

A303 Amesbury to Berwick Down

TR010025

6.3 Environmental Statement Appendices

Appendix 8.12A Fish survey report River Avon

Volume 6

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Planning Act 2008

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October 2018



Technical Note

A303 Amesbury to Berwick Down

Subject: River Avon Fish and Lamprey Surveys

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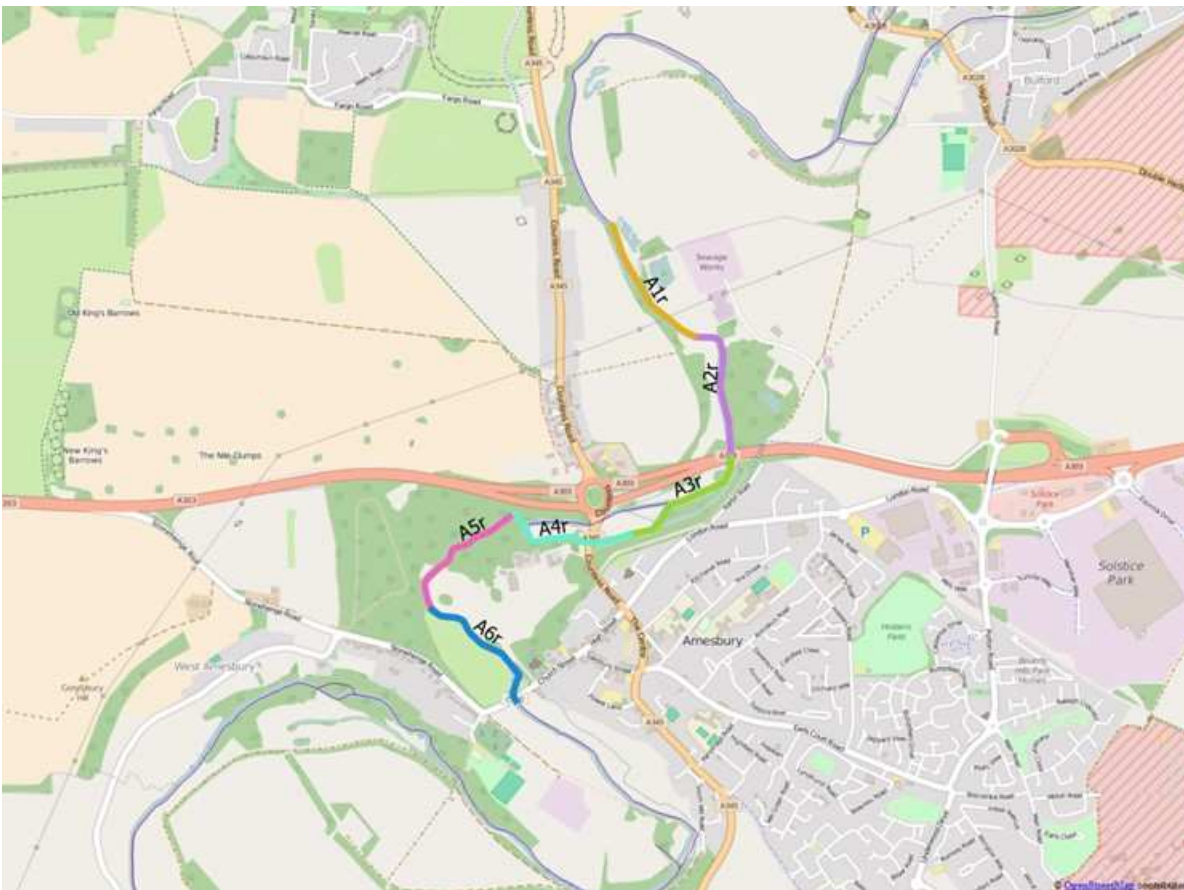
1 Introduction

1.1 Overview

1.1.1 Fish surveys (including lamprey ammocoete survey) were undertaken to establish baseline information on the fish populations of a 3km length of the River Avon at Amesbury. These surveys provide information on species presence and population metrics (density and biomass estimates).

1.1.2 Summary fisheries data is presented in this technical note. The raw catch data and habitat data used in calculating the estimates presented are available on request.

1.1.3 Surveys were undertaken along six 500m reaches as shown in Figure 1-1. Upstream and downstream grid references (NGR) for each survey reach are provided in Table 1-1.



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Figure 1-1 River Avon fish survey reaches

Table 1-1 Survey reach NGRs

RHS reach	Upstream NGR	Downstream NGR
River Avon A1r	SU 15450 42983	SU 15743 42604
River Avon A2r	SU 15743 42604	SU 15875 42187
River Avon A3r	SU 15875 42187	SU 15529 41900
River Avon A4r	SU 15529 41900	SU 15091 41961
River Avon A5r	SU 15091 41961	SU 14798 41639
River Avon A6r	SU 14798 41639	SU 15101 41316

2 Methods

2.1 Fish survey method

2.1.1 Fish surveys were undertaken between the 18th and 20th October 2016 by a specialist fisheries contractor. All surveys were consented by the Environment Agency.

2.1.2 Due to the width, depth profile and habitat variability of the River Avon along the survey reaches a multi-survey approach was adopted in the collection of baseline fisheries data.

2.1.3 Prior to undertaking the fish survey the proportion of each habitat type present (e.g. riffle, glide, pool) in each 500m reach was determined. This information was used to select the most effective survey method/s to be applied at the reach scale.

2.1.4 Sampling effort within each 500m reach was then apportioned relative to the overall amount of the specific habitat type present so that population metric estimates from the raw catch data could be calculated (after Carle and Strub, 1978¹).

2.1.5 The survey methods applied were as follows:

- Fully quantitative triple shock electric fishing:
 - Three run catch depletion survey within a known stop netted area.
- Timed, semi-quantitative, electric fishing runs:
 - Five minute timed run within discrete habitat type e.g. riffle of known area to provide an approximation of numbers.
- Seine netting:
 - Sample area determined by the length of the net deployed, thus allowing for estimates of numbers of fish (per species) per unit area of each habitat type sampled.

¹ Carle, F.L. & Strub, M.R. (1978). A new method for estimating population size from removal data. *Biometrics*, 34, 621-830.

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2.1.6 Fish captured were identified to species, counted and either fork length or total length measured to the nearest mm (depending on species caught). The weight (g) of individual fish were then calculated using fish length/weight conversion data held on the fishbase.org website. Note that length/weight conversion data is not available for smaller species such as stone loach, bullhead and minnow, therefore biomass estimates exclude minor species.

2.1.7 All electric fishing surveys followed standard practice for operators and equipment as developed by the European Standards Committee (CEN, 2001) as detailed in the Environment Agency Code of Practice and Electric Fishing Equipment Annex A and B, Issue II regulations (1998).

2.2 Lamprey ammocoete survey method

2.2.1 Lamprey surveys concentrated on the quantification of ammocoete (larval) populations as this approach provides the best and most cost-effective approach in the assessment of recruitment success within the population.

2.2.2 Lamprey ammocoete surveys were undertaken between the 18th and 20th October 2016 according to the LIFE (Harvey & Cowx, 2003²) method which uses electric fishing within a standard 1m square quadrat.

2.2.3 Surveys were carried out in both optimal and sub-optimal habitat (where present) within each 500m reach. Prior to undertaking lamprey ammocoete survey a search was undertaken to quantify the occurrence of optimal and sub-optimal lamprey habitat.

2.2.4 Optimal lamprey ammocoete habitat was defined as:

- Several square metres of stable, fine sediment at least 150mm deep (Potter *et al.*, 1986³; Harvey & Cowx, 2003²);
- Low water velocity (Thomas, 1962⁴; Malmqvist, 1980⁵);
- Shallow water depth (Malmqvist, 1980⁵); and
- Organic detritus (Potter *et al.*, 1986³).
- Presence of shade (Potter *et al.*, 1986³)

2.2.5 Sub-optimal habitat was defined as patchy, shallow sediment interspersed among coarser substrate with comparatively high velocity flow, more typically described as salmonid fry and parr habitat.

² Harvey, J.P. & Cowx, I.G. (2003). Monitoring the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough, pp. 35.

³ Potter, I.C., Hillard, R.W., Bradley, J.S. & McKay, R.J. (1986). The influence of environmental variables on the density of larval lampreys in different seasons. *Oecologia*, 70, 433-440.

⁴ Thomas, M.L.H.: Observations on ecology of ammocoetes *Petromyzon marinus* L. and *Entosphenus lamottei* (Le Sueur). Thesis, University of Toronto, Canada. (1962)

⁵ Malmqvist, B. (1980). The spawning migration of the brook lamprey, *Lampetra planeri* Bloch, in a South Swedish stream. *Journal of Fish Biology*, 16:1, 105-114.

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2.2.6 Quantitative surveys of optimal and sub-optimal habitat were undertaken by enclosing a 1m² area of habitat within a quadrat (2mm fine mesh netting). Electric fishing for lamprey was then undertaken within the quadrat in such a way as to draw individual lamprey out of the sediment rather than stunning and trapping them in the silt (see APEM 2002⁶, for further details of the procedure).

2.2.7 Lamprey were enumerated, measured (to the nearest mm) and an absolute population estimate calculated using the Carle and Strub (1978¹) depletion methodology. A carrying capacity of each survey reach was then estimated based availability of optimal and/or sub-optimal habitat.

3 Summary results

3.1 Avon fish summary data

3.1.1 Summary fisheries data is presented in Table 3-1 for the six, 500m survey reaches, sampled on the River Avon. These data include catch data from the fishing method/s applied as well population metric estimates. Density and biomass estimates are presented for all species data and for data excluding minor species. The latter is less biased by the abundance of smaller species (e.g. minnow) and has used to provide comparative review in Section 4.

3.1.2 Lamprey data is presented separately in Section 3.2.

Table 3-1 Fish survey summary data for the River Avon survey reaches

Survey stretch ID	A1r	A2r	A3r	A4r	A5r	A6r
Survey date/s	18 Oct 2016	18 Oct 2016	18 Oct 2016	17 Oct 2016	19 Oct 2016	19 Oct 2016 20 Oct 2016
Combined survey data						
Number of species caught	6	6	5	7	11	8
Brown trout <i>Salmo trutta</i>	✓	✓	✓	✓	✓	✓
Bullhead <i>Cottus gobio</i>	✓	✓	✓	✓	✓	✓
Grayling <i>Thymallus</i>	✓	✓	✓	✓	✓	✓
Pike <i>Esox lucius</i>	✓	✓			✓	✓
European eel <i>Anguilla anguilla</i>		✓	✓	✓	✓	✓
Stone loach <i>Barbatula barbatula</i>	✓		✓	✓	✓	
Minnow <i>Phoxinus phoxinus</i>	✓	✓		✓	✓	✓
Perch <i>Perca fluviatilis</i>				✓		
Chub <i>Squalius cephalus</i>					✓	
Dace <i>Leuciscus leuciscus</i>					✓	✓
3-spined sb <i>Gasterosteus aculeatus</i>					✓	✓
Roach <i>Rutilus rutilus</i>					✓	

⁶ APEM (2002). Sampling methodologies for condition assessment within SAC Rivers for adult sea, river and brook lamprey, bullhead and spined loach. Phase IIa Report. LIFE in UK Rivers Project, pp. 38.

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Survey stretch ID	A1r	A2r	A3r	A4r	A5r	A6r
Survey summary (excluding minor species*)						
Overall density (no./100m ²)	6.6	19.7	5.2	14.7	3.4	10.4
Overall biomass (g/100m ²)	2,175.1	7,710.3	658.9	1,483.6	705.4	731.8
Survey summary (all species)						
Overall density (no./100m ²)	102.4	97.5	10.9	24.6	5.7	13.7
Overall biomass (g/100m ²)	2,175.1	7,710.3	658.9	1,487.6	706.2	732.4
Survey data by method applied (all species)						
Timed run survey data (if available)						
Number of species caught	n/a	n/a	n/a	2	4	4
Number of fish caught				18	28	44
Total weight caught (g)				179	179	683
Density (no./100m ²)				32.1	4.7	14.7
Biomass (g/100m ²)				319.6	29.8	227.7
Seine net survey data (if available)						
Number of species caught	n/a	n/a	n/a	n/a	9	5
Number of fish caught					35	57
Total weight caught (g)					**	2711
Density (no./100m ²)					14.1	114.6
Biomass (g/100m ²)					**	5450.8
Catch depletion survey data (if available)						
Number of species caught	6	6	5	7	10	4
Number of fish caught	>572	≤309	59	88	34	11
Population estimate (catch depletion)	>576	≤317	63	94	37	13
Total weight caught (g)	11640	20717	2294	6340	10225	2431
Total weight estimate (inc. catch depletion; g)	12235	25059	2656	6604	10414	2683
Standing crop density (no./100m ²)	102.4	97.5	10.9	23.5	4.1	2.7
Standing crop biomass (g/100m ²)	2175.1	7710.3	885.3	1651.1	1157.1	559
Species present / absent						
Salmonids	Present	Present	Present	Present	Present	Present
Invasive fish species	Absent	Absent	Absent	Absent	Absent	Absent

* Minor species excluded from calculations are bullhead; stone loach; minnow & 3-spined stickleback. ** Not measured.

3.2 Avon lamprey ammocoete data

3.2.1 Summary lamprey survey data is presented in Table 3-2 for the six 500m survey reaches sampled on the River Avon. The data presented includes the raw catch data as well as an estimate of the carrying capacity of each survey reach.

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Table 3-2 Lamprey summary data for the River Avon Survey reaches

Survey stretch ID	A1r	A2r	A3r	A4r	A5r	A6r
Survey date	18 Oct 2016	18 Oct 2016	18 Oct 2016	17 Oct 2016	19 Oct 2016	20 Oct 2016
SURVEY TOTALS						
Combined survey data						
Number of river/brook lamprey caught	10.0	0.0	0.0	4.0	6.0	11.0
Number of river/brook lamprey caught inc. population estimate (catch depletion)	11.0	0.0	0.0	5.0	7.0	12.0
Overall standing crop density (no/m ²)	5.5	0.0	0.0	2.5	3.5	6.0
Estimated carrying capacity of survey stretch	1,980	0.0	0.0	175.0	2,660	2,475
Optimal habitat						
Number of river/brook lamprey caught	10.0	0.0	0.0	4.0	0.0	8.0
Population estimate (catch depletion)	11.0	0.0	0.0	5.0	0.0	9.0
Standing crop density (no./m ²)	11.0	0.0	0.0	5.0	0.0	9.0
Estimated carrying capacity of survey stretch	1,980.0	0.0	0.0	175.0	0.0	1,575.0
Sub-optimal habitat						
Number of river/brook lamprey caught	0.0	0.0	0.0	0.0	6.0	3.0
Population estimate (catch depletion)	0.0	0.0	0.0	0.0	7.0	3.0
Standing crop density (no./m ²)	0.0	0.0	0.0	0.0	7.0	3.0
Estimated carrying capacity of survey stretch	0.0	0.0	0.0	0.0	2,660	900

4 Fisheries data

4.1 Overview

4.1.1 The fisheries surveys conducted along the 3 km of the River Avon yielded a total of 13 species (including lamprey). No invasive fish species were recorded.

4.1.2 Brown trout, bullhead, grayling and minnow were well distributed throughout the six survey reaches, with a notable feature of the upstream reaches (A1r and A2r) being the presence of a high proportion by catch of large brown trout (>350mm), most likely to have been stocked individuals for angling.

4.1.3 Species richness increased in the downstream direction as a result of the occurrence of species such as perch, chub, dace, three-spined stickleback and roach through reaches A4r – A6r.

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4.1.4 When averaging reach values the following population metrics apply to the 3 km of River Avon surveyed (excluding minor species):

- Overall density (no./100m²) = 10.0
- Overall biomass (g/100m²) = 2,244.2

4.1.5 The highest fish density and biomass was recorded in Reach A2r, at 19.7 no./100m² and 7,710.3 g/100m², respectively. The lowest fish density was recorded in Reach A5r at 3.4 no./100m² and the lowest biomass in Reach A3r at 658.9 g/100m².

4.1.6 Lamprey ammocoetes were recorded in four of six survey reaches. The estimated carrying capacity for the 3 km section was calculated at 3,730 individuals, with the greatest capacity being recorded in reaches A5r and A6r.

4.1.7 The following sections provide a commentary on the characteristics of the fishery for each of the 500m reaches surveyed.

4.2 River Avon A1r

4.2.1 The fully quantitative triple shock method was used to survey this reach. A representative 75m sub-section of this reach was surveyed with an average width of 7.5m, resulting in a total survey area of 562.5m². The sub-section comprised run and glide habitats with an average depth of 0.9m (maximum depth 1.4m). Substrate was predominantly silt, and sand with some gravel. Riparian vegetation consisted of nettles, sedge and alder trees.

4.2.2 Six species were recorded: brown trout (18), bullhead (23), grayling (15), pike (2), stone loach (14) and minnow (>500 estimate). Of the brown trout captured, a high proportion (44 %) were large individuals (over 350mm/500 g), which are almost certainly fish stocked for angling.

4.2.3 Survey data provided an overall density estimate of 6.6 fish per 100m² and an overall biomass estimate of 2,175 g per 100m² (excluding minor species).

4.2.4 Ten river/brook lamprey were recorded from optimal habitat within the reach, which equated to an estimated carrying capacity of 1,980 individuals for the reach.

4.3 River Avon A2r

4.3.1 The fully quantitative triple shock method was used to survey this reach. A representative 50m sub-section of this reach was surveyed with an average width of 6.5m, resulting in a total survey area of 325m². The sub-section comprised run and glide habitats with an average depth of 0.7m (maximum depth 1.1m). Substrate was a mixture of silt, sand and gravel. Riparian vegetation consisted of grasses and alder trees.

4.3.2 Six species were recorded: brown trout (29), bullhead (2), eel (1), grayling (25), pike (2) and minnow (≥250 estimate). As at site A1r, over 50 % of the brown trout recorded were larger than 350mm or 500 g suggesting these were stocked individuals.

4.3.3 Survey data provided an overall density estimate of 19.7 fish per 100m² and an overall biomass estimate of 7,710.3g per 100m² (excluding minor species).

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4.3.4 Both the density and biomass estimates are higher than those reported for Reach A1r, with the notably higher biomass estimate for this site being driven by the presence of greater numbers of large brown trout and grayling.

4.3.5 No lamprey ammocoetes were recorded from optimal or sub-optimal habitats.

4.4 River Avon A3r

4.4.1 The fully quantitative triple shock method was used to survey two separate representative sub-sections of the reach. The first sub-section was a 50m length of river with an average width of 6m resulting in a survey area of 300m². This sub-section comprised glide habitat with an average depth of 0.9m (maximum depth 1.6m) characterised by the presence of silt, sand and gravel with a small proportion of cobbles (10%).

4.4.2 The second sub-section was a 40m length of river with an average width of 7m resulting in a survey area of 280m². This sub-section comprised shallow glide/riffle habitat with an average depth of 0.7m (maximum depth 1.4m). A greater proportion of cobbles and pebbles (total 60%) were recorded here compared with the first sub-section, also with sand, silt and gravel.

4.4.3 Five species were recorded from the combined sub-sections: brown trout (21), bullhead (30), eel (5), grayling (1) and stone loach (2). The size of brown trout recorded suggests an absence of stocked individuals. Of note, one of the four eel recorded exceeded 800mm (700 g).

4.4.4 Riparian vegetation consisted of mixed woodland, grasses and sedges.

4.4.5 Survey data provide an overall density estimate of 5.2 fish per 100m² and an overall biomass estimate of 658.9 g per 100m² (excluding minor species). This is a notable reduction when compared to the estimates recorded in the two reaches upstream, in the main attributable to the capture of only one grayling.

4.4.6 No lamprey ammocoetes were recorded from optimal or sub-optimal habitats.

4.5 River Avon A4r

4.5.1 The fully quantitative triple shock method was combined with timed electric fishing runs to survey representative sub-sections of the reach. The triple shock method was applied to a 50m length of river with an average width of 8m resulting in a survey area of 400m². This sub-section comprised glide habitat with an average depth of 0.7m (maximum depth 1.6m) and a mixture of sand, silt and gravel with a small proportion of cobbles (10%).

4.5.2 Two timed electric fishing runs were undertaken in shallow riffle/run habitats (total survey area 56m²). These sub-sections had an average depth of 0.3m (maximum depth 0.4m) and were dominated by cobble substrate (60%) with silt, sand and gravel also present.

4.5.3 Riparian vegetation consisted of mixed woodland and grassland.

4.5.4 Seven species were recorded from the combined survey: brown trout (42), bullhead (26), eel (3), grayling (10), stone loach (2), minnow (13) and perch (10).

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4.5.5 Survey data provided overall density of 14.7 fish per 100m² and an overall biomass of 1,483.6 g per 100m² (excluding minor species). The high density is attributable to large numbers of brown trout combined with the occurrence of both grayling and perch.

4.5.6 Four river/brook lamprey ammocoetes were recorded from optimal habitat within the reach, which equated to an estimated carrying capacity of 175 individuals.

4.6 River Avon A5r

4.6.1 The fully quantitative triple shock method was combined with timed electric fishing runs and a seine net survey of representative sub-sections of the reach. The triple shock method was applied to a 60m length of river with an average width of 15m resulting in a survey area of 900m². This sub-section comprised glide habitat with an average depth of 0.5m (maximum depth >1.0m) characterised by a mixture of sand, silt, gravel and pebble substrate.

4.6.2 Two timed electric fishing runs were undertaken in shallow riffle/run habitats (total survey area 600m²). These sub-sections had an average depth of 0.2m (maximum depth 0.4m) and were dominated by gravel substrate (80%) with silt, sand and cobble also present.

4.6.3 A 25m seine net was deployed to sample 249m² of pool habitat with an average depth of 2m (maximum depth >3.0m).

4.6.4 Riparian vegetation was recorded as mixture of trees, grassland, scrub and low herbs.

4.6.5 Eleven species were recorded from the combined survey: brown trout (10), chub (2), dace (2), eel (1), grayling (28), pike (4), roach (12), bullhead (29), stone loach (2), minnow (6) and three-spined stickleback (1). This was highest species richness for the reaches surveyed.

4.6.6 Survey data provided an overall density estimate of 3.4 fish per 100m² and as a result a relatively low biomass estimate, of 705.4 g per 100m² (excluding minor species). This was the lowest overall reach density recorded at survey driven in the main by the low densities recorded in the run and glide habitats sampled.

4.6.7 Six river/brook lamprey ammocoetes were recorded from sub-optimal habitat within the reach, which equates to an estimated carrying capacity of 2,660 individuals. This was the highest carry capacity recorded at survey.

4.7 River Avon A6r

4.7.1 The fully quantitative triple shock method was combined with timed electric fishing runs and a seine net survey of representative sub-sections of the reach. The triple shock method was applied to a 40m length of river with an average width of 12m resulting in a survey area of 480m². This sub-section comprised glide habitat with an average depth of 0.7m (maximum depth 0.8m) characterised by a mixture of silt, sand and gravel and small amount of pebble (5%) substrate.

4.7.2 Two timed electric fishing runs were undertaken in shallow riffle/run habitats (total survey area 300m²). These sub-sections had an average depth of 0.15m (maximum depth 0.4m) and were dominated by gravel substrate (50%) with silt, sand and pebble also present.

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4.7.3 A 25m seine net was deployed to sample 50m² of pool habitat with an average depth of 1.0m (maximum depth 1.5m).

4.7.4 Riparian vegetation was recorded as mixture of trees, grassland, shrubs, herbs and reed.

4.7.5 Eight species were recorded from the combined survey: brown trout (22), dace (10), eel (2), grayling (49), pike (1), bullhead (23), minnow (2) and three-spined stickleback (3). This was highest species richness for the reaches surveyed.

4.7.6 Survey data provided an overall density estimate of 10.4 fish per 100m² and biomass estimate, of 731.8 g per 100m² (excluding minor species). Whilst the biomass estimate for this reach is comparable to Reach A5r, the higher density is attributable to notably high numbers of brown trout and grayling.

4.7.7 Eleven river/brook lamprey ammocoetes were recorded from optimal and sub-optimal habitat within the reach, which equates to an estimated carrying capacity of 2,475 individuals.

Arup Atkins Joint Venture Approvals

Version	Role	Name	Signature	Date
P01	Author	Esther Wade		23 November 2016
	Checker	Ian Morrissey		29 November 2016
	Checker	Liz Brown		29 November 2016
	Approver	Andy Keen		29 November 2016

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