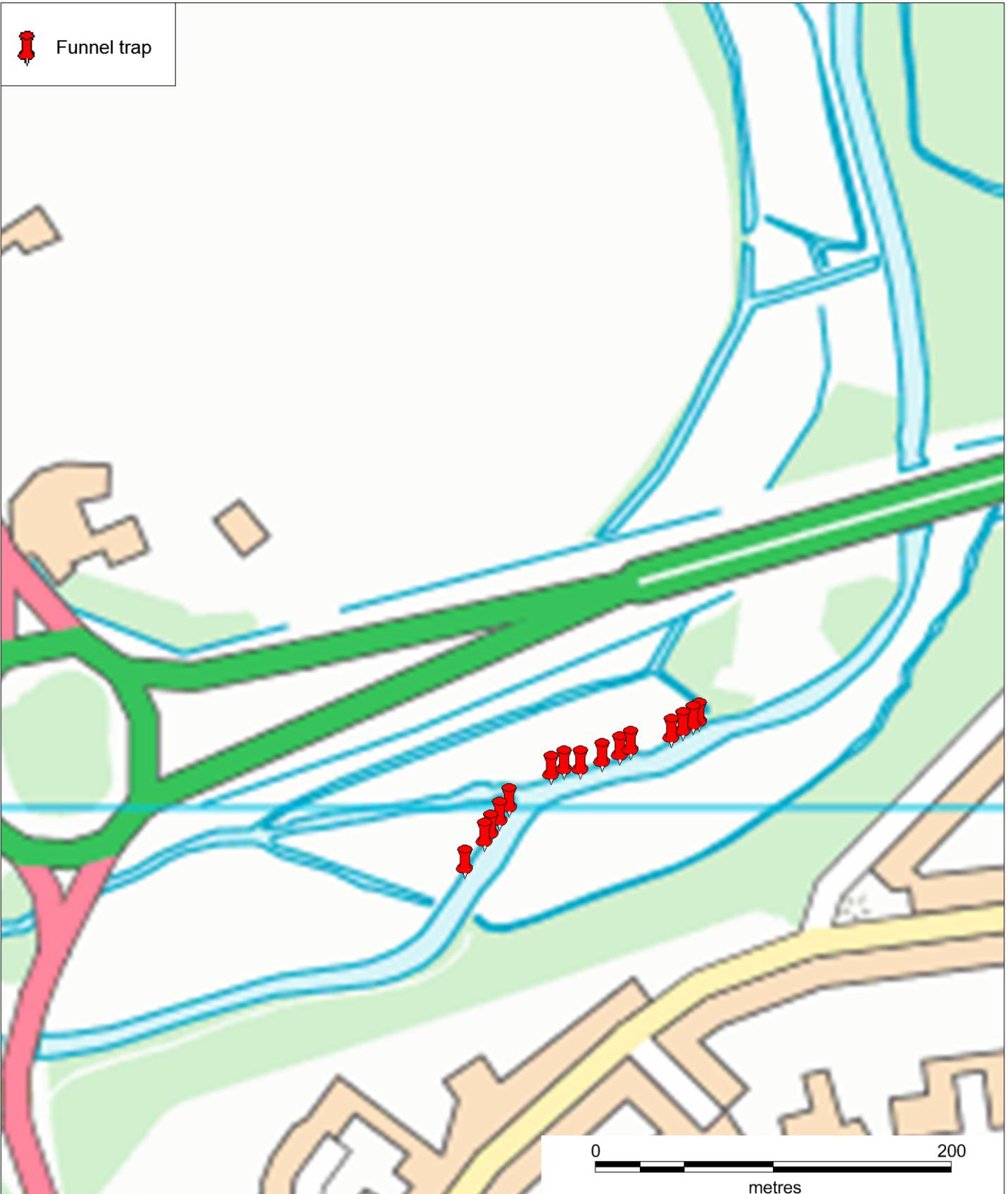
Map 5. Location of Artificial Refuge Traps at the River Till survey site

A303 Stonehenge Amesbury to Berwick Down



Map 6. Location of funnel traps: 14/08/2017 - 15/08/2017

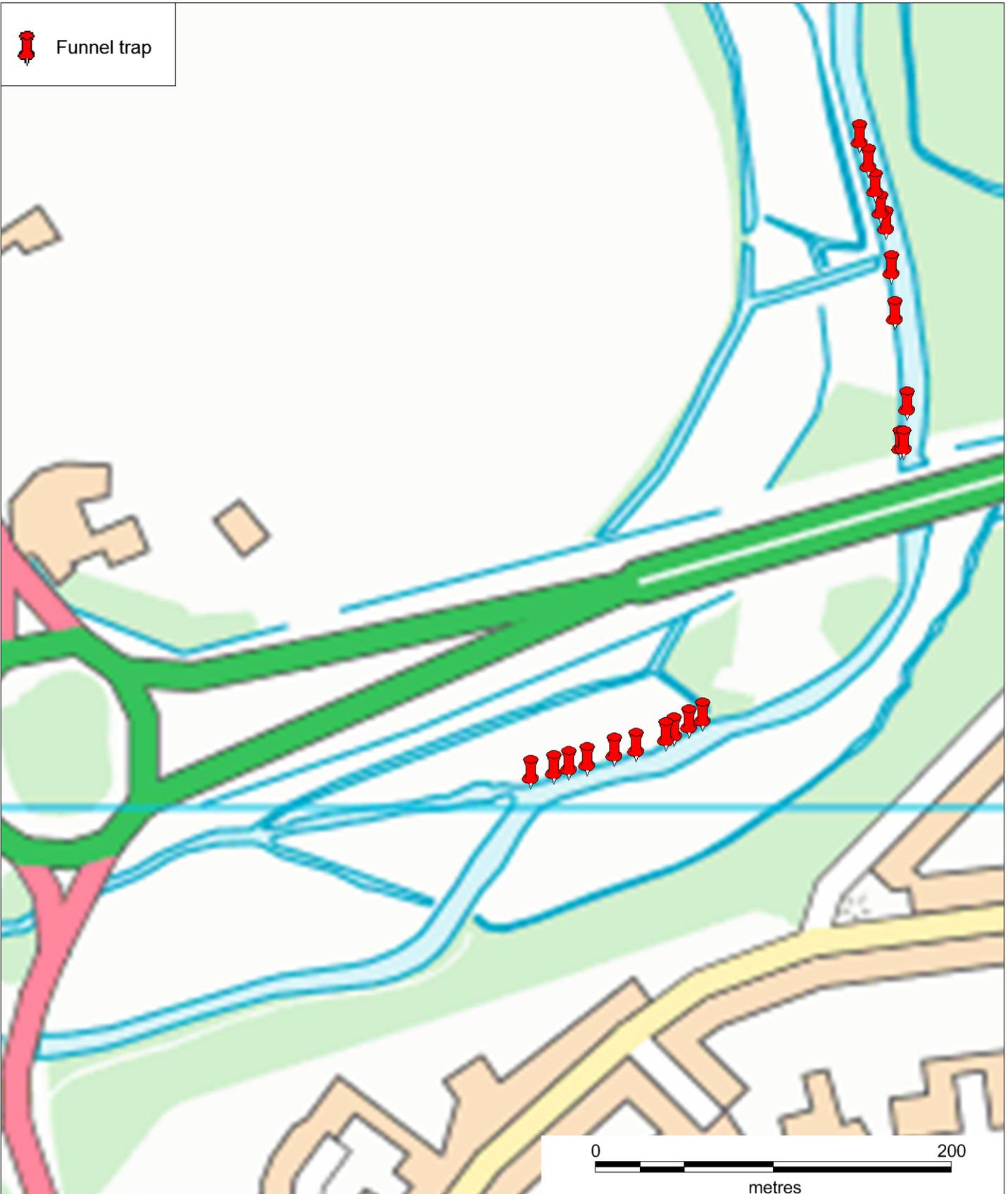
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Map 7. Location of funnel traps: 30/08/2017 - 31/08/2017

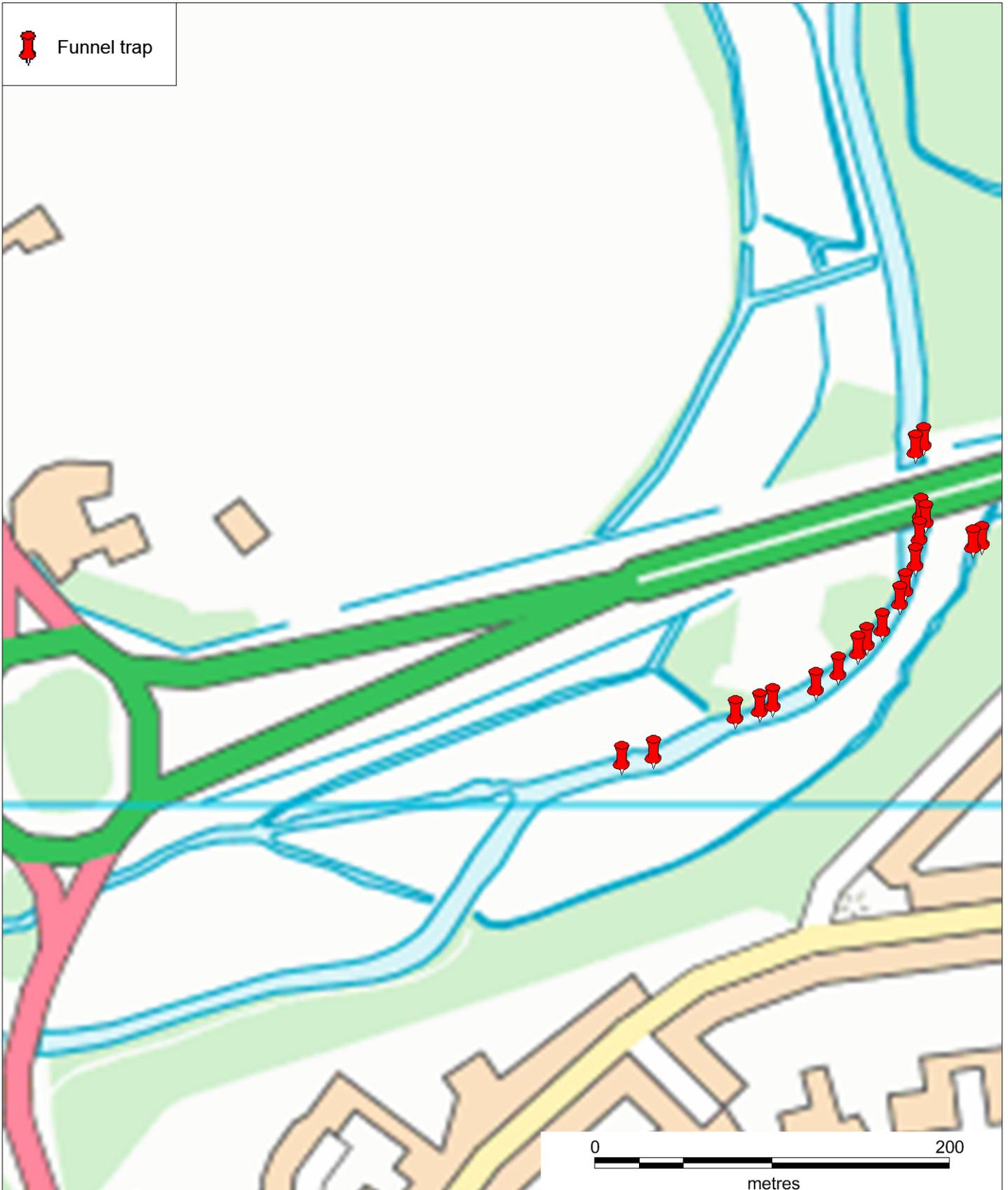
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Map 8. Location of funnel traps: 13/09/2017 - 14/09/2017

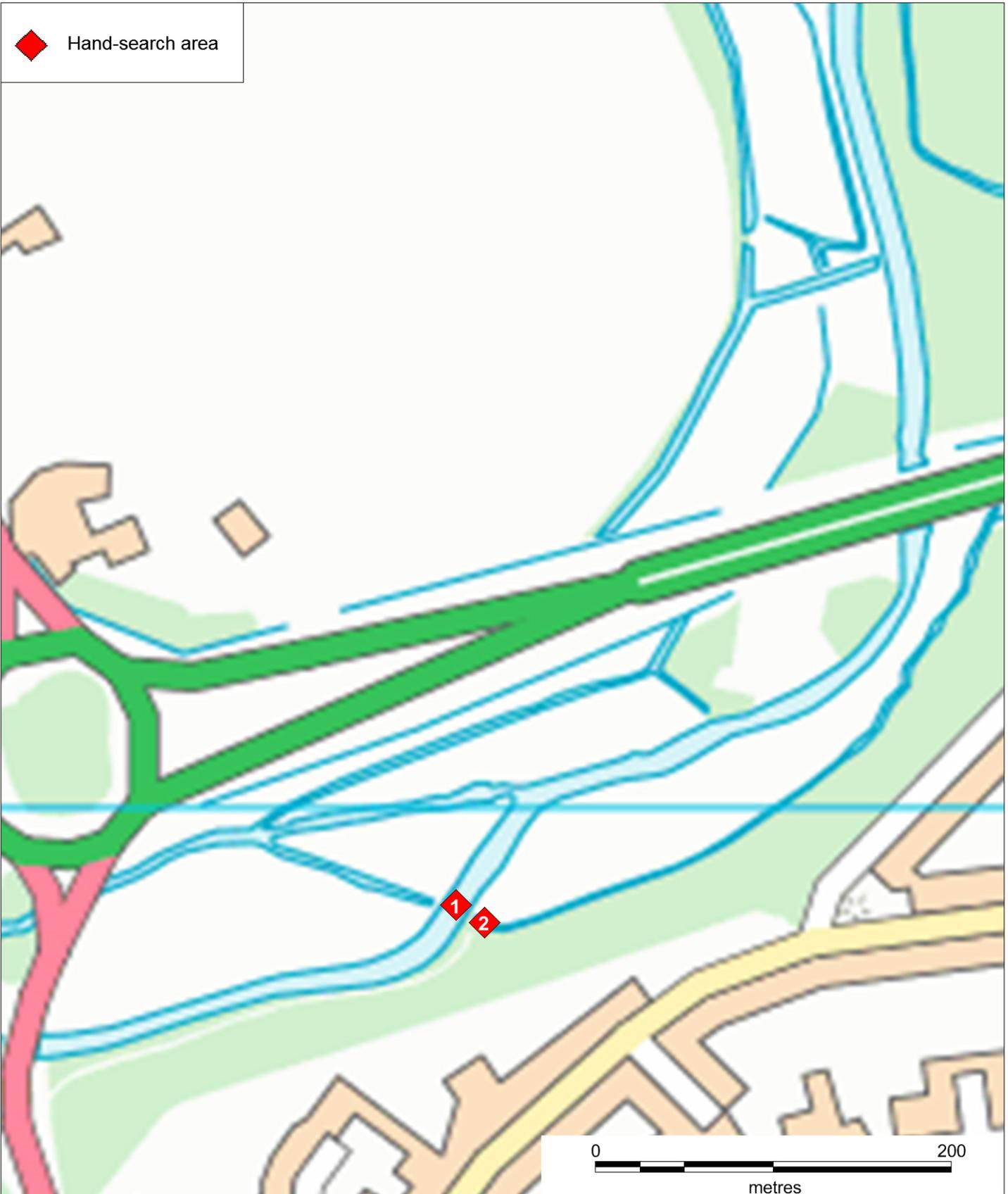
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Map 9. Location of hand-searching on the River Avon

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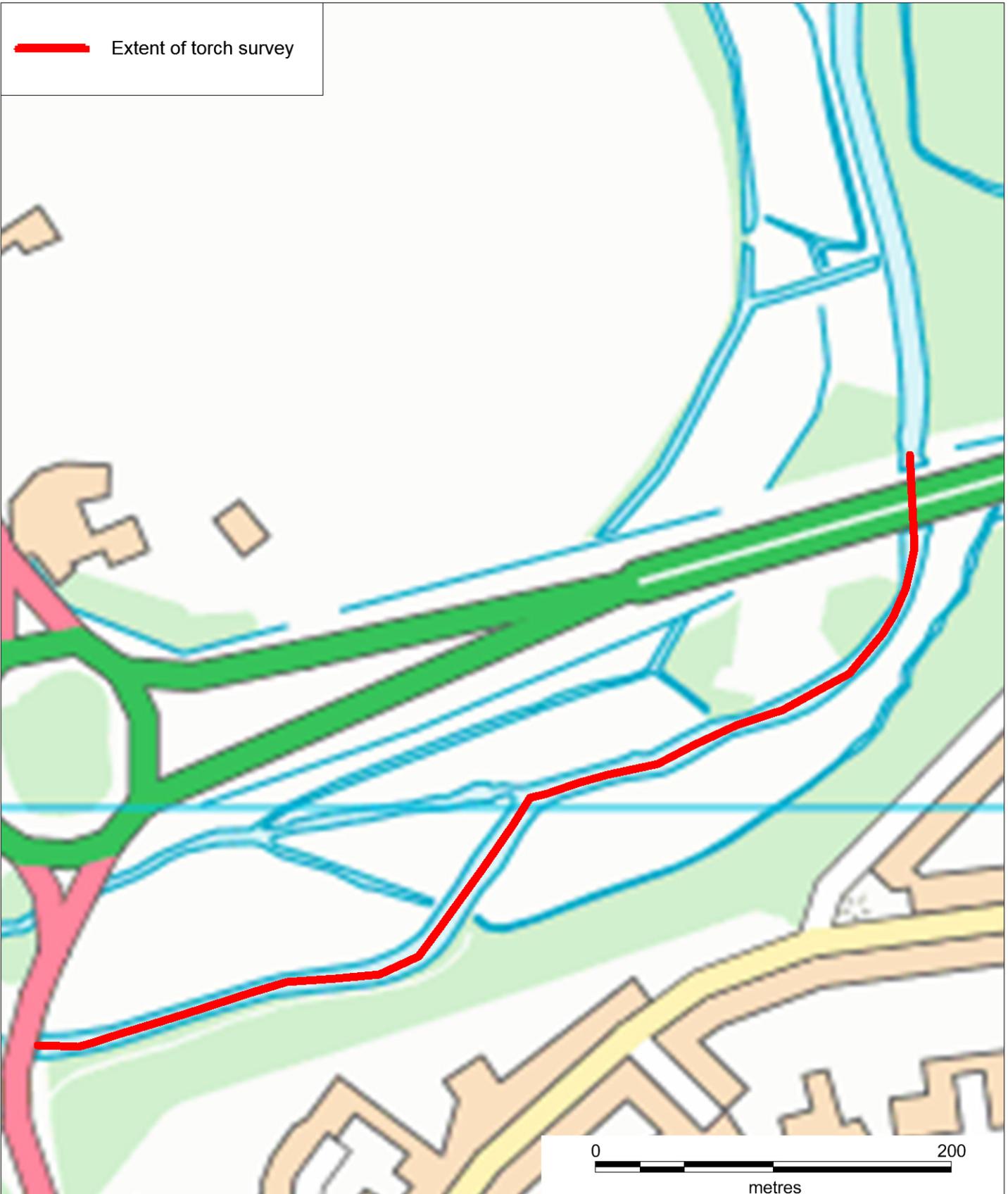
Map 10. Location of hand-searching on the River Till

A303 Stonehenge Amesbury to Berwick Down



Map 11. Extent of torch survey on the River Avon

A303 Stonehenge Amesbury to Berwick Down



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Map 12. Location of signal crayfish recorded on the River Avon

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PHOTOGRAPHS



Photograph 1: Shallow section of River Avon characterising the lower reaches of the main river channel



Photograph 2: Section of the River Till with overhanging and emerging willow limbs.



Photograph 3: Lower reaches of River Till



Photograph 4: An Artificial Refuge Trap (ART)



Photograph 5: A collapsible funnel trap



Photograph 6: A surveyor hand-searching



Photograph 7: Adult signal crayfish from the River Avon



Photograph 8: Juvenile signal crayfish from the River Avon



Photograph 9: Imported cobbles located at the margins of the river to protect the banks of the River Avon

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