highways england

A417 Missing Link
TR010056

6.4 Environmental Statement
Appendix 8.23 River Habitat Survey
and Fish Habitat Assessment Report

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
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A417 Missing Link

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**6.4 Environmental Statement Appendix 8.23 River Habitat Survey
and Fish Habitat Assessment Report**

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Foreword

This report sets out the results of fish habitat mapping and River Habitat Surveys (RHS) undertaken in October 2019 and January 2020. The objective of these surveys was to collect data from the tributary of Norman's Brook as it would be realigned by the scheme. Data from tributaries of the River Frome and River Churn, Horsbere Brook and Painswick Stream also informs the assessment. To gain a full appreciation of the overall aquatic and semi-aquatic species assemblages across the scheme, this report should be read in conjunction with the other aquatic habitat or species survey reports for the scheme:

- ES Appendix 8.15 Great Crested Newt Survey Report (Document Reference 6.4)
- ES Appendix 8.17 Otter Technical Report (Document Reference 6.4)
- ES Appendix 8.18 Water Vole Technical Report (Document Reference 6.4)
- ES Appendix 8.19 White-Clawed Crayfish Technical Report (Document Reference 6.4)
- ES Appendix 8.22 Aquatic Invertebrate Survey Report (Document Reference 6.4)

Executive Summary

This report presents the methodology and baseline survey data recorded from a review of existing fisheries records, as well as River Habitat Surveys and fish habitat surveys conducted in 2019 to 2020 across the scheme.

A framework of international (European), national and local legislation and planning policy guidance exists to protect and conserve fish assemblages.

River Habitat Surveys were undertaken following the methods set out in the River Habitat Survey in Britain and Ireland – Field Survey Guidance Manual: 2003 Version 1 (Environment Agency, 2003). The quantitative mapping of fish habitat was conducted by a suitably qualified aquatic ecology specialist using industry standard techniques.

River Habitat Survey analysis concluded that the rivers surveyed are "Severely Modified" as a result of realignment and the presence of artificial features such as culverts, bridges and weirs. Despite this they provide functional freshwater habitat. The tributary of Norman's Brook, upstream of the existing A417, was calculated to be of "High" habitat quality compared to similar rivers in the RHS database. The tributary of Norman's Brook downstream of the A417 and a Tributary of Horsbere Brook were calculated to be of "Low" habitat quality compared to similar rivers in the RHS database.

Fish habitat within the survey sites is fragmented by significant weirs and culverts, many of which are considered to be impassable to all fish species (with the potential exception of European eel). Nevertheless, diverse and varied habitats were recorded with the potential to support all life stages of salmonids, and potentially coarse fish. These habitats have the potential could sustain isolated populations if present.

1   Introduction

1.1   Purpose of this document

1.1.1   This document details baseline data for fish, collected from desk studies, fish habitat surveys and river habitat surveys carried out in October 2019 and January 2020. This report informs the Environmental Impact Assessment (EIA) and Water Framework Directive (WFD) Compliance Assessment (ES Appendix 13.2, Document Reference 6.4) of the A417 Missing Link 'the scheme'.

1.2   Scope of the report

1.2.1   This technical report outlines the survey scoping, methodology and results of a fisheries desk study, fish habitat assessment and river habitat surveys for the scheme.

2   Methodology

2.1   Overview

2.1.1   Details of the methodology used for establishing the ecological baseline for freshwater fish and river habitat are provided below.

2.2   Survey guidance

2.2.1   The following survey guidance has been considered in the methodology design. Any deviation from standard industry practice is noted in section 2.7 Limitations and survey constraints of this report.

- Water Framework Directive – UK Technical Advisory Group (WFD-UKTAG). (2008). Rivers Assessment Methods Fish Fauna (Fisheries Classification Scheme 2 (FCS2)).
- Environment Agency Fisheries Technical Manual 4 – Restoration of riverine salmon habitats (Hendry and Cragg-Hine, 1997).
- River Habitat Survey in Britain and Ireland – Field Survey Guidance Manual: 2003 Version 1 (Environment Agency, 2003).

2.3   Desk study

2.3.1   An environmental desk study was undertaken to identify records of fish for watercourses within the scheme, and the wider catchment.

2.3.2   Freshwater fish records were obtained via data request from the Environment Agency. Data was requested from six waterbodies which either fall within the scheme and wider catchment.

2.3.3   The Environment Agency also provided Fisheries Classification System Version 2 (FCS2) modelling outputs for rivers within the scheme and local area. The FCS2 tool is a Bayesian statistical model, which classifies the quality of a sites fish assemblage based on the observed fish catch compared to the expected catch of an undisturbed site.

2.3.4   The comparison of observed against expected values produces an Ecological Quality Ratio (EQR), which is used to classify the quality of fish populations as High, Good, Moderate, Poor or Bad. These EQR scores are generated under the same parameters used by the Water Framework Directive (WFD) for assessing

biological quality elements. EQR scores were not generated for river habitat surveys or for the results of the field surveys.

2.3.5   Data was requested from:

- River Churn (source to Perrots Brook) (WFD ID: GB106039029810);
- River Frome - source to Ebley Mill (WFD ID: GB109054032470);
- Horsbere Brook - source to confluence River Severn (WFD ID: GB109054032760);
- Painswick Stream – source to confluence Stroudwater (WFD ID: GB109054032460);
- Norman's Brook - source to confluence Hatherley Brook (WFD ID: GB109054032780); and
- Hatherley Brook - source to confluence River Severn (WFD ID: GB109054032801).

2.4   Survey scoping and design

2.4.1   Prior to field surveys commencing, scoping activities were undertaken by a suitably qualified and experienced aquatic ecologist to identify rivers and streams within the scheme boundary and wider river network. Scoping activities included: a review of desk study information; Ordnance Survey mapping and aerial imagery; site visits; and consultation with various stakeholders including local conservation groups, Gloucestershire Wildlife Trust, Natural England and the Environment Agency.

2.4.2   Field survey sites outlined in Table 2-1 and shown in ES Figure 8.6 Fish habitat mapping survey locations (Document Reference 6.3) were selected which are representative of the relevant watercourses and capture the spatial variation in habitat. To enable an integrated understanding of the aquatic ecology baseline, survey site locations were also aligned with the Surface Water Quality Monitoring locations and survey sites for other aquatic ecology receptors (i.e. macroinvertebrates).

Table 2-1   Fish habitat and river habitat survey sites

Site number	Watercourse name	Survey type	Grid reference
1	Tributary of Norman's Brook	RHS and Fish habitat assessment	SO 92836 15723 to SO 92382 15706
2	Tributary of Norman's Brook	RHS and Fish habitat assessment	SO 91342 16295 to SO 91130 16693
3	Horsbere Brook	RHS and Fish habitat assessment	SO 91367 15494 to SO 90992 15545
4	Tributary of River Churn	Fish habitat assessment	SO 94570 16497 to SO 95993 16015
5	Tributary of River Churn	Fish habitat assessment	SO 94544 14807 to SO 96193 15340
6	Tributary of River Frome	Fish habitat assessment	SO 93911 13370 to SO 94834 12187

2.5   River habitat survey

2.5.1   In broad terms, river habitat survey is a method designed to characterise and assess the physical structure of freshwater streams and rivers. The river habitat survey system is based on information from major baseline surveys of streams

and rivers in the UK and the Isle of Man. It has four distinct components: (1) standard methodology for field survey; (2) a computer database, for result comparison; (3) methods for assessing habitat quality; and (4) methodology for describing the extent of artificial channel modification. Field surveys were undertaken following the guidance laid out in the River Habitat Survey in Britain and Ireland – Field Survey Guidance Manual: 2003 Version 1 (Environment Agency, 2003).

2.5.2   River habitat survey is carried out along a 500m length of channel. Observations are made at ten equally spaced spot-checks. At the end of the survey, a sweep-up of the whole 500m stretch occurs to complement spot-check data. The sweep-up is to include any features not occurring at the spot-check locations. Information on the surrounding land-use and valley form provide additional context.

2.5.3   All surveys were undertaken by an accredited RHS surveyor, trained by the Environment Agency.

Data analysis

2.5.4   Using the application of a set of rules to RHS data, artificial modification to the physical structure of the channel can be expressed as a Habitat Modification Score (HMS). HMS is based upon the type and extent of artificial features at the RHS site.

2.5.5   HMS can be used at a site level to audit predicted or actual impacts resulting from channel works. The spot check and sweep-up data collected from RHS is entered into the RAPID database (developed by the Centre for Ecology and Hydrology) enabling the calculation of an HMS and as a result, a Habitat Modification Class (HMC). Points are based on the relative impact of modification on habitat features. At each spot-check scores are assigned for evidence of modification such as sectioning, reinforcement and weirs. HMCs generated as a result of HMS are outlined in Table 2-2 with a description of the level of modification for each class provided.

Table 2-2   Habitat modification class and habitat modification score

Habitat Modification Class (HMC)	HMC description	Habitat Modification Score (HMS)
1	Pristine/semi-natural	0-16
2	Predominantly unmodified	17-199
3	Obviously modified	200-499
4	Significantly modified	500-1399
5	Severely modified	1400+

2.5.6   The HMS relates only to modification of the channel, while the Habitat Quality Assessment (HQA) score is a broad measure of the diversity and 'naturalness' of the physical (habitat) structure of a site. The HQA score is determined by the presence and extent of habitat features of known wildlife interest recorded during the field survey. Rare features, such as large waterfalls and extensive fallen trees result in additional points.

2.5.7   For HQA scores to be meaningfully interpreted they are subject to context analysis. Context analysis consists of comparing a site HQA score to the distribution of HQA scores for sites of similar type using a nearest neighbour approach. The method, approved by the Environment Agency, uses a statistical

recombination of map-derived attributes representing known drivers of geomorphological change (i.e. specific stream power and shear stress; Jeffers, 1998) to select 150 sites of a similar type. A site is then assessed according to its position within the distribution of HQA scores for the 150 sites. The bottom quintile of the distribution represents very low habitat quality and the top quintile very high quality (Table 2-3).

Table 2-3   Habitat quality assessment class descriptions

HQA Score - Context Analysis Quintile	HQA Class	HMS
81 – 100%	1	Very high
61 – 80%	2	High
41 – 60%	3	Moderate
21 – 40%	4	Low
0 – 20%	5	Very low

2.6   Fish habitat assessment

2.6.1   Fish habitat mapping was undertaken at several sites as shown on ES Figure 8.6 Fish habitat mapping survey locations (Document Reference 6.3). The methodology used to map fish habitat was designed by a suitably qualified aquatic ecologist to provide an overview of the potential of a river to support juvenile and adult fish.

2.6.2   Habitat descriptions (Table 2-4) are adapted from the Environment Agency Fisheries Technical Manual 4 - Restoration of riverine salmon habitats (Hendry and Cragg-Hine, 1997). Juvenile lamprey habitat definitions are based on descriptions in Conserving Natura 2000 Rivers: Monitoring the River, Brook and Sea Lamprey (Harvey and Cowx, 2003).

2.6.3   The main objective of the method is to obtain a detailed representation of the precise location, extent, condition and juxtaposition of habitats within the wetted width of the river. This is recorded by walking the riverbank and annotating high resolution maps with the habitats present. Crucially, the 'habitat' types for salmonids (e.g. fry, parr etc.), as opposed to 'flow' types, are recorded. Fish habitat types are defined by the interaction of the following variables: water depth; water velocity; substrate composition; and cover.

Table 2-4   Fish habitat definitions

Habitat type	Definition
Spawning gravel	Ideally stable (but not compacted) gravel. Mean grain size <25mm for trout and up to 80mm for salmon. 'Fines' (<2mm grain size) to be less than 20% by weight. Water depth 17-76cm. Velocity 25-90cm/s.
Fry habitat	Shallow fast flowing (50-65cm/s) water (predominantly run and riffle). Water depth <20cm. Substrate pebble and cobble dominated.
Parr habitat	Fast flowing water generally with a broken surface (predominantly run and riffle). Water depth 20-40cm. Substrate cobble and boulder dominated.

Habitat type	Definition
Mixed juvenile	A combination of fry and parr habitat. Fast flowing water generally with a broken surface (predominantly run and riffle) Water depth <40cm Substrate cobble and boulder dominated with few pebbles.
Pools (adult)	No perceptible flow, smooth surface. Water depth usually > 60cm. Substrate typically fine; often not visible.
Glides (adult)	Smooth surface with little turbulence. Water depth typically <30cm. Substrate generally fine dominated by pebbles and fines.
Juvenile lamprey habitat	Optimal habitat: stable, fine sediment or sand >15cm deep, low water velocity and the presence of organic detritus. Sub-optimal habitat: shallow sediment, often patchy and interspersed among coarser substrate. Also includes areas of organic detritus overlying bedrock, submerged tree roots trapping organic material, submerged silt banks, silt-dominated cattle drinks, and submerged bankside vegetation rooted in sand/silt.

2.6.4   Further to in-stream habitat, additional features of the watercourse were recorded and mapped where present, to provide a broader understanding of the watercourse and any pressures which may alter the suitability of the river for aquatic communities (fish, macrophytes, diatoms and macroinvertebrates). This included:

- in-stream and riparian habitat features such as width, depth, exposed substrate, bars, macrophytes, spawning redds and coarse woody debris;
- in-stream obstacles to fish passage including natural obstacles, weirs, sluices, dams, flap gates, culverts and fords;
- point and diffuse sources of catchment pollution including domestic and industrial discharges or runoff, arable fields, livestock fields and forestry plantations; and
- river abstractions and details on fish screening facilities.

2.7   Limitations and survey constraints

2.7.1   The fish habitat assessment and the river habitat surveys were carried out during October 2019 and January 2020. This is outside of the optimal survey season for river habitat surveys due to the seasonal nature of in-channel and riparian plants.

2.7.2   Some small sections of survey sites for fish habitat assessment were not accessible due to landowner permissions, physical barriers or health and safety constraints.

2.7.3   Environment Agency fish monitoring sites were not available within the scheme. As an alternative, sites were selected at the nearest geographic location to the scheme.

3   Results

3.1   Desk study

3.1.1   The location of records returned for the Environment Agency monitoring sites can be seen in ES Figure 8.5 Environment Agency (Desk Study) fish monitoring sites (Document Reference 6.3). No records were returned for either the River Churn

(source to Perrots Brook; WFD ID: GB106039029810) or Normans Brook (source to confluence Hatherley Brook; WFD ID: GB109054032780).

3.1.2 The Environment Agency data provided records of the following fish species, with species of conservation importance highlighted in red:

- Brown trout Salmo trutta; Natural Environment and Rural Communities (NERC) Act - Species of Principal Importance, 2006. UK Biodiversity Action Plan (BAP) - JNCC, 2007.
- European eel *Anguilla anguilla*; IUCN – Critically Endangered, 2001. NERC Act - Species of Principal Importance, 2006. UK BAP - JNCC, 2007.
- Common bream *Abramis brama*
- Common carp *Cyprinus carpio*
- Roach *Rutilus rutilus*
- Perch *Perca fluviatilis*
- Roach x bream hybrid *Rutilus rutilus x Abramis brama*
- Brook lamprey *Lampetra planeri*; Habitat Directive – Annex II species, 2003.
- Lamprey sp. ammocoetes; Habitat Directive – Annex II species, 2003.
- Three-spined stickleback *Gasterosteus aculeatus*
- Pike *Esox lucius*
- Tench *Tinca tinca*
- Flounder *Platichthys flesus*
- Gudgeon *Gobio gobio*
- Bullhead *Cottus gobio*; Habitat Directive - Annex II species, 2003.
- Dace *Leuciscus leuciscus*
- Stone loach *Barbatula barbatula*

3.1.3 A summary of the desk study data by watercourse is described below.

Painswick Stream (source to confluence Stroudwater Brook)

3.1.4 This water body was classified as 'Moderate' for fish in 2016 under the WFD Cycle 2 classification. The pressures on the catchment preventing it from achieving 'Good' status are industrial pollution, and agriculture and rural land management.

3.1.5 Data from five Environment Agency fisheries monitoring sites on the Painswick Stream were available: Site 21611, Site 21608, Site 21606, Site 12219 and Site 6317.

3.1.6 The upstream most site, Site 21611, is 4.2km downstream of the source and has been surveyed three times over the past 20 years. Species diversity was low, with only brown trout recorded at this location.

3.1.7 Site 21608 is 5.1km downstream of the source and has been surveyed once in the last 20 years. Species diversity was low, with only brown trout being recorded at this location.

3.1.8 Site 21606 is 7km downstream of the source and has been surveyed twice in the past 20 years. Species diversity was low, with only brown trout and European eel being recorded at this location. In 2011, FCS2 analysis was run on data from Site 21606 giving an EQR of 0.3482, corresponding to a WFD status of Moderate for fish.

3.1.9 Site 12219 is 11.1km downstream of the source and has been surveyed once in the last 20 years. The species diversity was highest at this site (within the

waterbody) with common bream, common carp, roach, perch and roach x bream hybrid being recorded at this location.

3.1.10   Site 6317 is 11.6km downstream of the source and has been surveyed twice in the past 20 years. Species diversity was low, with only brown trout and perch being recorded at this location. In 2011, FCS2 analysis was run on data from Site 21606 giving an EQR of 0.3072, corresponding to a WFD status of Moderate for the site in relation to fish.

Frome – source to Ebley Mill

3.1.11   This waterbody was classified as 'Good' for fish in 2016 under the WFD Cycle 2 classifications. Data from eight Environment Agency fisheries monitoring sites on the Frome (source to Ebley Mill) were analysed: Site 35933 Site 39210, Site 6236, Site 22431, Site 31122, Site 22531, Site 6290 and Site 3493.

3.1.12   Site 35933 is the furthest upstream, is 5.8km downstream of the source and has been surveyed three times in the last 20 years. Species diversity was low, with only brown trout, brook lamprey and Lamprey sp. ammocoetes being recorded at this location.

3.1.13   Site 39210 is 7.4km downstream of the source and has been surveyed three times in the last 20 years. Species diversity was low, with 3-spined stickleback, brown trout and European bullhead being recorded at this location. In 2015, FCS2 analysis was run on data from Site 39210 giving an EQR of 0.5784, corresponding to a WFD status of Good for the site in relation to fish.

3.1.14   Site 6236 is 15.6km downstream of the source and has been surveyed six times in the last 20 years. Species diversity was high at this site, with 3-spined stickleback, brown trout, European bullhead, brook lamprey, lamprey sp. and roach being recorded at this location. In 2013, FCS2 analysis was run on data from Site 6236 giving an EQR of 0.5006, corresponding to a WFD status of Good for the site in relation to fish.

3.1.15   Site 22431 is 19.0km downstream of the source and has been surveyed once in the last 20 years. Species diversity was low at this site, with only brown trout being recorded at this location.

3.1.16   Site 31122 is 19.6km downstream of the source and has been surveyed five times in the last 20 years. Species diversity was low at this site, with only brown trout and European eel being recorded at this location.

3.1.17   Site 22531 is 22.3km downstream of the source and has been surveyed once in the last 20 years. Species diversity was low at this site, with only brown trout and European eel being recorded at this location.

3.1.18   Site 6290 is 24.5km downstream of the source and has been surveyed once in the last 20 years. Species diversity was low at this site, with only brown trout and European eel being recorded at this location.

3.1.19   Site 3493 is 24.9km downstream of the source and has been surveyed six times in the last 20 years. Species diversity was high at this site, with 3-spined stickleback, brown trout, European eel, lamprey sp., perch, pike and roach.

Horsbere Brook (source to confluence River Severn)

3.1.20   This waterbody was classified as 'Poor' for fish in 2016 under the WFD Cycle 2 classifications. The pressures on the catchment preventing it from achieving

'Good' or 'Moderate' status are barriers and impoundments. Data from six Environment Agency fisheries monitoring sites on Horsbere Brook were analysed: Site 50167, Site 50166, Site 30451, Site 30452, Site 13387 and Site 10278.

3.1.21   The most upstream site, Site 50167, is 3.1km downstream of the source and has been surveyed once in the last 20 years. Species diversity was average at this site, with brown trout, European eel, perch and roach being recorded at this location.

3.1.22   Site 50166 is 3.6km downstream of the source and has been surveyed once in the last 20 years. Species diversity was average at this site, with brown trout, European eel, perch and roach being recorded at this location.

3.1.23   Site 30451 is 6.3km downstream of the source and has been surveyed three times in the last 20 years. Species diversity was low at this site, with European eel, tench and roach being recorded at this location. In 2013, FCS2 analysis was run on data from Site 30451 giving an EQR of 0.039, corresponding to a WFD status of Poor for the site in relation to fish.

3.1.24   Site 30452 is 8.2km downstream of the source and has been surveyed once in the last 20 years. Species diversity was low at this site, with European eel, gudgeon and tench being recorded at this location.

3.1.25   Site 13387 is 10.4km downstream of the source and has been surveyed twice in the last 20 years. Species diversity was low at this site, with only European eel being recorded at this location. In 2012, FCS2 analysis was run on data from Site 13387 giving an EQR of 0.3436, corresponding to a WFD status of Moderate for the site in relation to fish.

3.1.26   Site 10278 is 11.8km downstream of the source and has been surveyed once in the last 20 years. Species diversity was low at this site, with only gudgeon being recorded at this location.

Hatherley Brook (source to River Severn)

3.1.27   This waterbody was classified as 'Good' for fish in 2016 under the WFD Cycle 2 classifications. Data from two fisheries monitoring sites on Hatherley Brook were analysed: Site 4345 and Site 10276.

3.1.28   The most upstream site, Site 4345, is 12.0km downstream of the source and has been surveyed once in the last 20 years. Species diversity was average at this site, with bream, common carp, perch and roach being recorded at this location.

3.1.29   Site 10276 is 12.7km downstream of the source and has been surveyed twice in the last 20 years. Species diversity was high at this site, with 3-spined stickleback, dace, European eel (glass eel, elver and adult), flounder, gudgeon and stone loach being recorded at this location.

3.2   River habitat survey

3.2.1   River habitat surveys were conducted on three reaches of waterbodies within the scheme and wider catchment. The results are summarised below, with the full data provided in Appendix A of this report.

Site 1 – Upstream of A417 (SO9285615723)

3.2.2   This section of the tributary of Norman's Brook is classified as "Severely Modified" (Class 5, HMS = 4055). The HMS is driven by the presence of weirs, culverts and

the artificial bed and bank materials associated with them. Despite its modified state, the natural features within the river corridor and high habitat diversity result in a HQA score of 64. This places this section of river in HQA Class 2, indicating that it is of "High" habitat quality, when compared to similar rivers in the RHS database. The overall habitat quality score is driven by high sub-scores for vegetation structure, number of flow types and the variety of substrates present. The watercourse flows through broadleaved woodland. Channel vegetation included liverworts and emergent reeds.

Site 2 – Downstream of A417 (SO9134216295)

3.2.3   This section of the tributary of Norman's Brook is classified as "Severely Modified" (Class 5, HMS = 2170). The HMS is driven by the presence of channel realignment, culverts, bridges and the artificial bed and bank materials associated with them. The HQA score of 39 places this section of river in HQA Class 4, indicating that it is of "Low" habitat quality, when compared to similar rivers in the RHS database. The overall low habitat quality score is driven by the absence of natural channel and bank features, and the due to the low diversity of substrates present. The watercourse flows through tall herbs and scrub. Channel vegetation included liverworts, emergent broad-leaved herbs and emergent reeds.

Site 3 – Tributary of Horsbere Brook (SO9136715494)

3.2.4   The surveyed section of this river is classified as "Severely Modified" (Class 5, HMS = 2000). The HMS is driven by the presence of channel realignment and culverts. The HQA score of 44 places this section of river in HQA Class 4, indicating that it is of "Low" habitat quality, when compared to similar rivers in the RHS database. The overall low habitat quality score is driven by the absence of natural bank features, and the low diversity in substrate type and in-channel plants recorded. The watercourse is characterised by a realigned and culverted channel flowing through irrigated land. Channel vegetation was limited to liverworts.

3.3   Fish habitat assessment

3.3.1   The results of the fish habitat assessment are detailed in ES Figures 8.7- 8.12 Fish habitat within sites 1-6 (Document Reference 6.3). Details of the barriers to fish passage recorded are provide in Table 3-1 with their location shown in ES Figures 8.7 to 8.12 as above. Photographs taken during the surveys are provided in Appendix B of this report.

Site 1: Tributary of Norman's Brook - Upstream of A417

3.3.2   Site, 1 shown on ES Figure 8.7 Fish habitat within site 1 (Document Reference 6.3), is situated on a tributary of Norman's Brook near to Dog Lane, upstream of the existing A417. At the time of the survey the river was in a flow fed by autumnal rain and groundwater. This site is in a rural setting with the surrounding land use used for recreational and agricultural activities. The riparian habitat is comprised of scrub, wet woodland, marginal vegetation and semi-improved grassland.

3.3.3   Fish habitat within the Site 1 survey area is fragmented by several man-made weirs and other barriers, as described in Table 3-1. The dominant habitat across the reach was mixed juvenile (fry and parr habitats), with some potential lithophilic spawning (gravel) habitat recorded downstream of the weirs.

3.3.4   Whilst habitat suitable for mixed juvenile fish (salmonid fry and parr) and potential salmonid spawning habitat was recorded, it is considered highly unlikely that this reach provides spawning habitat for salmonids migrating from the wider catchment due to the high number of impassable weirs. However, there is potential for the reach to support an isolated population of brown trout and bullhead.

Site 2: Tributary of Normans Brook - Downstream of A417

3.3.5   Fish habitat within the Site 2 survey area, shown on ES Figure 8.8 Fish habitat within site 2 (Document Reference 6.3), is heavily fragmented by a number of weirs and other obstacles, as described in Table 3-1. This site is in a semi-rural setting with the surrounding land use used for agricultural activities and residential housing. Organic matter had accumulated around several weirs, causing low flow and a build-up of wide, shallow water behind the weirs. Downstream of these, run was the dominate flow type across the reach with pools present.

3.3.6   This reach has a range of habitats with the potential to support a mixed coarse and salmonid population, as well as lamprey.

Site 3: Horsbere Brook

3.3.7   Fish habitat within the Site 3 survey area, shown in ES Figure 8.9 Fish habitat within site 3 (Document Reference 6.3), is fragmented by a number of weirs and culverts, as described in Table 3-1. Several areas were inaccessible to survey. The only habitat type recorded at this site was mixed juvenile and adult habitat was absent.

3.3.8   This reach has the potential to support juvenile salmonids and bullhead.

Site 4: Tributary of River Churn

3.3.9   Fish habitat within the Site 4 survey area, shown on ES Figure 8.10 Fish habitat within site 4 (Document Reference 6.3), was predominantly unsuitable for fish due to low water levels, however there was a small amount of mixed juvenile habitat present. No barriers to fish passage were identified on site.

3.3.10   This reach is unlikely to support a significant fish assemblage, due to shallow depth, low flow and the silt dominated substrate.

Site 5: Tributary of River Churn

3.3.11   Fish habitat within the Site 5 survey area, shown on ES Figure 8.11 Fish habitat within site 5 (Document Reference 6.3), is fragmented by several barriers and weirs, as described in Table 3-1. The dominant habitat recorded was mixed juvenile, with some deeper parr habitat present. There is a pool at the downstream end of the reach providing some adult habitat.

3.3.12   This reach has potential to support a mixed coarse fish and salmonid population.

Site 6: Tributary of River Frome

3.3.13   Fish habitat within the Site 6 survey area, shown on ES Figure 8.12 Fish habitat within site 6 (Document Reference 6.3), is fragmented by weirs and culverts, as described in Table 3-1. All habitat upstream of the pool is considered to be of poor quality, consisting of agricultural drainage ditches that are heavily managed. The dominant habitat type recorded was mixed juvenile, with some potential some spawning habitat noted at the downstream end of the site. However,

immediately downstream of this habitat, there is a series of five weirs obstructing fish passage.

3.3.14 This reach is disconnected from the wider catchment due to a series of weirs and is therefore considered to be accessible to migratory fish from the wider catchment. However, there is potential for the reach to support isolated populations of brown trout and bullhead.

3.3.15 Details of the barriers to fish passage recorded are provide in Table 3-1 with their location shown in ES Figures 8.7 to 8.12 Fish habitat within site (Document Reference 6.3).

Table 3-1 Barriers to fish passage

Site and reference for ID	ID	Barrier type	Description
1 (A)	AB1	Natural barrier	Log jam, 0.7m long and 0.7m diameter
	AB2	Natural barrier	Wooded, stepped drop with organic matter accumulation behind obstruction.
	AW1	Man-made weir	Stepped weir. Varies between 0.5m to 1.0m drops
	AW2	Man-made weir	Stepped weir. Varies between 0.5m to 1.0m drops
	AW3	Man-made weir	Stepped weir. Varies between 0.5m to 1.0m drops
	AW4	Man-made weir	Stepped weir. Varies between 0.5m to 1.0m drops
	AW5	Man-made weir	Stepped weir. Varies between 0.5m to 1.0m drops
	AW6	Man-made weir	Stepped weir. Varies between 0.5m to 1.0m drops
	AW7	Man-made weir	Stepped weir. Varies between 0.5m to 1.0m drops
	AW8	Man-made weir	Stepped weir. Varies between 0.5m to 1.0m drops
	AW9	Man-made weir	Stepped weir. Varies between 0.5m to 1.0m drops
	AW10	Man-made weir	Concrete 2.5m weir. Barrier to all fish passage except potentially eel.
	AC1	Culvert	Outflow culvert at end of survey reach. Roughly 20m long with continuation from site.
	AC2	Culvert	Inflow culvert connecting to AC1. 8.0m long and 5.0m in diameter. Increase in flow velocity at this point.
	AC3	Culvert	Culvert after AW10. 0.7m height, 0.3m width and approximately 50m long. High flow velocity at this point.
	AC4	Culvert	Culvert with no access. 0.5m height, 0.7m width and approximately 12m long. No fish passage through culvert
2 (B)	BW1	Natural	Assumed natural although close to managed areas where a bridge is present; unable to view properly due to habitat overgrowth. Approximately 0.5m width and 0.5m drop (including pool).
	BW2	Natural	Long, natural obstruction. 1.5m width and 2.0m length with white water forming at the bottom.
	BW3	Natural	Stepped, likely to be clay or bedrock formation. Approximately 0.5m width and 0.75m drop (including pool).

Site and reference for ID	ID	Barrier type	Description
	BC1	Culvert	Culvert located at the start of the reach. Approximately 0.5m diameter. Unknown length. Outflow from CC2
	BC2	Culvert	Culvert under road. Approximately 3.0m length and 0.5m diameter. Inflow into CC1.
	BC3	Culvert	Culvert under housing/commercial buildings. Small, stepped weir at culvert exit, likely artificial concrete base. Approximately 0.75m diameter. Outflow from CC4.
	BC4	Culvert	Culvert under housing/commercial buildings. Approximately 0.75m diameter and 7.0m length. Channel prior to culvert is modified and reinforced with concrete and steel, encouraging faster flow through culvert entrance. Inflow into CC3.
	BC5	Culvert	Assumed culvert under residential buildings. Culvert not visible, so no observations can be made.
	BC6	Culvert	Culvert under residential driveway. Approximately 0.5m diameter and 4.0m length. Assumed inflow into CC5.
	BC7	Culvert	Culvert at end of survey reach. Unknown dimensions.
3 (C)	CW1	Natural	Natural obstruction, 0.5m width with 0.5m drop. Weir is stepped in nature with a small drop.
	CB1	Barrier	Organic matter accumulation spanning the full channel width. 0.5m width and approximately 0.3m in height/depth.
	CB2	Barrier	Dry stone wall. Unknown age, moss growing on the face. 0.75m width and 1.25m depth. Most likely used for passage of livestock between fields. Unlikely to allow passage for fish.
	CB3	Natural barrier	Tree fall with large trunk spanning channel width. Organic matter accumulation behind tree trunk. Approximately 1.5m width and 2.0m height.
	CC1	Culvert	Piped culvert, approximately 0.5m diameter. Unknown length
	CC2	Culvert	Piped culvert, approximately 0.5m diameter. Unknown length
	CC3	Culvert	Piped culvert, approximately 0.5m diameter. Approximately 5.0m length and is believed to connect to BC4 and BC5. High flow exiting pipe.
	CC4	Culvert	Piped culvert, approximately 0.5m diameter. Unknown length. Believed to connect to BC3 and BC5.
	CC5	Culvert	Piped culvert, approximately 0.5m diameter. Unknown length. Believed to connect to BC3 and BC4.
	CC6	Culvert	Piped culvert under road, approximately 0.5m diameter. Unknown length.
4 (D)	DC, DW or DB; N/A	N/A	Restrictions to passage such as weirs or natural barriers were not noted at this site. A culvert was

Site and reference for ID	ID	Barrier type	Description
			noted at the beginning of the site but this was not mapped as it was outside of the survey area.
5 (E)	EB1	Barrier	Lots of logs and woody debris. Natural barrier to fish passage and migration.
	EB2	Barrier	Fallen bridge fencing causing organic matter accumulation in channel and restricting fish passage. Related to EB3
	EB3	Barrier	Fallen bridge fencing causing organic matter accumulation in channel and restricting fish passage. Related to EB2
	EB4	Barrier	Fallen bridge within the channel causing barrier to fish passage.
	EW1	Man-made weir	Artificial, concrete weir holding back the pond. No passage of any fish apart from eel.
	EC1	Culvert	Culvert leading into Clerk's Patch woodlands.
6 (F)	FW1	Man-made weir	Artificial weir, 1.0m drop including pools.
	FW2	Weir	No comments made
	FW3	Man-made weir	Sloped artificial weir. Approximately 6.0m long, angle of 20 degrees and a drop of 0.5m.
	FW4	Man-made weir	Sloped artificial weir. Unknown length with and angle of 50 degrees. Drop of 0.75m including pool. Impassable to all fish.
	FW5	Weir	No comments made
	FW6	Weir	No comments made
	FC1	Culvert	Culverted section of pipe, assumed to be linked to FC1
	FC2	Culvert	Culverted section with pipe roughly 0.5m diameter. No estimations made to length of piped section

ID key:
Site name (A, B, C, D, E or F);
obstruction type (B = barrier, W = weir or C = culvert); and
number recorded (1 – 10)
For example; An ID labelled AB1 indicates the first barrier to be identified at sample site 1.

4   Conclusion

4.1.1   Seventeen fish species were identified during the desk study. Based on desk study records, the following fish species of conservation importance have the potential to be within the scheme:

- Brown trout; NERC Act - Species of Principal Importance, 2006. UK BAP - JNCC, 2007.
- European eel; IUCN – Critically Endangered, 2001. NERC Act - Species of Principal Importance, 2006. UK BAP - JNCC, 2007.
- Brook lamprey; Habitat directive – Annex II, 2003.
- Lamprey sp. ammocoetes; Habitats Directive – Annex II species, 2003.
- European bullhead; Habitats Directive - Annex II species, 2003.

4.1.2   Fish habitat within the survey sites is fragmented by significant weirs and culverts, many of which are considered to be impassable to all fish species (with the potential exception of European eel). Nevertheless, diverse and varied habitats with the potential to support all life stages of salmonids, and potentially coarse fish were recorded, should isolated populations exist.

4.1.3   Detailed impact assessment and mitigation measures are reported in ES Chapter 8 Biodiversity (Document Reference 6.2).

4.1.4   Mitigation measures are included in ES Appendix 2.1 EMP Annex D Landscape and Ecological Management Plan (Document Reference 6.4).

References

Environment Agency. (2003). The River Habitat Survey in Britain and Ireland Field Survey Guidance Manual: 2003 Version 1. Environment Agency; Peterborough.

Hendry, K. & Cragg-Hine, D. (1997) 'Restoration of riverine salmon habitats'. Fisheries Technical Manual 4, Environment Agency, Bristol.

Harvey, J. & Cowx, I. (2003) 'Monitoring the River, Brook and Sea Lamprey, *Lampetra fluviatilis*, *L. planeri and Petromyzon marinus*'. Peterborough: Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature.

Jeffers, J.N.R. (1998) Characterization of river habitats and prediction of habitat features using ordination techniques. Aquatic Conservation: Marine and Freshwater Ecosystems., 8, 529-540.

Appendix A River habitat survey results

Table A-1   Site 1

Survey parameters	Results
Upstream grid reference	SO9285615723
Downstream grid reference	SO9238215706
Date	29/10/2019
Predominant valley form	Deep vee
Number of riffles, pools and point bars	6 riffles, 3 pools and 1 unvegetated point bar
Realigned channel	No
Over-deepened channel	No
Impoundments	Yes, <33%
Banktop land use and vegetation structure	Broadleaved woodland with continuous trees on both banks
Channel dimensions	Left bank top height 0.4m Right bank top height 0.45m Channel bank full width 2.25m Channel water depth 0.04m Channel water width 1.75m
Locations of channel measurements	Riffle
Embankments	None present
Trashline	None present
Bed material	Consolidated
Invasive species	None present
Habitat Modification Score	4055
Habitat Modification Class	5 – Severely Modified
Habitat Quality Assessment Score	65
HQA Class	2 – High habitat quality

Table A-2   Site 2

Survey parameters	Results
Upstream grid reference	SO9134216295
Downstream grid reference	SO9111316693
Date	16/01/2020
Predominant valley form	No obvious valley side
Number of riffles, pools and point bars	2 pools, no riffles or point bars
Realigned channel	Yes, <33%
Over-deepened channel	Yes, <33%
Impoundments	No
Banktop land use and vegetation structure	Tall herbs/scrubs with semi-continuous trees on both banks
Channel dimensions	Left bank top height 0.25m Right bank top height 0.25m Channel bank full width 1.00m Channel water depth 0.20m Channel water width 0.50m
Locations of channel measurements	Riffle
Embankments	None present
Trashline	None present
Bed material	Unconsolidated
Invasive species	None present
Habitat Modification Score	2170
Habitat Modification Class	5 – Severely Modified
Habitat Quality Assessment Score	39
HQA Class	4 – Low habitat quality

Table A-3   Site 3

Survey parameters	Results
Upstream grid reference	SO9136715494
Downstream grid reference	SO9099215545
Date	16/01/2020
Predominant valley form	No obvious valley side
Number of riffles, pools and point bars	9 riffles, 3 pools, 1 unvegetated point bar
Realigned channel	Yes, >33%
Over-deepened channel	No
Impoundments	No
Banktop land use and vegetation structure	Irrigated land with semi-continuous trees on both banks
Channel dimensions	Left bank top height 1.00m Right bank top height 0.75m Channel bank full width 0.50m Channel water depth 0.05m Channel water width 0.50m
Locations of channel measurements	Riffle
Embankments	None
Trashline	None
Bed material	Unconsolidated
Invasive species	None present
Habitat Modification Score	2000
Habitat Modification Class	5 – Severely Modified
Habitat Quality Assessment Score	44
HQA Class	4 – Low habitat quality

Appendix B Photos

Site 1 – Potential lamprey habitat

Site 1 – Natural broad crested weir which is impassable for migratory species

Site 2 - Natural weir with an inclined crest

Site 2 - Habitat suitable for mixed juveniles

Site 3 - Suitable mixed juvenile habitat with some spawning potential

Site 3 - Habitat identified as unsuitable for fish

Site 4 – Pipe culvert

Site 4 – Habitat surrounded by decidious woodland

Site 5 – Mixed juvenile habitat with margins providing potential lamprey habitat

Site 5 – Man made concrete and metal barrier made impassable to migratory fish; except eel

Site 6 – Large, man-made concrete weir with a vertical drop.

Site 6 – Mixed juvenile habitat with marginal, emergent and submerged macrophytes.