A30 Chiverton to Carland Cross
Environmental Statement

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Fish Survey Report

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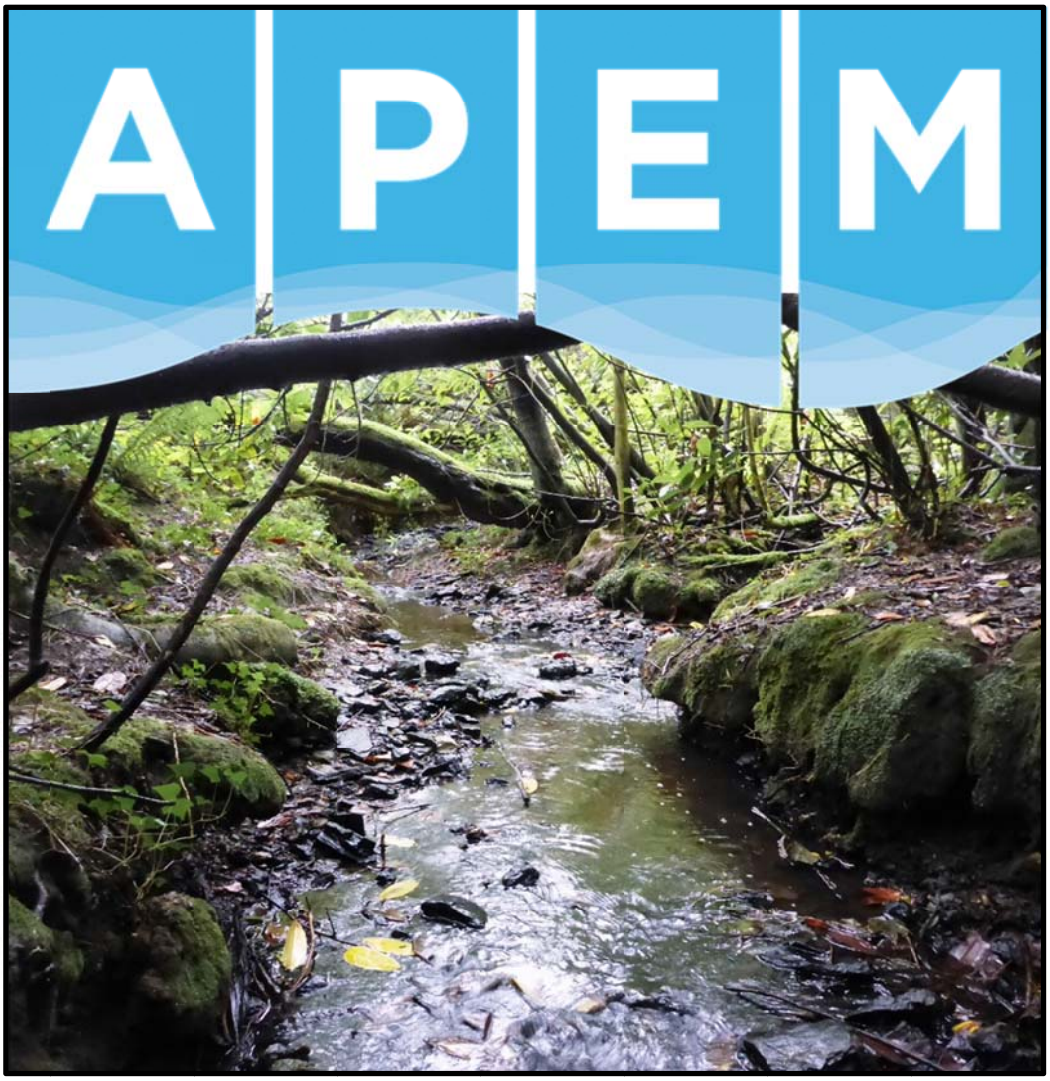
Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)
APFP Regulation 5(2)(a)



A30 Chiverton to Carland Cross Fish Population Surveys - 2017

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APEM Ref: P00001470

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Contents

1. Introduction

APEM Ltd. was commissioned by WSP to undertake fish population surveys in respect of the proposed A30 Chiverton to Carland Cross Improvement Scheme (hereafter referred to as 'the proposed Scheme').

This document provides the results of the fish population surveys, which were completed in 2017. The surveys have been undertaken to establish an understanding of the baseline aquatic constraints associated with the proposed Scheme and will ultimately inform an Ecological Impact Assessment (EcIA) forming part of an Environmental Statement (ES) supporting a Development Consent Order (DCO) Application..

The targeted survey approach was specifically designed to provide a baseline dataset for freshwater fish, where it is thought that a historical ecological dataset is lacking. Data may be used as a reference against which any impacts of the proposed Scheme could be ascertained, but also used to inform future surveys or mitigation measures. The surveys would also advise the presence / absence of conservation species and furthermore will provide complementary data on water quality throughout the system.

Therefore, the objectives of this project were:

- To provide a baseline dataset for freshwater fish species in the relevant watercourse reaches, including targeted surveys for lamprey.
- Provide high-level recommendations regarding mitigation measures designed to protect fish populations.

2. Methods

2.1 Geographical scope

The watercourses of interest and the location of aquatic ecology (including fish) survey locations were selected based on consideration of the proposed Scheme development footprint, as provided by WSP and a walkover conducted in 2016. During the walkover any watercourse located within 100m of the draft footprint was included and surveyed (walkover visual survey) for fish habitat for a minimum of 500m distance from the footprint (walkover survey conducted in late 2016).

Watercourses that could be directly or indirectly 'impacted' by the works were scoped into the geographical scope of this study.

Potential 'directly impacted' reaches are those that would be intersected by the proposed Scheme; there were four such reaches i.e. 2.1, 12.1, 12.2 and 13.4 (see Table 1). Potential direct impacts could include channel intrusion (cutting or realignment), reduction in bank stability and/or generation of sediment to the watercourses (associated with temporary or permanent crossing works).

Potential 'indirectly impacted' reaches are those that although not directly intersected by the proposed route, are sufficiently near that indirect effects may reasonably be deemed to be possible; indirect impacts could include sediment ingress via site runoff. For the purposes of this study, all watercourses within 100m of the draft footprint were considered to have the potential for indirect impacts. 100m is considered to be a sensible threshold for identification of any potential indirectly impacted reaches, and may be considered to be precautionary given the low topographical gradients in this general area and the legislative compliance assumption of best-practice construction methodologies.

Of the 14 potential 'indirectly impacted' watercourses, three were deemed (on the basis of walkover observations) very unlikely to be suitable for all fish and macroinvertebrate communities (4.1, 13.2 & 18.1). These streams were likely ephemeral, too shallow and narrow for aquatic ecology to establish, or so denuded to be ineffectual for fish and macroinvertebrates. However it was recommended that macroinvertebrate surveys be conducted at sites 4.1 and 18.1 to validate these findings (to be reported separately). Watercourse 5.1 was not accessed during the initial walkover survey due to a lack of landowner permission and no follow up monitoring has been recommended at this location (not deemed essential given vicinity of site 5.2).

Survey requirements are further discussed in APEM (2016b) - Report P888 – A30 River and Pond Habitat Assessments (APEM Scientific Report P000888, 2016).

Table 1 Identified direct and indirect survey locations (cross reference Figure 1)

Potential impact	Reach	Fish (incl .lamprey) Late summer	Comments
Direct	2.1	Y, later removed	Removed due to revisions of site footprint – no longer considered in potential hydrauliic connectivity with the development.
	12.1	Y	
	12.2	Y	
	13.4	Y	
Indirect	4.1	N	No fish surveys undertaken - based on walkover observations
	4.2	Y	
	5.1	N	No fish surveys undertaken – based on proximity of site 5.2 and access restrictions
	5.2	Y	
	6.1	Y	
	8.1	Y	
	10.1	Y	Access denied at time of survey – see Section 4.
	12.3	Y	
	13.1	Y	
	13.2	N	No fish surveys undertaken - based on walkover observations
	15.1	Y	
	16.2	Y	
	17.1	Y	
	18.1	N	No fish surveys undertaken - based on walkover observations

The precise survey site within the reach of interest was selected to provide a representative location of the wider stream, where relevant to allow a wide range of species to be sampled and also having regard for survey accessibility (see Figure 1).

Subsequent revisions to the proposed Scheme footprint (all of which were minor) were critically reviewed to ensure all sites remained relevant and to identify any new requirements. Only site 2.1 was removed due to footprint revisions as it was no longer considered within potential hydraulic connectivity with the development. No additional watercourses were identified during footprint revisions.

2.2 Fish population survey methods

2.1.1 Electrofishing surveys

Electrofishing (EF) surveys were successfully undertaken using battery powered, backpack pulsed-DC current EF equipment at a total of 12 sites (Figure 1). The location of the survey sites were informed by the habitat walkover survey undertaken by APEM (APEM 2016) and detailed in relevant EA licenses. Site 2.1 was scoped out on account of proposed Scheme footprint changes and surveyors were denied access to site 10.1 (see Section 4 for further consideration of this site).

At the sites which may be directly impacted by the works, fully quantitative surveys were conducted, which involved placing stop nets at the upstream and downstream limits of each site and three passes being conducted to collect depletion estimate data. This enabled a population density to be quantified at each site. At sites which may be indirectly impacted by the works, semi-quantitative surveys were conducted, which involved a single run within a known area and included a single stop net or similar barrier at the upstream limit of each site to provide semi-quantitative results for fish. All fish captured were identified, counted, and measured (fork length) to the nearest mm. After processing, all fish were returned alive to the watercourse from which they were captured. Precise grid references of those sites surveyed, together with confirmation of the survey method utilised i.e. sites subject to fully-quantitative sampling or subject to timed runs, are provided in Table 2.

Quantitative population density estimates were, where necessary, based upon the depletion rate of consecutive catches taken from a known surface area between the stop nets. At all sites surveyed, three runs (shocks) were sufficient to produce an accurate depletion estimate (Carle & Strub 1978). A period of twenty minutes was left between each run to allow water clarity to return and fish to become naturally distributed after each disturbance. The density of each fish species (no./100 m^2) was calculated at each site.

In addition to a general description of the site characteristics being recorded, a multi-parameter probe was used to record the following *in-situ* water quality parameters: conductivity (microsiemens [µs]), pH, oxygen (mg/l), oxygen (% saturation), temperature (^oC) and salinity (parts per thousand [ppt]).

2.1.2 Lamprey surveys

Lamprey surveys were undertaken at the 12 sites, including both optimal and sub-optimal juvenile lamprey habitat where possible. The protocol for surveying lampreys followed Common Standards Monitoring (CSM) guidelines, which entails electric fishing within a ≥1 m^2 quadrat four times over each 100m survey stretch, positioned over the selected optimal lamprey habitat. Short 20 second bursts of electricity are applied to draw out the lamprey, with 5 seconds of power off, with the anode held 10-15cm above the habitat so as to avoid stunning them and trapping them in the silt. Individual lamprey were identified, counted, and measured at each site.

Population densities were calculated as per the CSM, using the mean of the results from each patch of habitat within the site expressed as juveniles per m^2.

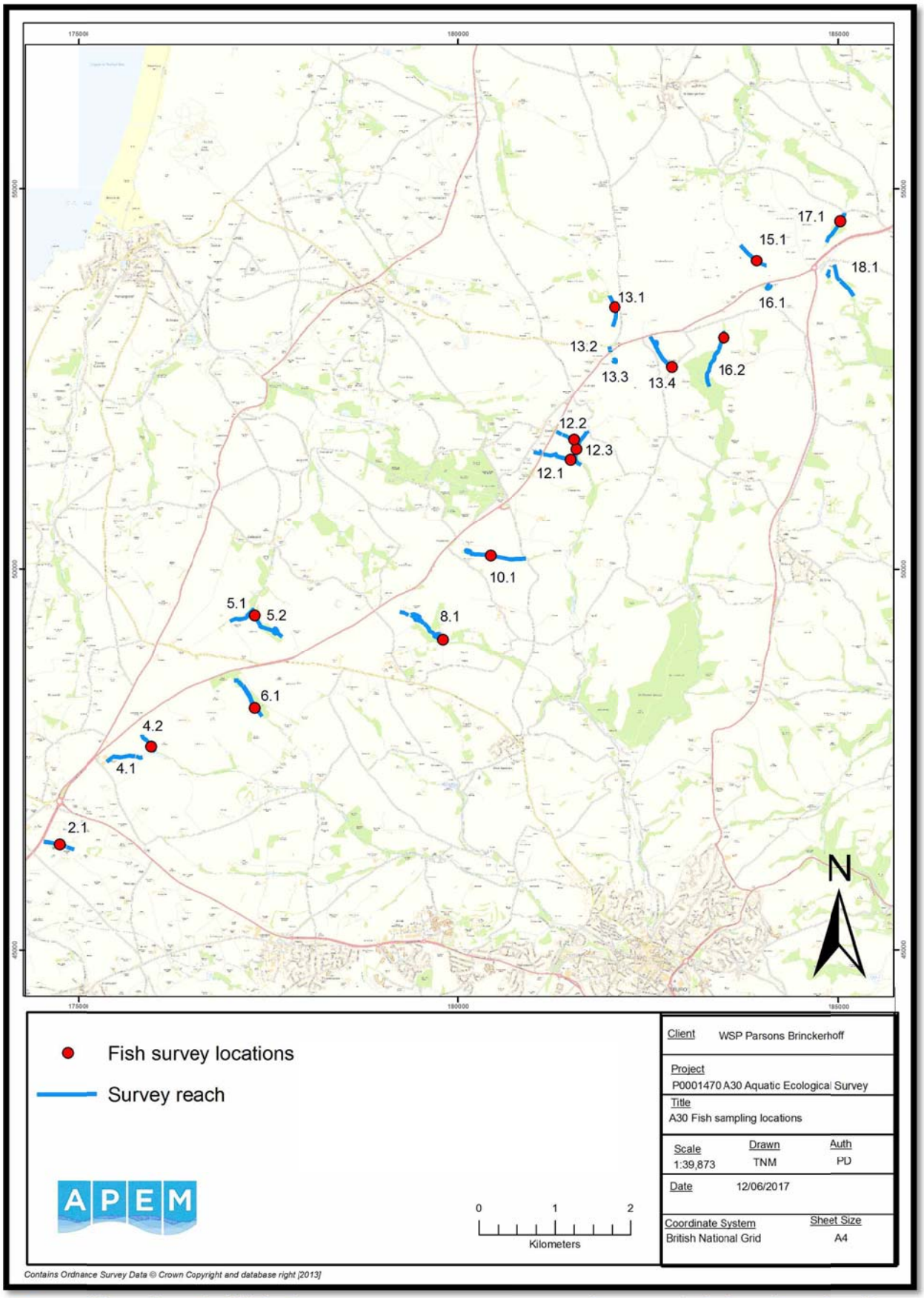


Figure 1 Location of all fish sites (note 13.3 and 16.1 are ponds – reported elsewhere; locations surveyed provided in Table 2).

3. Results

3.1 Fish population survey results

The fish population surveys were conducted during July 2017 during 'typical' flow conditions and during a dry, stable climatic window. All surveys were performed at sites selected during the walkover survey and were thought to represent typical habitat characteristics of the target reach. Multi-species fish surveys were undertaken at all sites where the habitat was suitable for such surveys, while lamprey specific surveys were performed where feasible.

Table 2 Confirmation of survey location grid references (cross reference Figure 1) and quantitative sampling method employed.

Reach	NGR	Fully quantitative sampling / Semi quantitative sampling (timed runs)
4.2	SW7595847674	Semi
5.2	SW7731949397	Semi
6.1	SW7731748174	Semi
8.1	SW7979949074	Semi
12.1	SW8147851442	Full
12.2	SW8152351705	Full
12.3	SW8155351579	Semi
13.1	SW8206153449	Semi
13.4	SW8280852669	Full
15.1	SW8392154060	Semi
16.2	SW8348653050	Semi
17.1	SW8502954583	Semi

3.1.1 Site 4.2

The fish survey at Site 4.2 covered a total area of 25m^2. Specialist quantitative lamprey surveys were also undertaken with both optimal and suboptimal habitat assessed. The watercourse was typical of the reach with cobble, pebble dominated substrate with gravel inundated with fine sediment throughout the survey reach (Fig.2). The flow was very low with ponded areas reported. Instream woody debris was common in the survey reach and provides good habitat for fish.

Figure 2 Substrate condition at Site 4.2

The physico-chemical results from Site 4.2 were within the expected ranges and with good dissolved oxygen concentrations (8.70 mg/L) (Table 8 & Figure 19) would be capable of supporting a diverse fish population, notably those salmonid species which rely on such levels. However, no fish of any species were caught during the surveys of all habitats at site 4.2. It is thought that the ephemeral nature of the flow in the watercourse is likely to be the primary factor limiting fish populations at the site.

3.1.2 Site 5.2

The fish survey at Site 5.2 covered a total area of 20m^2. Specialist quantitative lamprey surveys were also undertaken with both optimal and suboptimal habitat assessed. The channel was narrow, linear and dominated by overgrown riparian vegetation (Fig.3). The watercourse was typical of the reach with cobble, pebble dominated substrate with gravel inundated with fine sediment throughout. Water levels and flows were very low with ponding in areas reported.

Figure 3 Overgrown channel at Site 5.2

The physico-chemical results from Site 5.2 were within the expected ranges although dissolved oxygen concentrations were relatively low (6.74mg/L) compared to other sites (Table 8 & Figure 19), which may be a reflection of the lack of flow in the survey reach.

No fish of any species were caught at 5.2 potentially due to the lack of connectivity between habitats.

3.1.3 Site 6.1

The channel at Site 6.1 was sinuous and incised and meandered through a mix of deciduous woodland, grasses and ferns. The water levels were low but flow was continuous throughout

the survey reach. The substrate comprised of cobble and pebbles with clean gravel interstices throughout the survey reach (Fig.4).

Figure 4 Angular and generally clean substrate at Site 6.1

The fish survey at Site 6.1 covered a total area of 50m^2. Specialist quantitative lamprey surveys were also undertaken with both optimal and suboptimal habitat assessed. Two fish species were caught i.e. bullhead and brown trout fry, which were encountered in very low numbers (Table 3 & Figure 4). Lamprey were absent in both optimal and suboptimal habitat.

The seven bullhead captured were all of similar size (47 – 60mm) and are thought to represent the same age class. The lack of juvenile bullhead suggests that recruitment is likely to be constrained to years when conditions are suitable.

Two juvenile brown trout were captured in optimal habitat and were fish representing the young of the year (0+) fish.

The physico-chemical results from Site 6.1 were within the expected ranges with high dissolved oxygen concentrations (9.73mg/L) (see Table 8 & Figure 19).

Table 3 Electrofishing catch at Site 6.1

Species	Number	Estimated Density (/m²)	Average length (mm)	Length range (mm)
Bullhead	7	0.14	51	45-60
Brown Trout	2	0.04	62	60-63

Figure 5 Brown trout fry captured at Site 6.1

3.1.4 Site 8.1

The river channel at Site 8.1 was highly incised, narrow and shallow throughout the reach, with overgrown riparian vegetation in parts (Fig.6). The gradient of the river bed was high creating fast riffles, shallow runs and cascades over a cobble, pebble dominated substrate. Gravel suitable for salmonid nursery was observed in the reach although some were inundated with fine sediment, smothering the habitat available for fish.

Figure 6 Incised channel at site 8.1

The fish survey at Site 8.1 covered a total area of 40m^2. Specialist quantitative lamprey surveys were also undertaken with both optimal and suboptimal habitat assessed. Only juvenile brown trout (fry) were encountered at Site 8.1 and in very low numbers (0.07/m^2). These fish were captured in the areas where clean gravel and well oxygenated water was observed which constitutes ideal brown trout nursery habitat.

The physico-chemical results from Site 8.1 were within the expected ranges with high dissolved oxygen levels (8.80mg/L) (Table 8 & Figure 19).

Table 4 Electrofishing catch at Site 8.1

Species	Number	Estimated Density (/m^2)	Average length (mm)	Length range (mm)
Brown Trout	3	0.07	70	63-75

3.1.5 Site 12.1

The channel at Site 12.1 was highly incised, narrow and shallow throughout the survey reach, with minimal flow recorded on the day of the survey (Fig.7). The substrate consisted of cobble and pebble with gravel inundated with fine sediment. The channel was poached by cattle in places resulting in fine sediment ingress, and sections of the survey reach were overgrown with vegetation.

Figure 7 Low flow exhibited at Site 12.1

The fish survey at Site 12.1 covered a total area of 20m^2. Specialist quantitative lamprey surveys were also undertaken with both optimal and suboptimal habitat assessed.

Three fish species were caught during the survey at Site 12.1 with bullhead, juvenile lamprey and brown trout fry all encountered. The population density of bullhead was highest (1.4/m^2) with a range of sizes (27 – 60mm), suggesting recruitment to a number of year classes and active breeding in the survey reach (Table 5 & Figure 8).

Juvenile lamprey were present in both optimal and suboptimal habitat, although in small numbers (0.30/m^2). The lamprey were identified as brook or river lamprey (as opposed to sea lamprey); brook and river lamprey are indistinguishable at the juvenile life stage.

Juvenile brown trout were captured in low numbers (0.10/m^2) and were only caught where the conditions were favourable with clean substrate and adequate flow. These fish represented the young of the year (0+) fish hatched earlier in the year.

Table 5 Electrofishing catch at Site 12.1 (*all specimens identified as either brook or river lamprey and combined catch from optimal and suboptimal).

Species	Number	Estimated Density (/m²)	Average length (mm)	Length range (mm)
Bullhead	29	1.45	32	27-57
Brown Trout	2	0.10	57	46-67
Lamprey*	6	0.30	93	64-108

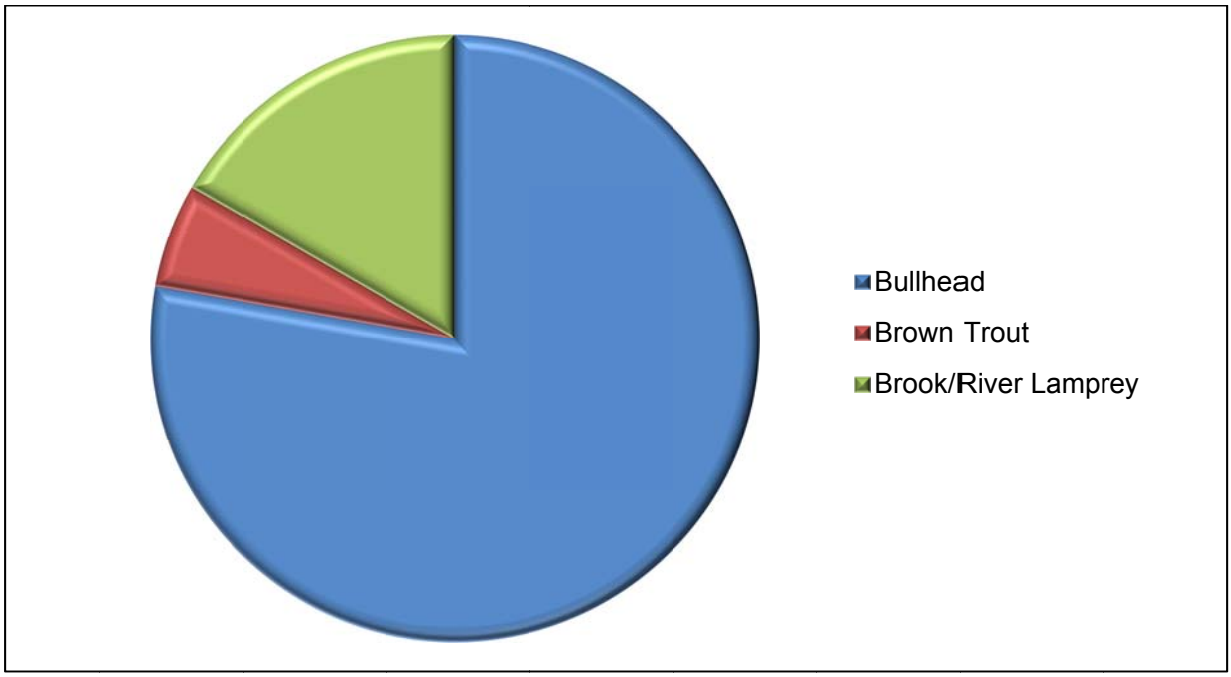


Figure 8 Species composition for fish captured at Site 12.1

3.1.6 Site 12.2

The watercourse at Site 12.2 was narrow, overgrown and hard to access. The flow was negligible on the day of the fish survey and ponded areas were reported. Substrate was dominated by pebble and gravel inundated with fine sediment (Fig.9). The channel was poached by cattle in places resulting in fine sediment ingress, and parts were overgrown with vegetation.

No fish of any species were caught during the surveys of all habitats at 12.2. It is thought that the ephemeral nature of the flow in the watercourse may be a primary factor limiting fish populations at the site.

Figure 9 Sediment prevalence at Site 12.2

The quantitative fish survey at Site 12.2 covered a total area of 40m^2. Specialist quantitative lamprey surveys were also undertaken with both optimal and suboptimal habitat assessed.

The physico-chemical results from Site 12.2 were within the expected ranges and with good dissolved oxygen levels (10.0mg/L) (Table 8 & Figure 19) would be capable of supporting a diverse fish population. However, no fish of any species were caught during the surveys of all habitats at 12.2. It is thought that the physical effects of the sediment loading and the intermittent flow nature are likely to be responsible for the lack of fish colonisation.

3.1.7 Site 12.3

The river channel at Site 12.3 was sinuous with steep sides and tunnel vegetation covering most of the survey reach. The flows in the reach were dominated by riffles and pool sequences with short glide and run also present. The pebble and gravel substrate was generally inundated with fine sediment although clean gravels favoured by juvenile salmonids were present in part (Fig.10).

Figure 10 Predominantly pebble substrate at Site 12.3

The fish survey at Site 12.3 covered a total area of 65m^2, with specialist quantitative lamprey surveys also undertaken with both optimal and suboptimal habitat assessed. This habitat was generally located in marginal areas.

Bullhead, lamprey and brown trout were encountered at Site 12.3. The population density of brown trout was relatively high (0.34/m^2) with a range of sizes (25 – 147mm), suggesting recruitment to a number of year classes and active breeding in the survey reach (Fig 11).

Juvenile lamprey were also present in both optimal and suboptimal habitat, although in very small numbers (0.08/m^2). Only four bullhead were captured with a population density of (0.08/m^2) and all specimens were of a similar size (Table 6).

The physico-chemical conditions at Site 12.3 were within the expected ranges and with high dissolved oxygen concentrations (9.84mg/L) (Table 8 & Figure 19) and continuous riffle sequences, the reach was ideal for juvenile salmonids, although the population density may be reduced.

Table 6 Electricfishing catch at Site 12.3 (*brook or river lamprey)

Species	Number	Estimated Density (/m^2)	Average length (mm)	Length range (mm)
Bullhead	4	0.08	61	55-69
Brown Trout	17	0.34	61	23-124
Lamprey	4	0.08	98	86-105

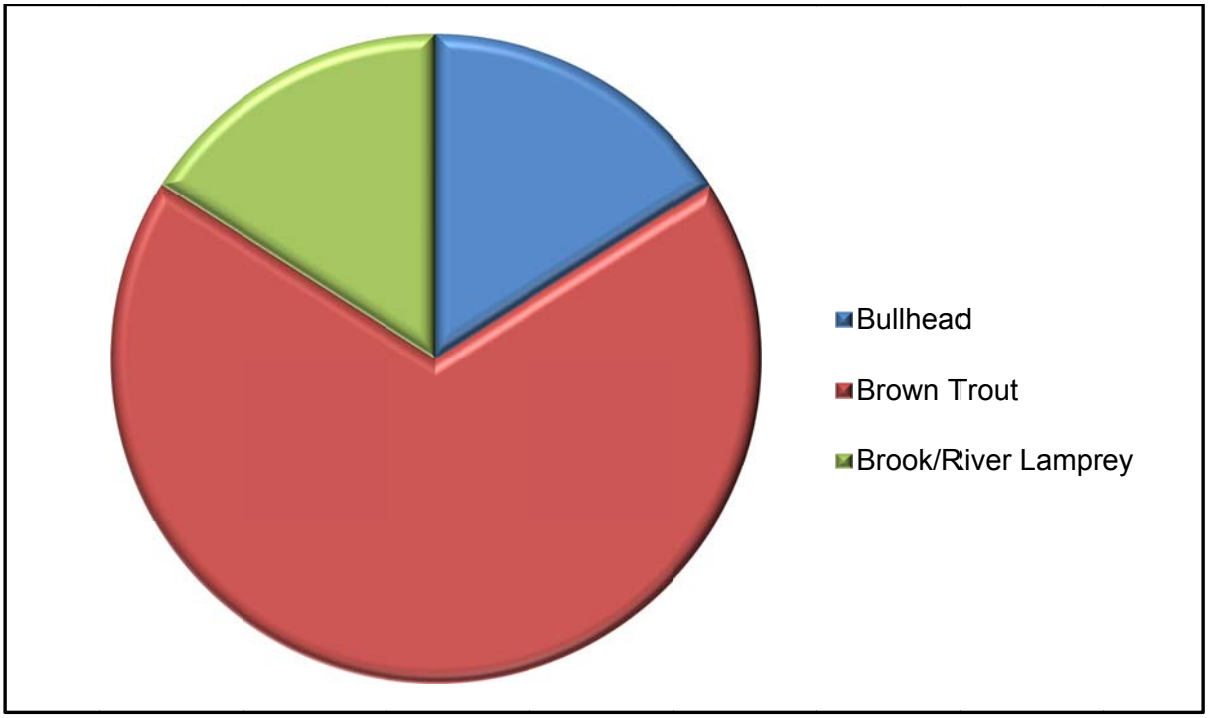


Figure 11 Species composition for fish captured at Site 12.3

Figure 12 Juvenile brown trout (parr) captured at Site 12.3

3.1.8 Site 13.1

The narrow, incised channel at Site 13.1 was heavily overgrown with bankside vegetation and ponded into a series of micro pools which were not continuously connected. The substrate in the reach consisted of cobbles and pebbles with gravel partly inundated with fine sediment (Fig.13). Evidence of higher flows at the site suggest that the watercourse is inundated with water during wet weather events, with water running off quickly due to the gradient of the channel.

Figure 13 Shallow water at Site 13.1

The fish survey at Site 13.1 covered a total area of 40m^2, with specialist quantitative lamprey surveys also undertaken with both optimal and suboptimal.

The physico-chemical results from Site 13.1 were within the expected ranges although dissolved oxygen concentrations (8.06mg/L) were moderate relative to other sites (Table 8 & Figure 19); although still capable of supporting a diverse fish population. However, no fish of any species were caught during the surveys of all habitats and the habitat discontinuity, sediment load of the substrate and fluctuating flows at the site are thought to be the primary contributory factors limiting fish populations.

3.1.9 Site 13.4

The river channel at Site 13.4 was highly incised with very steep banks and a narrow river corridor. The water was shallow throughout the reach with negligible flow recorded. The watercourse was extensively overgrown with a mixture of grasses and shrubs shrouding the water's surface. The substrate at Site 13.4 consisted mostly of gravel with the occasional pebble and cobble and small patches of fine sediment were observed in marginal areas.

The fish survey at Site 13.4 covered a total area of 20m^2, with specialist quantitative lamprey surveys also undertaken in the small areas of suboptimal habitat available for assessment (Fig.14).

Figure 14 Sediment ingress in marginal areas at Site 13.4

The physico-chemical results from Site 13.4 were within the expected ranges and with moderate dissolved oxygen concentrations (8.95mg/L) (Table 8 & Figure 19), would be capable of supporting a diverse fish population. However, no fish of any species were caught during the surveys of all habitats. It is thought that intermittent flow and the physical effects of the sediment loading of the stream in the reach are such that fish are unable to colonise successfully.

3.1.10 Site 15.1

The watercourse at Site 15.1 was extremely narrow, linear and flowed within a steep sided, elevated corridor with steep gradient throughout. The stream was extensively overgrown in places making access for the survey difficult (Fig.15).Minimal flow was reported on the day of the fish survey although evidence of higher recent flows were observed. The substrate at Site 15.1 consisted mostly of pebble, gravel and fine sediment, with woody debris and other organic material congregating within the channel.

Figure 15 Incised channel at Site 15.1

The fish survey at Site 15.1 covered a total area of 8m^2 (primarily due to lack of access and overgrown river channel). Quantitative lamprey surveys were also undertaken with only suboptimal habitat available for assessment.

The physico-chemical results from Site 15.1 were within the expected ranges and with high dissolved oxygen concentrations (9.90mg/L) (Table 8 & Figure 19), would be capable of supporting a diverse fish population. However, no fish of any species were caught during the surveys of all habitats. It is thought that the stream is ephemeral and ceases to flow during dry climatic conditions and is thus not capable of supporting a fish population.

3.1.11 Site 16.2

The reach surveyed at Site 16.2 was steep sided and extensively overgrown by fallen branches, ferns and shrubs. The channel was narrow, shallow with water ponded in places, although continuous flow throughout the reach with short riffles was observed. The substrate at Site 16.2 consisted mostly of pebbles and cobbles, with gravel partly inundated with fine sediment (Fig. 16).

Figure 16 Substrate at Site 16.2

The fish survey at Site 16.2 covered a total area of 18m^2, with quantitative lamprey surveys undertaken in suboptimal habitat where it was available for assessment.

Table 7 Electrofishing catch at Site 16.2

Species	Number	Estimated Density (/m^2)	Average length (mm)	Length range (mm)
Brown Trout	6	0.34	57	54-61

Only juvenile brown trout (fry) were encountered at Site 16.2 but in relatively high numbers (0.34m^2). These fish were captured in the areas where clean gravel was observed i.e. ideal brown trout nursery habitat.

3.1.12 Site 17.1

The reach was sinuous following a meandering course through woodland and improved grassland. The stream channel was narrow, shallow and overgrown in places, with substrate consisting mostly of pebbles with some gravel and fine sediment. The channel was poached by cattle in places resulting in fine sediment ingress (Fig. 17).

Figure 17 Poached channel at Site 17.1

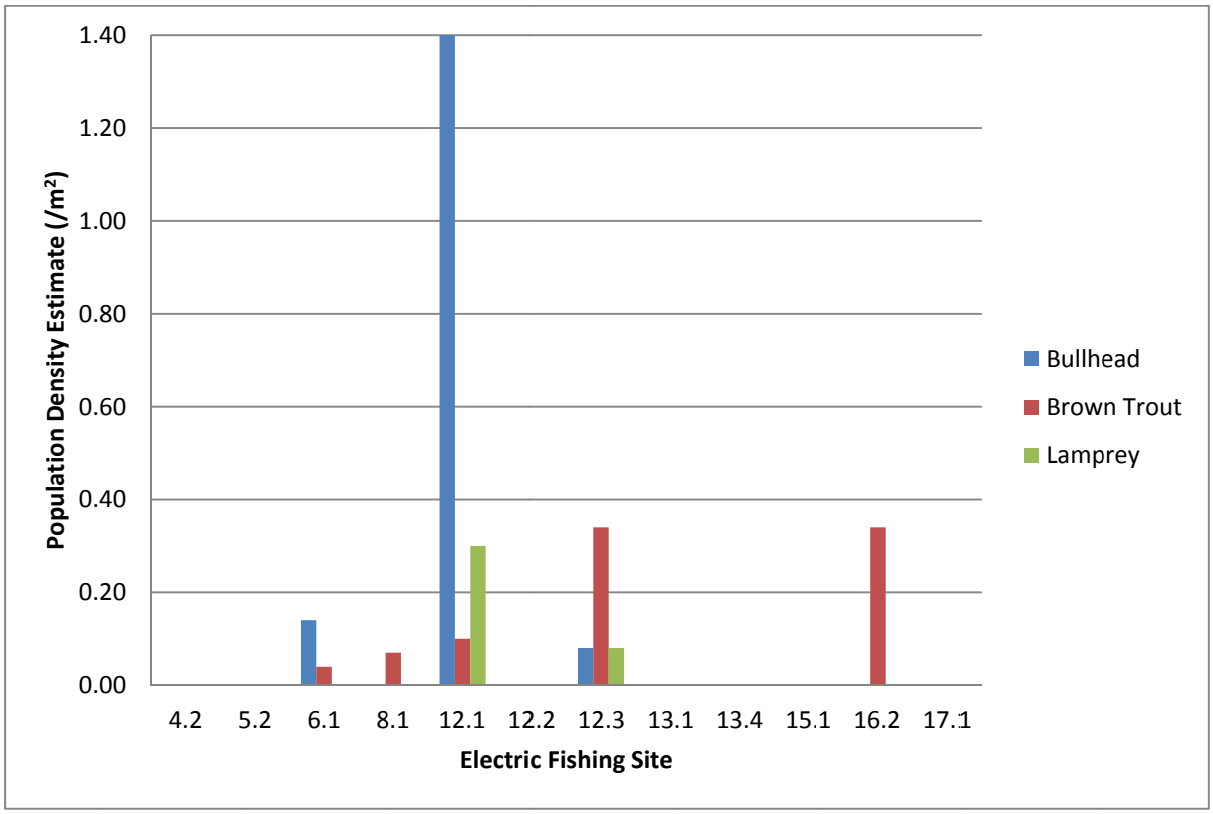
The fish survey at Site 17.1 covered a total area of 28m^2. Quantitative lamprey surveys were also undertaken within suboptimal habitat available for assessment.

The physico-chemical results from Site 17.1 were within the expected ranges and with good dissolved oxygen concentrations (9.96 mg/L) (Table 8 & Figure 19) would be capable of supporting a diverse fish population. However it is thought that water levels are not continuously sufficient to support a successful population and that the physical impacts of cattle encroachment are negatively affecting the aquatic ecology of the site – there were zero fish captured.

3.2 Summary catch data & conservation status

All fish species were absent from 7 of the 12 sites. At sites where fish were present they are in very low numbers with the exceptions of Site 12.1 where bullhead were present in high numbers of 28 specimens, Site 12.3 and Site 16.2 where brown trout were also present in relatively good numbers (Figure 18).

Figure 18 Population densities of bullhead, brown trout and lamprey within 12 surveyed sites



3.3 Summary physico–chemical data

The aquatic physico-chemical conditions at each of the fish survey sites was generally good with moderate to high dissolved oxygen concentrations (Figure 19), neutral pH and low conductivity (Table 8). These conditions are typical of the headwaters of small streams in the southwest of England and provide adequate conditions for most UK fish species.

Table 8 Table of physico-chemical data across all 12 surveyed sites

Site	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	pH	Conductivity (µs)	Temperature (°C)
4.2	8.70	87.80	7.59	263.20	13.00
5.2	6.74	66.50	7.50	226.50	15.00
6.1	9.73	91.80	7.44	231.30	13.10
8.1	8.80	88.30	7.36	210.10	15.50
12.1	9.57	94.00	7.80	326.20	13.80
12.2	10.00	93.60	7.63	359.60	12.50
12.3	9.84	94.10	7.74	327.00	13.30
13.1	8.06	80.40	7.46	300.10	15.00
13.4	8.95	86.50	7.69	269.90	14.50
15.1	9.90	95.60	7.89	280.80	14.50
16.2	7.69	75.60	7.81	276.70	14.20
17.1	9.96	97.40	7.97	294.80	14.50

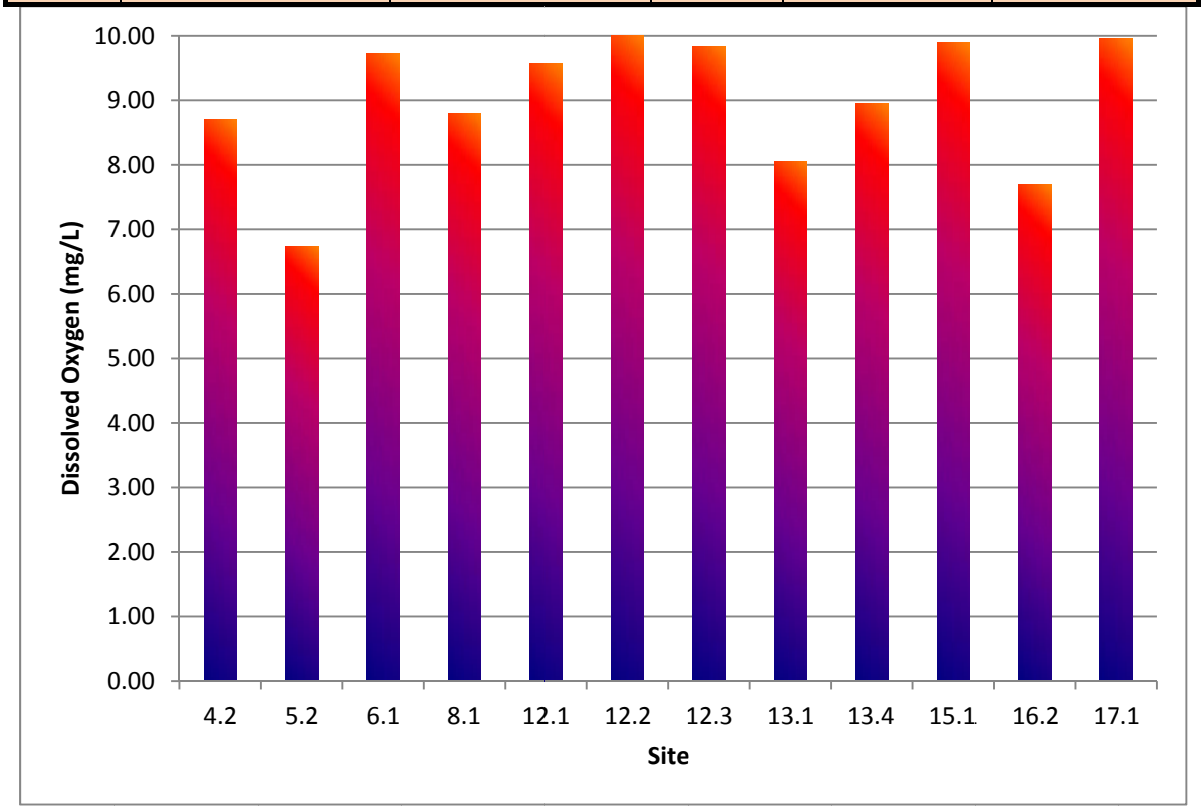


Figure 19 Dissolved oxygen (mg/L) concentrations across all 12 surveyed sites

4 Discussion

The watercourses surveyed during this study are typical of small headwater streams which are often ephemeral and are sensitive to hydromorphological (and water quality) pressures. All of the sites surveyed had evidence of fluctuating flows with some sites thought to cease flowing during dry periods. It is thought that this inconsistent and unpredictable flow is the main contributory factor limiting the fish populations in the survey footprint.

Bullhead and lamprey are both Annex II species under the the Habitats Directive[1] however are not afforded European Protected Species (EPS) status under UK law. Of greater relevance from a UK planning context are the Section 41 priority species under the NERC act[2], which constitute those species of principal importance for the conservation of biodiversity in England, of which brown trout are one and river lamprey are another (although it is not possible to distinguish the specific juvenile lamprey type present). All three fish species found (across all sites) are commonly encountered in small upstream streams.

Overall, the population densities of these 3 species was poor (or unfavourable) with the exception of sites 12.1 & 12.3 which had fish populations which appeared to be self-sustainable and moderately diverse. It was notable that the aquatic conditions, notably the cleanliness of the substrate at these sites were favourable for fish with minimal upstream pressures arising from cattle encroachment or channel realignment.

In most cases the clean, well oxygenated gravel deposits required for viable salmonid and lamprey spawning was rare within the survey reaches. The interstitial substrate spaces required for egg deposition and incubation was generally inundated by fine sediment at most sites to a level above the 15% threshold suitable for viable salmonid nurseries (EA 1999). This was validated by the habitat walkover which identified sediment ingress from agricultural sources, notably cattle poaching.

Although generally absent at most sites juvenile lamprey were encountered at two locations where conditions were favourable (12.1 & 12.3). Although generally sedentary in their juvenile life stage, these fish may be transient according to flow and dissolved oxygen level pressures and are thus capable of assimilating to the unstable conditions reported.

Bullhead were reported at three sites and generally in very low numbers with the exception of Site 12.1 where the bullhead population was relatively high. It is thought that the larval fly populations upon which bullhead feed would largely be unable to establish themselves in the unstable, intermittent flow conditions reported at most sites, thus limiting the carrying capacity of the watercourses.

At the sites where fish were encountered it is thought that they are very fragile communities and would be extremely sensitive to changes in water quality conditions. It is therefore recommended that any engineering activity related to the proposed Scheme which may result in a change of aquatic conditions downstream should be designed to include mitigation measures. These controls should look to reduce or avoid sediment ingress into watercourses and could include the use of stilling ponds, sediment absorbent matting, bank

[1] European Union Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC)

[2] Natural Environment and Rural Communities (NERC) Act 2006

reinstatement / stabilisation and avoiding instream activity during wet weather events. Regardless of whether a fish community is present at a given location it is recommended that these measures are initiated due to the possibility of future colonisation into watercourses in the future.

It is recommended that if instream work is unavoidable on any of the watercourses where fish were recorded then a fish relocation should be undertaken which would look to move fish from impacted reaches to suitable habitat elsewhere. This should only be done under license from the Environment Agency. Given that the potentially 'indirectly impacted' site 10.1 was inaccessible on permission grounds at the time of survey, then control measures (as above) should assume that the same fish species found elsewhere are present at this location i.e. bullhead, lamprey and brown trout.

5 References

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UK Biodiversity Action Plan (2007) Report on the Species and Habitat Review Report by the Biodiversity Reporting and Information Group (BRIG) to the UK Standing Committee.

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