European Site Conservation Objectives: Supplementary advice on conserving and restoring site features

River Axe Special Area of Conservation (SAC)
Site Code UK0030248

www.Devon.gov.uk

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About this document

This document provides Natural England's supplementary advice about the European Site Conservation Objectives relating to River Axe SAC. This advice should therefore be read together with the SAC Conservation Objectives available here.

This advice replaces a draft version dated January 2019 following the receipt of comments from the site's stakeholders.

You should use the Conservation Objectives, this Supplementary Advice and any case-specific advice given by Natural England when developing, proposing or assessing an activity, plan or project that may affect this site.

This Supplementary Advice to the Conservation Objectives presents attributes which are ecological characteristics of the designated species and habitats within a site. The listed attributes are considered to be those that best describe the site's ecological integrity and which, if safeguarded, will enable achievement of the Conservation Objectives. Each attribute has a target which is either quantified or qualitative depending on the available evidence. The target identifies as far as possible the desired state to be achieved for the attribute

The tables provided below bring together the findings of the best available scientific evidence relating to the site's qualifying features, which may be updated or supplemented in further publications from Natural England and other sources. The local evidence used in preparing this supplementary advice has been cited. The references to the national evidence used are available on request. Where evidence and references have not been indicated, Natural England has applied ecological knowledge and expert judgement. You may decide to use other additional sources of information.

In many cases, the attribute targets shown in the tables indicate whether the current objective is to 'maintain' or 'restore' the attribute. This is based on the best available information, including that gathered during monitoring of the feature's current condition. As new information on feature condition becomes available, this will be added so that the advice remains up to date.

The targets given for each attribute do not represent thresholds to assess the significance of any given impact in Habitats Regulations Assessments. You will need to assess this on a case-by-case basis using the most current information available.

Some, but not all, of these attributes can also be used for regular monitoring of the actual condition of the designated features. The attributes selected for monitoring the features, and the standards used to assess their condition, are listed in separate monitoring documents, which will be available from Natural England.

These tables do not give advice about SSSI features or other legally protected species which may also be present within the European Site.

If you have any comments or queries about this Supplementary Advice document please contact your local Natural England adviser or email HDIRConservationObjectivesNE@naturalengland.org.uk

About this site

European Site information

Name of European Site	River Axe Special Area of Conservation (SAC)
Location	Devon, Dorset
Site Map	The designated boundary of this site can be viewed here on the MAGIC website
Designation Date	1st April 2005
Qualifying Features	See section below
Designation Area	25.78 ha
Designation Changes	N/A
Feature Condition Status	Details of the feature condition assessments made at this site can be found using Natural England's Designated Sites System
Names of component Sites of Special Scientific Interest (SSSIs)	River Axe SSSI
Relationship with other European or International Site designations	N/A

Site background and geography

The River Axe comprises of a mixed catchment geology of sandstones and limestones where calcareous waters gives rise to a diverse mix of aquatic and marginal flora. Stream water-crowfoot *Ranunculus penicillatus* ssp. *pseudofluitans* dominates, giving way to river water-crowfoot *R. fluitans* further downstream and short-leaved water-starwort *Callitriche truncata* is an unusual addition to the water-crowfoot community.

The active geomorphology of the river has generated a range of natural features (including long riffles, deep pools, islands and meanders), which provide a variety of ecological niches. This variety of river channel habitat also supports an important fish community, including Atlantic salmon *Salmo salar*, sea lamprey *Petromyzon marinus*, brook lamprey *Lampetra planeri* and bullhead *Cottus gobio*.

The River Axe falls within the Blackdowns National Character Area (NCA). Long, dark ridges, deep valleys and dynamic cliffs are the essence of the Blackdowns NCA and the ridges create prominent backdrops from afar and offer far-reaching views. Flat plateaux, large, regular fields and long, straight roads create a sense of openness and uniformity on the ridges. A myriad of springs and streams flow south through the valleys and can often be traced by semi-natural habitats: springline mires, rush pasture and carr woodland. Some valley floors widen and provide an opportunity for arable production, notably the Axe Valley which is characterised by a much wider flood plain. Further information on the National Character Area can be found here:

About the qualifying features of the SAC

The following section gives you additional, site-specific information about this SAC's qualifying features. These are the natural habitats and/or species for which this SAC has been designated.

Qualifying habitats:

- **H3260 Water courses of plain to montane levels with *R. fluitantis***

This habitat type is generally characterised by the abundance of water-crowfoots *Ranunculus* spp. Floating mats of these white-flowered species are characteristic of river channels in early to mid-summer. They may modify water flow, promote fine sediment deposition, and provide shelter and food for fish and invertebrate animals.

Watercourses of this habitat type have a high degree of naturalness and are governed by dynamic processes which result in a mosaic of characteristic physical biotypes, including a range of substrate types, variations in flow, channel width and depth, in-channel and side-channel sedimentation features, bank profiles, erosion features and both in-channel and bankside vegetation cover.

There are several variants of this habitat in the UK, depending on geology and river type, and at each site, the *Ranunculus* species will be associated with a different assemblage of other aquatic plants.

Qualifying Species:

- **S1095 Sea lamprey, *Petromyzon marinus***

The sea lamprey *Petromyzon marinus* is a primitive, jawless fish resembling an eel. It occurs in estuaries and easily accessible rivers, and is an anadromous species (i.e. spawning in freshwater but completing its life cycle in the sea). The sea lamprey is the largest of the three species, reaching a size of approximately one metre in length.

After spending 18-24 months feeding at sea, adult sea lampreys migrate into rivers during the spring and early summer. Like other species of lamprey, sea lampreys need clean gravel for spawning, and marginal silt or sand for the burrowing larvae following egg-hatching. They spawn between the months of May-July in areas of pebble and cobble substrate

- **S1096 Brook lamprey, *Lampetra planeri***

The brook lamprey is a primitive, jawless fish resembling an eel, and is the smallest of the lampreys found in the UK. It is a non-migratory freshwater species, occurring in streams and occasionally in lakes in north-west Europe. Like other lamprey species, the brook lamprey requires clean gravel beds for spawning and soft marginal silt or sand for the ammocoete larvae. It spawns mostly in parts of the river where the current is not too strong. The spawning season of this species in British rivers starts when the water temperatures reach 10–11ºc, generally in April-June. There is a clear relationship between water temperature and the number of fish at spawning sites, numbers declining as the temperature drops

The brook lamprey has declined in parts of the UK, although it is still widespread. This species is the most abundant and widespread of the British lampreys and is often found in the absence of the other two species, for example above a barrier that precludes the presence of the migratory species.

- **S1163 Bullhead, *Cottus gobio***

The bullhead is a small bottom-living fish that inhabits a variety of rivers, streams and stony lakes. It appears to favour fast-flowing, clear shallow water with a hard substrate (gravel/cobble/pebble) and is

frequently found in the headwaters of upland streams. However, it also occurs in lowland situations on softer substrates so long as the water is well-oxygenated and there is sufficient cover. It is not found in badly polluted rivers.

Bullheads spawn from February to June and up to four times. The male excavates a nest under a suitable large stone to attract a female. Part of this may be achieved by emission of acoustic 'knocking' sounds by the males. The female lays a batch of up to 400 eggs (2–2.5 mm in diameter), which adhere to the underside of the stone. In situations without suitable stones, bullheads may use other media, such as woody material or tree roots. The male then defends the brood against egg predators such as caddis larvae and manages the nest by fanning the eggs with his pectoral fins. The eggs hatch after 20 to 30 days, depending on water temperature. The newly hatched larvae (6–7mm in length) are supplied by a large yolk sac, which is absorbed after 10 days, after this time they leave the nest. Generally, bullheads attain a length of 40–50 mm after their first year, 60 mm after their second and 70–90 mm after their third. They do not generally live for more than three or four years, although fish of over 10 years old have been recorded.

Table 1: Supplementary Advice for Qualifying Features: H3260. Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; Rivers with floating vegetation often dominated by water-crowfoot

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Maintain the total extent (25.78ha) of the H3260 feature to that characteristic of the natural fluvial processes associated with the river type	There should be no measurable reduction (excluding any trivial loss) in the extent and area of this feature, and in some cases, the full extent of the feature may need to be restored. The baseline-value of extent given has been generated using data gathered from the listed site-based surveys. Area measurements given may be approximate depending on the methods, age and accuracy of data collection, and as a result this value may be updated in future to reflect more accurate information. The extent of an Annex I habitat feature covers the sum extent of all of the component vegetation communities present and may include transitions and mosaics with other closely-associated habitat features. Where a feature is susceptible to natural dynamic processes, there may be acceptable variations in its extent through natural fluctuations. Where a reduction in the extent of a feature is considered necessary to meet the Conservation Objective for another Annex I feature, Natural England will advise on this on a case-by-case basis.	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request
Structure and function (including its typical species)	**Biotope (habitat) mosaic**	Restore the extent and pattern of in-channel and riparian biotopes (habitats) to that characteristic of natural fluvial processes.	Watercourses with a high degree of naturalness are governed by dynamic processes which result in a mosaic of characteristic physical habitats or biotopes, including a range of substrate types, variations in flow, channel width and depth, in-channel and side-channel sedimentation features (including transiently exposed sediments), bank profiles (including shallow and steep slopes), erosion features (such as cliffs) and both in-channel and bankside (woody and herbaceous) vegetation cover. All of these biotopes, and their characteristic patterns within the river corridor, are important to the full expression of the biological community. A range of physical habitat modifications cause simplification of biotope mosaics, resulting in declines of characteristic biota	*R.64 of The Conservation of Habitat and Species Regulations 2017

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			dependent upon biotopes that have been lost or reduced in extent. Rivers that have sections that are already significantly physically modified should be subject to a process for planning and implementing physical restoration measures. This should be based on restoring natural geomorphological processes (including restoration of hydrological continuity between river and floodplain) as far as possible to allow restoration of characteristic and sustainable biotope mosaics, working within the practical constraints of essential* flood protection for people and the built environment (*e.g. where human health or public safety are at risk or 'imperative reasons of overriding public interest' can be demonstrated.) Excessive levels of livestock grazing denudes the riparian zone, causes artificially high bank instability, and degradation of the fauna and flora of exposed riverine sediments. Low levels* of grazing by suitable livestock are important in generating the full expression of riparian biotopes. (*e.g. 1LU/ha or less with cattle or sheep)	
Structure and function (including its typical species)	**Riparian zone**	Restore a patchy mosaic of natural woody and herbaceous (tall and short swards) riparian vegetation. The riparian zone should be sufficiently wide to act as a healthy and functional habitat zone within the river corridor.	A mosaic of natural and semi-natural riparian vegetation types provides conditions for all characteristic in-channel and riparian biota to thrive, creating patches of tall and short riparian swards, a mixture of light and shade on the river channel, and tree root systems and a supply of large woody debris that add channel complexity. Patchy tree cover provides shade protection against rising water temperatures caused by climate change. Between 30 and 50% riparian tree cover is generally considered optimal for in-channel and riparian habitats. Intensive cutting across significant proportions of the riparian zone is not appropriate. Also see above comments on livestock grazing. Tree and vegetation planting and removal has been undertaken as part of local Environmental Scheme funded works, with the aims to avoid continued heavy shading of the river and keep within the aforementioned target of 30-50% riparian tree cover.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	**Woody debris**	Restore the presence of coarse woody debris within the structure of the channel. In smaller watercourses, temporary debris dams should be a feature of channel dynamics.	Dead woody material that falls into streams ('woody debris') plays an important role in increasing habitat diversity, providing shelter for fish, supplying a food source for aquatic invertebrates, and for slowing the passage of nutrients downstream. Woody debris is therefore a key feature of healthy rivers. Woody debris should be left in situ, unless there are overriding reasons of public safety (for example to prevent flooding or bridge collapse).	
Structure and function (including its typical species)	**Water course flow**	Restore the natural flow regime of the river, with daily flows as close to what would be expected in the absence of abstractions and discharges (the naturalised flow). Flow standards deviation from naturalised flow for the SAC are; Low flows – 5% Low-moderate flows – 10% Moderate-high flows – 10% High flows – 10%	The natural flow regime both shapes and sustains characteristic biotope mosaics, affecting factors such as current velocities and bed hydraulics, water levels and depths, wetted area, temperature regime and dissolved oxygen regime, All parts of the natural flow regime are important, including flushing flows, seasonal baseflows and natural low flows. Natural seasonal flow recession is critical in supporting the full expression of ephemeral habitats (marginal and riparian vegetation, exposed riverine sediments, ephemeral headwaters). Any significant impacts on the natural flow regime should be rectified sustainably by reducing flow modifications, not by artificial augmentation, or by altering channel form to fit reduced levels of flow. There should be no increase in the existing level of impact on the natural flow regime, and any significant impacts should be controlled to acceptable levels. Flow targets for WFD high ecological status should be used to avoid deterioration and for restoration where this is technically feasible. These are: <5% deviation at <Qn95 and <10% at >Qn95 - based on 'natural' water (i.e. water that has not been abstracted and returned). As a minimum, the flow regime should be restored to the values given in the site's Favourable Condition Table. Where multiple natural channels exist, flow targets should apply across all of these channels - any artificial channels should not create non-compliances in natural channels.	Flow targets taken from Moving towards common standards monitoring guidance targets for SAC rivers: 186 River Axe document

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	**Sediment regime**	Restore the natural supply of coarse and fine sediment to the river	Coarse sediment supply is essential for the stability of the river channel and for creating and sustaining key biotopes including riffles and exposed shingle banks. Coarse sediment supply can be interrupted by weirs and other impounding structures, and by dredging or extraction, and can result in channel incision and heavy bankside erosion that have consequences for both biodiversity and river management (e.g. flood risk). Excessive fine sediment supply can lead to the smothering of coarse substrates and the loss of flora and fauna dependent on them (note that impoundment of the river can have the same effects). A significant proportion of the sediment input into the Axe SAC is derived from pasture topsoils, possibly as a result of more intensive grazing and soil compaction. Increased compaction on grassland can lead to a reduction in water infiltration and an increase in run-off which will increase soil wash from grassland, but will also have an impact on increasing the mobilisation of sediment from damaged road verges. Contributions from untimely arable cultivations, maize growing, and slurry spreading when soils are wet also add to the overall fine sediment load to the river.	Natural England (2014) River Axe SSSI/SAC Diffuse Water Pollution Plan, Natural England (2014) M. Thomas (2017) Sediment Impacts in the Axe Catchment Natural England (2014) River Axe Site Improvement Plan Mainstone, C.P. (2007) Guidance to Natural England staff on setting and applying sediment targets to protect designated wildlife sites against fine sediment-related problems. Internal information note.
Structure and function (including its typical species)	**Thermal regime**	Restore a natural thermal regime to the river subject to a changing climate, ensuring that water temperatures should not be significantly artificially elevated	Climate change is driving increases in river temperatures which will create stress for a range of characteristic riverine species, particularly those on the southern limit of their range. This must not be exacerbated by catchment activities that are likely to raise water temperatures further. These may include impoundment, abstraction, discharges, excessive tree removal or maintenance or other activities. Restoration of riparian tree cover to suitable levels will be needed in many cases, particularly in headwater streams, systems affected by alder phytophthora and river reaches lacking any riparian trees.	
Structure and function	**Biological connectivity**	The movement of characteristic biota should not be artificially	Many species, including fish and invertebrates, require natural freedom of movement to complete their life cycle in rivers and	Natural England (2014) River Axe Site Improvement Plan,

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
(including its typical species)		constrained.	maximise their population size and genetic diversity. Longitudinal connectivity within the river channel and lateral connectivity between the channel and the floodplain are both critical to a healthy river ecosystem. Constraints to longitudinal movement such as waterfalls and debris dams are a natural feature of rivers and add to the complexity and diversity of the habitat. Natural waterfalls in headwater areas can create unique (often fishless) communities of conservation importance. New artificial constraints to movement should be avoided and existing artificial constraints should be addressed through strategic river restoration as outlined above. Barriers should be removed wherever possible to restore all aspects of habitat integrity - fish passes constitute a partial mitigation measure for longitudinal biological movement and should only be considered where it is not possible to remove the barrier. Where established, they should allow for the passage of as many characteristic species as possible, including Annexe II fish species such as allis and twaite shad and lamprey species. A major cause of unfavourable/declining condition on the River Axe is the presence of obstructive buildings and structures along the watercourse. Artificial channel modifications can cause reduced flow and increased siltation, altering the physical structure of the river and its ability to support special features. In addition, artificial barriers can significantly impair characteristic migratory species from carrying out essential life-cycle movements e.g. weirs at Axminster and Weycroft where fish passes are required. River Restoration Projects aim to remove inappropriate structures where possible.	
Structure and function (including its typical species)	**Invasive, non-native and/or introduced species**	Ensure non-native species categorised as 'high-impact' in the UK under the Water Framework Directive are either rare or absent but if present are causing minimal damage to the feature	Non-native species constitute a major threat to many river systems. Impacts may be on the river habitat itself (e.g. damage to banks and consequent siltation) or directly on characteristic biota (through predation, competition and disease), or a combination of these. For example, species such as signal crayfish have been responsible for much of the decline of native crayfish through competition, habitat damage	Natural England (2014) River Axe Site Improvement Plan, Natural England (2014)River Axe SSSI/SAC Diffuse Water Pollution Plan,

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			and the introduction of crayfish plague. The UK Technical Advisory Group of the Water Framework Directive produces a regularly updated classification of aquatic alien species (plants and animals) according to their level of impact. In general high impact species are of greatest concern but low or unknown impact species may be included in the target on a site-specific basis where there is evidence that they are causing a negative impact (for example high cover values or abundances). Those taxa considered likely to colonise lakes, are indicated by an 'L' in the UKTAG guidance. Examples of such high-impact species may include Water Fern, New Zealand pygmyweed and the zebra mussel. Some of the main invasive plant species within the Axe catchment include Himalayan balsam, Japanese knotweed and Giant hogweed. The most notable of these is Himalayan balsam which is almost ubiquitous throughout the catchment. The balsam out-competes native flora and covers river banks during the summer months. At the start of the winter it dies back leaving the banks exposed, which leads to increased rates of erosion. This accelerates the deposition of sediment into the river channel.	C. Woodruff (2017), River Axe Invasive Species Project
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Restore the abundance of the species listed to enable each of them to be a viable component of the Annex I habitat feature: River water-crowfoot *Ranunculus fluitans*, Stream water-crowfoot R. *penicillatus* ssp. *pseudofluitans*, perfoliate pondweed *Potamogeton perfoliatus*, fennel pondweed *P. pectinatus,* Horned pondweed *Zannichellia palustris*, Spike water-milfoil *Myriophyllum spicatum*, Flowering rush *Butomus umbellatus*, Great	Some plant or animal species (or related groups of such species) make a particularly important contribution to the necessary structure, function and/or quality of an Annex I habitat feature at a particular site. These species will include; • Structural species which form a key part of the Annex I habitat's structure or help to define that habitat on a particular SAC (see also the attribute for 'vegetation community composition'). • Influential species which are likely to have a key role affecting the structure and function of the habitat (such as bioturbators (mixers of soil/sediment), grazers, surface borers, predators or other species with a significant functional role linked to the habitat)	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		yellow-cress *Rorippa amphibia*, Marsh woundwort *Stachys palustris*, Various-leaved water-starwort *Callitriche platycarpa* and Short-leaved water-starwort *Callitriche truncata*	• Site-distinctive species which are considered to be a particularly special and distinguishing component of an Annex I habitat on a particular SAC. There may be natural fluctuations in the frequency and cover of each of these species. The relative contribution made by them to the overall ecological integrity of a site may vary, and Natural England will provide bespoke advice on this as necessary. The list of species given here for this Annex I habitat feature at this SAC is not necessarily exhaustive. The list may evolve, and species may be added or deleted, as new information about this site becomes available.	
Structure and function (including its typical species)	**Fisheries**	Restore fish densities at or to a level at or below the natural environmental carrying capacity of the river, and below historical levels (this means no stocking to previously unstocked rivers or river sections). Trout stocking should not elevate densities of adult trout (stocked plus natural) to more than 1-3 fish $100m^{-2}$, this being the estimated range of natural trout densities in SAC rivers.	Fish stocking can cause elevated levels of competition and predation that may damage the characteristic biological community. Ideally, fishery management should be based on natural recruitment, with an emphasis on restoring characteristic river habitat in ways that promote natural recruitment. Exploitation should be controlled to suitable levels, and net limitations and catch-and-release techniques used where necessary to avoid population impacts. Fish introductions, exploitation and other removals should not interfere with the ability of the river to support self-sustaining populations of characteristic species. Stocking should be undertaken so as to avoid risks of disease transfer, including crayfish plague where white-clawed crayfish populations are at risk Exploitation and removals should not cause significant suppression of characteristic fish species (e.g. Atlantic salmon, eel, pike) or affect the balance of the fish or wider biological community. The stocking of carp to still waters immediately adjacent to SAC rivers is undesirable if there is continuity between river and still water during periods of flood and no effective biosecurity measures are in place. Stocking for population conservation purposes should only be considered as an interim measure whilst underlying environmental problems are addressed, and should not be undertaken if natural recovery can be achieved in reasonable timescales.	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Fish should be sourced to avoid impacts on the genetic integrity of local populations (including sub-catchment genetics where appropriate, e.g. for salmon).	
Structure and function (including its typical species)	**Vegetation structure: riparian zone**	Restore grazing activity in the riparian zone and in the river channel at or to suitably low levels.	A mosaic of lightly grazed, infrequently mown and marginal tree/scrub cover is consistent with Favourable condition of the habitat. Ideally, any grazing should be managed at low levels* across whole riparian fields. Where this is not feasible, set-back fencing (10 -12m) may be established with access provision for limited grazing within the riparian zone. Particularly sensitive areas (e.g. exposed riverine sediments likely to support good invertebrate communities) may need to be fenced off to avoid any livestock activity, even if only present in low numbers**. Close (i.e. within 1 metre) bankside fencing that excludes the development of a functional river corridor is not appropriate. (*1LU/ha with cattle or sheep)	(** SW11 Riparian Management Strip option of 4-12m)
Structure and function (including its typical species)	**Vegetation structure: cover of submerged macrophytes**	Restore a sufficient proportion of all aquatic macrophytes to allow them to reproduce in suitable habitat and unaffected by river management practices.	Removal of submerged aquatic vegetation (often called 'weed-cutting') might be undertaken for flood risk management or fishery purposes. Except in situations of extreme flood risk, best practice is for cutting to leave a mosaic of submerged and marginal vegetation, and should promote a characteristic diversity of plant species. It is recommended that where appropriate a weed management plan is developed for the site, allowing for higher levels of cutting at flood risk pinch-points, balanced by lower levels of cutting in other stretches.	
Structure and function (including its typical species)	**Screening of intakes and discharges**	All intakes and discharges likely to trap a significant number of individuals of characteristic species are being adequately screened.	Intakes and discharges can be responsible for significant mortalities of fish. Long-distance migratory species such as Atlantic salmon sea trout and European eel can be particularly susceptible. Archimedes screw turbines are a recent development in small-scale hydropower and should also be screened until such times that there is robust evidence that they cause no damage to characteristic fish populations.	
Structure and function (including its typical species)	**Supporting off-site habitat**	Habitats beyond the site boundary upon which characteristic biological communities of the site depend should be Restored in a state	The characteristic biological communities of the site are dependent on the integrity of sections of river channel, riparian areas, and transitional and marine waters that lie outside of the site boundary. Headwater areas and tributaries may not fall within the site boundary, yet a range of species characteristic of	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		that does not impair the full expression of the characteristic biota within the site.	the site may use these areas for spawning and juvenile development and be critical for sustaining populations within the site. Fully developed riparian zones are essential to site integrity, yet part of this zone may lie outside of the site boundary, particularly if the river channel is operating under natural processes and moves laterally over time within the floodplain. The conditions experienced by long-distance migratory species (such as salmon, sea and river lampreys, allis and twaite shads and eels) outwith the site (through the saline transition zone, estuary, coastal waters and into the high seas) are critical to the well-being of populations within the site. Sea lamprey – clean gravel/pebble/cobble substrate and marginal soft silt/sand in tributaries, unpolluted estuaries down-stream Brook lamprey – clean gravels and soft marginal silt/sand in tributaries Bullhead – fast-flowing, clear, shallow, well-oxygenated water with hard substrate in tributariess.	
Supporting processes (on which the feature relies)	**Water chemistry - alkalinity**	Maintain natural levels of alkalinity	Natural alkalinity levels are critical to characteristic biological communities, with many species adapted to certain parts of the alkalinity range. Mass transfers of water can disrupt the natural alkalinity regime.	
Supporting processes (on which the feature relies)	**Water quality - nutrients**	The natural nutrient regime of the river should be protected, with any anthropogenic enrichment above natural/background concentrations should be limited to levels at which adverse effects on characteristic biodiversity are unlikely. Maximum phosphorus concentrations (µg L-1 SRP) should be 50µg/l, however as this target is not achievable in 5 years the interim target is 82µg/l. The Total Inorganic Nitrogen	Elevated nutrient levels interfere with competitive interactions between higher plant species and between higher plants and algae, leading to dominance by attached forms of algae and a loss of characteristic plant species (which may include lower plants such as mosses and liverworts). Through changes to plant growth and plant community composition and structure they also affect the wider food web, altering the balance between species with different feeding and behavioural strategies. The respiration of artificially large growths of benthic or floating algae may generate large diurnal sags in dissolved oxygen and poor substrate conditions (increased siltation) for fish and invertebrate species. The management focus is typically on phosphorus in rivers, on the assumption that it can be more easily controlled at levels that limit the growth of plant species. However, nitrogen may also be important in river eutrophication and ideally co-limitation would be the	Flow targets taken from Moving towards common standards monitoring guidance targets for SAC rivers: 186 River Axe document (2014)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		(TIN) target is 0.2mg/l N.	management aim.	
Supporting processes (on which the feature relies)	**Water quality - organic pollution**	Organic pollution levels should be controlled to levels that have minimal impact on the characteristic biota Organic pollution: 10%ile Dissolved Oxygen: 85% saturation Mean Biological Oxygen Demand: - 4 mg L-1 90%ile total ammonia - 0.15 mg (L-1 NH3-N) 95%ile un-ionised ammonia - 0.025 m (L-1 NH3-N)	Organic pollution effects the biota in a number of ways, including direct toxicity (from ammonia and nitrite), reduced dissolved oxygen levels (from microbial breakdown of organic material), and nutrient enrichment. Reducing organic pollution levels reduces toxic effects but unmasks enrichment effects. Controlling the continuous input of low levels of organic material is critical to controlling the enrichment effect. The values given apply throughout the site not just at routine sampling points - assessment can be made by modelling (assuming full mixing of effluents at the point of discharge).	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request River Axe Site Improvement Plan, Natural England (2014)
Supporting processes (on which the feature relies)	**Water quality - acidification**	Maintain levels of acidity to those which reflect unimpacted conditions Acid Neutralising Capacity: Mean ANC >80 pH (Clear waters with DOC <10mgL-1) – mean > 6.54 pH (Humic waters with DOC <10mgL-1) mean >5.1	Acid deposition can cause major changes to flora, fauna and ecosystem functioning and affects organisms as diverse as diatoms, invertebrates and fish. Upland streams are particularly susceptible owing to the higher rainfall in these areas. Acid impacts are typically sporadic and tend to be greatest during the winter months. In humic (peat-stained) waters, pH is naturally lower due to the presence of weak acids, and the pH standard is correspondingly lower for these waters. However, humic compounds also provide buffering capacity that helps to reduce fluctuations in pH. Acidification lowers dissolved organic carbon in these waters, reducing the buffering capacity and altering ecosystem functioning. The values given should be applied throughout the site, not just at routine sampling points. Note that, in respect of ANC, some allowance may need to be made for anthropogenically elevated levels of humic substances in rivers and streams draining degraded peat bodies - this artificially raises the buffering capacity of the water and may under-estimate the anthropogenic acid load.	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request
Supporting processes (on which the	**Water quality - other pollutants**	Achieve at least 'Good' chemical status (i.e. compliance with relevant Environmental Quality	A wide range of pollutants may impact on habitat integrity depending on local circumstance. Good chemical status includes a list of Environmental Quality Standards (EQS) for	River Axe SSSI/SAC Diffuse Water Pollution Plan, Natural England (2014)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
feature relies)		Standards).	individual pollutants that are designed to protect aquatic biota with high levels of precaution. These values should be applied throughout the site, not just at routine sampling points.	
Supporting processes (on which the feature relies)	**Air quality**	Maintain as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	This habitat type is considered sensitive to changes in air quality. Exceedance of these critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure and composition and causing the loss of sensitive typical species associated with it. Critical Loads and Levels are recognised thresholds below which such harmful effects on sensitive UK habitats will not occur to a significant level, according to current levels of scientific understanding. There are critical levels for ammonia (NH3), oxides of nitrogen (NOx) and sulphur dioxide (SO2), and critical loads for nutrient nitrogen deposition and acid deposition. There are currently no critical loads or levels for other pollutants such as Halogens, Heavy Metals, POPs, VOCs or Dusts. These should be considered as appropriate on a case-by-case basis. Ground level ozone is regionally important as a toxic air pollutant but flux-based critical levels for the protection of semi-natural habitats are still under development. It is recognised that achieving this target may be subject to the development, availability and effectiveness of abatement technology and measures to tackle diffuse air pollution, within realistic timescales.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Version Control Advice last updated: **22 Mar 2019**: Addition of further text for biotope attribute 'where human health or public safety are at risk or 'imperative reasons of overriding public interest' can be demonstrated'. Additional text to **sediment regime** attribute; Contributions of sediment load from arable land practices. Further information added regarding species requirement of off-site habitat. Weed cutting paragraph removed since operation not a regular activity on this river				
Variations from national feature-framework of integrity-guidance: N/A				

Table 2: Supplementary Advice for Qualifying Features: S1095. *Petromyzon marinus*; Sea lamprey; S1096 Brook lamprey *Lampetra planeri*; S1163 Bullhead *Cottus gobio*

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population (of the feature)	**Juvenile densities**	Restore juvenile densities at those expected under unimpacted conditions throughout the site, taking into account natural habitat conditions and allowing for natural fluctuations	Impacts on physical, chemical or hydrological integrity, or from non-native species, may suppress juvenile densities. Lamprey species require a combination of coarse substrates for spawning and stable beds of fine sandy/silty material for larval development. The close proximity of these habitats facilitates movement to new preferred habitats with age. Larvae typically range from 10-150 mm, corresponding to up to six year classes. The largest larvae are usually brook lampreys while the smallest individuals are likely to be young-of-year sea lampreys, since this species spawns later in the year than Lampetra spp. Juvenile bullheads are generally easily identifiable using length-frequency analysis. 1-year old bullheads are typically between 30-50 mm, although they can vary in length. Field analysis methods makes it extremely difficult to capture smaller (young) fish so it is sufficient to confirm population recruitment by establishing their presence or absence	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request and further data can be requested from the Environment Agency
Population (of the feature)	**Population abundance**	Restore the abundance of the population to a level which is close to that expected under unimpacted conditions throughout the site (subject to natural habitat conditions and allowing for natural fluctuations), whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent. *Petromyzon* sp. i. Should reflect distribution under near-natural conditions	This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/restoration measures to achieve. This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any strategic objectives which may be set at a national level for this feature.	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		Lampetra sp. i. Should reflect distribution under near-natural conditions ii. As a minimum, *Lampetra* should be present in not less than 50% of all sampling sites surveyed with suitable habitat present within the natural range. iii. Where *Lampetra* have been found in the past they should be present in 90% of all sampling sites if suitable habitat remains. size classes should be present There should be no reduction in bullhead densities from existing levels, and in any case no less than 0.5 m^{-2} in lowland rivers (source altitude ≤100m).	Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated, and seeks to avoid plans or projects that may affect the site giving rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be taken into account in any assessment. Unless otherwise stated, the population size or presence will be that measured using standard methods, such as peak mean counts or breeding surveys. This value is also provided recognising there will be inherent variability as a result of natural fluctuations and margins of error during data collection. Whilst we will endeavour to keep these values as up to date as possible, local Natural England staff can advise that the figures stated are the best available.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Maintain the distribution and continuity of the feature and its supporting habitat, including where applicable its component vegetation types and associated transitional vegetation types, across the site	A contraction in the range, or geographic spread, of the feature (and its component vegetation) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes. Contraction may also reduce and break up the continuity of a habitat within a site and how well the species feature is able to occupy and use habitat within the site. Such fragmentation may have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for this feature and this may affect its viability.	Environment Agency (2005)
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Maintain the total extent of the habitat(s) which support the feature to: 25.78 hectares of H3260 habitat	In order to contribute towards the objective of achieving an overall favourable conservation status of the feature at a UK level, it is important to maintain or if appropriate restore the extent of supporting habitats and their range within this SAC.	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		(water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation)	The information available on the extent and distribution of supporting habitat used by the feature may be approximate depending on the nature, age and accuracy of data collection, and may be subject to periodic review in light of improvements in data.	
Supporting habitat: structure/ function	**Biological connectivity**	See general advice for river habitat (H3260)	Lampreys can pass some potential barriers by attaching themselves to structures or river banks by their suctorial discs and creeping up by strong bursts of swimming. However, many in-channel structures are known to either completely or partially block access to historical spawning grounds. Any significant alteration or management of channels that removes resting cover or creates stretches of fast flow (>2 m s-1) should be avoided all along the migration route. Whilst in-channel structures can artificially generate both siltbeds and clean gravels, both of value to lamprey species, this is not a justification for their continued existence or the construction of new structures. Suitable habitat for lamprey and other species can and should be generated by natural processes - where physical restoration of the channel is required this may involve changes in the distribution of species within the river system. Sea lamprey will require safe passage between rivers, coastal waters and estuaries. Vertical drops of >18-20 cm are sufficient to prevent upstream movement of adult bullhead. They will therefore prevent re-colonisation of upper reaches affected by lethal pollution episodes or drought, and more generally will also lead to constraints on genetic interactions that may have adverse consequences.	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request
Supporting habitat: structure/ function	**Biotope mosaic**	See general advice for river habitat (H3260)	Habitat conditions for lamprey species vary naturally in rivers. Some river sections may provide optimal habitat for some or all life stages whilst others may be largely unsuitable. Adult lamprey require spawning substrates of coarse material in which to deposit eggs in shallow scrapes (redds). Larval lamprey (ammocoetes) live in silt beds, which are often in channel margins but in relation to sea lamprey are known to	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request Maitland PS (2003) Ecology of the River, Brook and Sea

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			occur in deep water in main river reaches. Habitat conditions for bullhead vary naturally in rivers. Some river sections may provide optimal habitat whilst others may be largely unsuitable. Optimal conditions typically occur in relatively shallow, fast flowing reaches with coarse substrates (used for egg-laying and juvenile/adult cover). A characteristically diverse biotope mosaic allows the bullhead and other species to move within the channel to locate optimal habitat conditions in the face of a fluctuating flow regime. Pools, exposed tree root systems and marginal shallows are important high-flow refugia for the species. The advice for H3260 is based on natural river function, which provides a characteristic biotope mosaic that caters for bullhead to a degree characteristic of the river. The advice for H3260 is based on natural river function, which provides a characteristic biotope mosaic that caters for lamprey life stages to a degree characteristic of the river.	Lamprey
Supporting habitat: structure/ function	**Control of livestock grazing activity**	See general advice for river habitat (H3260)	Over-grazing of riparian areas can have a dramatic effect on lamprey habitat, trampling marginal siltbeds, eliminating marginal vegetation and generating excessive loads of fine sediment on spawning gravels.	
Supporting habitat: structure/ function	**Fisheries - exploitation**	All exploitation (e.g. netting or angling) of lamprey species should be undertaken sustainably without compromising any components of the population,	Controls on exploitation should include migratory passage within territorial waters, including estuarine and coastal net fisheries, as well as exploitation within the river.	
Supporting habitat: structure/ function	**Fisheries - introduction of fish species**	Ensure fish stocking/introductions do not interfere with the ability of the river to support self-sustaining populations of the feature	The presence of artificially high densities of fish may create unacceptably high levels of predatory pressure on brook lamprey and ammocoetes of all species. The management aim is to provide conditions in the river that support a healthy, natural and self-sustaining salmon population, achieved through habitat protection/restoration and the control of exploitation as necessary. Stocking represents a loss of naturalness and, if successful,	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			obscures the underlying causes of poor performance (potentially allowing these risks to perpetuate). It carries various ecological risks, including the loss of natural spawning from broodstock, competition between stocked and naturally produced individuals, disease introduction and genetic alterations to the population	
Supporting habitat: structure/ function	**Flow regime**	See general advice for river habitat (H3260).	The natural flow regime is critical to all aspects of lamprey life cycle. It shapes the characteristic biotope mosaic, maintains water in critical biotopes (including marginal siltbeds), and provides adequate flows for migratory passage (which is important not only for river and sea lamprey but also brook lamprey in its shorter distance migrations within the river). The natural flow regime is critical to all aspects of the bullhead life cycle, maintaining the high current velocities and substrate conditions that are optimal for the species.	
Supporting habitat: structure/ function	**Integrity of off-site habitats**	See general advice for river habitat (H3260)	Lamprey and bullhead populations may be dependent on the integrity of sections of river channel, riparian areas and transitional and marine waters that lie outside of the site boundary. Headwater areas and tributaries may not fall within the site boundary, yet lamprey (particularly brook and river lamprey) may use these areas for spawning and juvenile development and be critical for sustaining populations within the site. River and sea lamprey require safe passage through coastal waters and estuaries.	
Supporting habitat: structure/ function	**Riparian zone**	See general advice for river habitat (H3260)	Active marginal vegetation including riparian trees provides important habitat for lamprey ammocoetes, as it encourages and stabilises the formation of silt beds in which ammocoetes burrow. Riparian trees also add substrate diversity and aid the formation of siltbeds and clean gravels. They also provide temperature gradients in the channel that improves the availability of suitable micro-habitat.	
Supporting habitat: structure/ function	**Screening of intakes and discharges**	See general advice for river habitat (H3260)	Adult lamprey and migrating sub-adults (transformers) can be entrained in intakes and discharges along with other fish species. Bullhead can be entrained in intakes and discharges along with other fish species.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting habitat: structure/ function	**Sediment regime**	See general advice for river habitat (H3260)	Natural levels of coarse sediment supply are critical to the maintenance of high quality spawning habitat for lamprey and bullhead species, maintaining bed substrates in optimal condition for egg-laying and juvenile and adult cover. Excessive delivery of fine sediment, from the catchment or artificially enhanced bank erosion, can cause siltation of egg-laying sites and juvenile and adult refugia. Lamprey species require a combination of coarse substrates for spawning and stable beds of fine sandy/silty material for larval development. The close proximity of these habitats facilitates movement to new preferred habitats with age.	River Axe Favourable Condition Table (2018), Data may be available from Natural England upon request Mainstone, C.P. (2007) Guidance to Natural England staff on setting and applying sediment targets to protect designated wildlife sites against fine sediment-related problems. Internal information note.
Supporting habitat: structure/ function	**Soils, substrate and nutrient cycling**	Restore the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, within typical values for the supporting habitat	Soil supports basic ecosystem function and is a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with the supporting habitat of this Annex II feature.	
Supporting habitat: structure/ function	**Vegetation composition: invasive non-native species**	See general advice for river habitat (H3260)	Species such as signal crayfish can have a serious effect on lamprey habitat and may predate heavily on brook lamprey and ammocetes of all lamprey species if present at high densities. Chinese mitten crab is also of concern, not only in the lower reaches of main river but due to its potential to migrate long distances upstream.	
Supporting habitat: structure/ function	**Vegetation structure: cover of submerged macrophytes**	See general advice for river habitat (H3260)	In rivers where it naturally occurs, submerged and marginal vegetation can provide important cover for bullhead, particularly if coarse (cobble) substrates are in short supply for cover.	
Supporting habitat: structure/ function	**Water quality - acidification**	See general advice for river habitat (H3260)	Lamprey and bullhead may be affected by acidification in low alkalinity headwaters. Maps of critical loads provide an indication of acidification hotspots.	
Supporting habitat: structure/	**Water quality - nutrients**	Restore the natural nutrient regime of the rivers, with any anthropogenic enrichment above	Nutrient enrichment can lead to loss of substrate condition for spawning, egg development and ammocoete growth, due to benthic algal growth and associated enhanced siltation and	Environment Agency (2005)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
function		natural/background concentrations limited to levels at which adverse effects on the feature are unlikely.	sediment anoxia. Lamprey and bullhead species may be affected by both episodic and chronic organic pollution. Episodic pollution causes direct mortalities whilst chronic pollution affects substrate condition through the build-up of excessive microbial populations.	
Supporting habitat: structure/ function	**Woody debris**	See general advice for river habitat (H3260)	Woody debris is an important component of river habitat for lampreys as well as the wider biological community. It encourages characteristic heterogeneity in biotopes, provides a mosaic of substrates types that lamprey species need to fulfil their life cycle.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Adaptation and resilience**	Restore the feature's ability, and that of its supporting habitat, to adapt or evolve to wider environmental change, either within or external to the site	The overall vulnerability of this SAC to climate change has been assessed by Natural England (2015) as being high, taking into account the sensitivity, fragmentation, topography and management of its habitats/supporting habitats. This means that this site is considered to be the most vulnerable sites overall and are likely to require the most adaptation action, most urgently. A site based assessment should be carried out as a priority. This means that action to address specific issues is likely, such as reducing habitat fragmentation, creating more habitat to buffer the site or expand the habitat into more varied landscapes and addressing particular management and condition issues. Individual species may be more or less vulnerable than their habitat itself. In many cases, change will be inevitable so appropriate monitoring would be advisable.	Natural England (2015). Climate Change Theme Plan and supporting National Biodiversity Climate Change Vulnerability assessments ('NBCCVAs') for SACs and SPAs in England [Available at http://publications.naturalengland.org.uk/publication/4954594591375360]. Tomlinson ML & Perrow MR (2003) Ecology of the Bullhead *Cottus gobio*.
Supporting processes (on which the feature and/or its supporting habitat relies)	**Conservation measures**	Restore the management measures (either within and/or outside the site boundary as appropriate) which are necessary to Restore the structure, functions and supporting processes associated with the feature and/or its supporting habitats.	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, site management strategies or plans, the Views about Management Statement for the underpinning SSSI and/or management agreements.	English Nature (2005), Views About Management Natural England (2014) River Axe Site Improvement Plan Maitland PS (2003) Ecology of the River, Brook and Sea Lamprey

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
				Tomlinson ML & Perrow MR (2003) Ecology of the Bullhead *Cottus gobio*.
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quantity/ quality**	Where the feature or its supporting habitat is dependent on surface water and/or groundwater Restore water quality and quantity to a standard which provides the necessary conditions to support the feature See the target above for the H3260 habitat feature	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year. Poor water quality and inadequate quantities of water can adversely affect the structure and function of this habitat type. Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but in some cases more stringent standards may be needed to reflect the ecological needs of the species feature. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC.	
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: No comparable critical load data for these features				

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