Bournemouth Christchurch and Poole Council

River Avon Phosphates Technical Report

January 2023 (Updated October 2023)

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1 Preliminaries

1.1 Introduction

WSP UK Ltd has been commissioned to support Bournemouth Christchurch and Poole Council (BCP) in investigating the local effects of phosphates discharged from Wessex Water's Christchurch Water Recycling Centre (WRC) at Stony Lane, Christchurch (referred to in this report as Christchurch WRC) and new development applications. Natural England has objected to planning applications in Christchurch on the basis of the significant adverse effect of phosphates on the River Avon Special Area of Conservation (SAC). In particular, WSP have been asked to evaluate the impact of additional development on approximately 500m of this SAC as well as other relevant protected sites (those sites which were formerly known as Natura 2000 or European sites now referred to post-Brexit in the UK as National Site Network (NSN) sites) from the WRC discharge point to Christchurch Harbour.

In addition, WSP will work with BCP to provide suitable text for the Council as Competent Authority to use in agreement with Natural England relating to the assessment of planning applications in this location and the phosphates issue. This report sets out to provide the evidence base to enable an informed decision to be made on proposed development applications by BCP Council.

1.2 Background

In November 2022 BCP Council issued an update on the phosphates in the River Avon issue which summarises the background and current status of this matter.

On 16 March 2022, Natural England provided phosphate advice for the River Avon Special Area of Conservation:

'Natural England advise that the Council need not consider effects on the River Avon from additional phosphates, as the application falls within the catchment of the Christchurch Sewage Treatment Works which Natural England has advised will need to be the subject of further investigations as part of the new Local Plan'.

On 20 July 2022, a Written Ministerial Statement was made by the Secretary of State for the Environment, Farming and Rural Affairs about a package of measures to address nutrient neutrality across England. The two main measures announced were:

- *the intention to table an amendment to the Levelling Up and Regeneration Bill to require the upgrade of all wastewater treatment works within the affected catchments*
- *a nutrient mitigation scheme to be managed by Natural England aimed at delivering nutrient mitigation within the affected catchments*

Whilst Natural England may now be holding a consistent national approach to phosphorous when responding to planning applications, the actual situation in Christchurch has not materially changed.

In discussions with Natural England over the past year BCP Council have agreed the following:

1. *The River Avon is already saturated with phosphates upstream by the time it reaches Christchurch. Therefore, any additional phosphates from Christchurch Water Recycling Centre (WRC) cannot worsen the situation.*
2. *There is no means of offsetting any impact as there is very little river (approx. five hundred metres) between the WRC and the harbour. Any mitigation will involve upgrading the WRC to strip phosphates. However, at this stage there is little benefit as the upstream loading is already more than the SAC can cope with.*

Overall, the outflow from Christchurch WRC does not make the situation any worse than it already is as the river is already overloaded with phosphates and, from the WRC downstream to the harbour the brackish water makes it highly likely that the qualifying species for the SAC are not adversely affected by the outflow from Christchurch WRC.

However, BCP don't have the evidence to support this assertion. Therefore, BCP Council commissioned WSP UK Ltd to assess the river from the WRC to the harbour in relation to relevant qualifying species and to assess the impact of the quantum of the growth of dwellings in the Christchurch WRC catchment area.

Whilst waiting for this evidence, BCP is taking a pragmatic view that it is highly unlikely that development in Christchurch will have any adverse effect on the River Avon SAC. BCP are therefore continuing to grant planning permissions. BCP have 19 live applications for a total of 35 net homes on schemes under 10 dwellings. BCP also have 6 live applications for major schemes of 10 or more dwellings that would provide a supply of 215 net homes.

Where BCP grant permission, they will use a pre-commencement condition to restrict commencement until the Levelling Up and Regeneration Bill is enacted (expected May 2023) or our evidence is published (expected January 2023), whichever comes first. The condition could read:

The development shall not commence until (i) the enactment of the Levelling Up and Regeneration Bill requires upgrades to Christchurch WRC for phosphorus reductions; or (ii) evidence demonstrates that the phosphorus from the proposed development will not have a significant adverse effect upon the River Avon SAC, whichever comes first.

In the meantime, the BCP Council will set aside the required amount of Community Infrastructure Levy to provide mitigation in the event that it is required. If the announced improvements at the sewage treatment works is not forthcoming, or delayed, then the Council will ensure appropriate phosphorus offsetting measures are in place to ensure that nutrient neutrality is secured by the occupation of any permissions granted.

1.3 Approach to review

Water Quality review

The review of the potential impact of the additional phosphorus loads associated with foul flows generated by the new dwellings has considered the total catchment phosphorus loads discharged to the river Avon. This has been based on a synthesis of publicly available information and data relating to catchment phosphorus inputs. This included Wessex Water published WRC effluent flow and phosphorus concentration data, and information available from Annex 4 of the Phosphorus in the Hampshire Avon Special Area of Conservation Technical Report. The assessment has quantified the existing catchment phosphorus loads, which provide the context against which the additional phosphorus load from the new dwellings has been assessed.

The additional phosphorus load from the new dwellings has been estimated for the foul flows only. Given the scope, scale and programme of the review, it has not been possible to also assess the phosphorus load contribution associated with the land use change for each development. Such contributions are likely to be very small compared to the foul flow phosphorus load and have therefore been excluded from consideration.

The foul flow phosphorus loads have been estimated using the calculation method specified by Natural England, which relies on certain assumptions including the WRC total phosphorus discharge concentration. The load estimate has been refined based on the actual phosphorus concentration in the treated effluent discharged by Christchurch WRC.

The water quality impact of the additional phosphorus load from new dwellings has been considered in relation to the existing phosphorus load from the upstream catchment and Christchurch WRC.

Ecological review

WSP undertook a review of the current ecology baseline of data and information on the presence or likely absence of qualifying features (species and habitats) in the lower river and estuary of the River Avon SAC. A broad zone of influence from the vicinity (up to 100m upstream) of the WRC downstream to and including Christchurch Harbour has been applied as proportionate for this study. Hence other nearby designations as well supporting habitat for the qualifying species and habitats of the SAC have been included in this work.

This review also included an investigation into the sensitivities of those features to potentially elevated phosphorus loading as a result of the proposed housing developments in the Christchurch area. We approached this review in the terms of a potential Habitats Regulation Assessment. Our draft conclusions bring together the findings of the review into the water quality and ecology elements of this issue.

As the aim of this work is to facilitate BCP Council, as a competent authority under the Habitats Regulations, to reach a conclusion regarding Likely Significant Effects (LSE) of new development on the River Avon SAC (also noting other Ramsar and SPA

designations), the report uses the Habitats Regulations Assessment (HRA) terminology and process in the conclusions. These can then be agreed with Natural England and apply to planned development connecting to the WRC catchment.

In this review we have also sought to identify opportunities for the use of biological indicator species (potentially macroinvertebrates) as recorded within existing datasets.

Data and information on the presence of qualifying features has been drawn from a range of freely available online sources, including the Multi-Agency Geographic Information on the Countryside (MAGIC) (Defra, 2023). A request for records was made to the Dorset Environmental Records Centre (DERC), but their records for the lower River Avon and estuary are limited. DERC also checked with Dorset Wildlife Trust (DWT) for records of marine species (pers. com. Peter Tinsley DWT), but they have no recent records. DERC also noted that data from the terrestrial database for the lower River Avon and estuary is equally very limited.

Three primary sources of information have been used in this review:

- The Environment Agency online Data Explorer sites, including for fish and Water Framework Directive (WFD) information;
- The Inland Fisheries Conservation Agency (IFCA) for the inshore fishery-related fish species; and
- The British Trust for Ornithology (BTO) Wetland birds monitoring (WeBS) datasets[1] for recent presence and trends data.

In addition, a range of other publications and research papers have been investigated, including The SAC Site Improvement Plans[2] and papers from the Christchurch Harbour Macro-nutrients Project 2015-17[3].

Bringing the review together

The combination of these two approaches (water quality and ecology) will inform discussion on whether additional forecast development pressures are considered likely to fall below a “de minimis” threshold in HRA terms, i.e. such effects would not be detectable at the scale being discussed.

Following the reviews, consultation will be held with BCP ecologists and Natural England and considering their feedback, we will provide a final technical report with the findings of this work.

[1] BTO WeBS Reports
[2] Site Improvement Plan: Avon River and Valley - SIP185 (naturalengland.org.uk)
[3] Christchurch Harbour Macronutrients Project 2012-2017 (nerc.ac.uk)

Recommendations will be provided to the BCP Council client team to provide a concentrated location of the evidence base for future decision making relating to this issue and providing an agreed form of wording to support demonstration of consideration of this issue when carrying out the role of Competent Authority under the Habitat Regulations.

2 Baseline information

2.1 WRC location

The location of the WRC, the outflow into the River Avon estuary and Christchurch Harbour and the extent of the River Avon SAC in the lower river are given in Figure 1. Other designated sites which are considered in this review due to their proximity and hence within a zone of influence of the WRC outflow are also given, including those which have supporting habitats for the qualifying features of interest.

2.2 Water Quality - Phosphorus

The assessment of the impact of the phosphorus load from the new dwellings in Christchurch requires consideration of the existing phosphorus load to the Avon at the point of the potential impact (i.e. the Christchurch WRC discharge location). The various elements of the existing phosphorus load at this point are considered below.

River Avon Existing Phosphorus Load from the Catchment Upstream of Christchurch

The River Avon flows for approximately 96km primarily through Hampshire and has a catchment area of approximately 1,750km^2 [4]. Christchurch is located adjacent to the estuary and the river water quality at this point reflects all discharges of phosphorus in the catchment upstream. Such discharges consist of point sources including those from WRCs, fish farms and watercress farms, and diffuse sources including from agricultural land and natural sources including the underlying geology.

The population in the catchment is approximately 230,000[5]. Wessex Water operates 37 WRCs in the catchment that treat sewage and discharge the treated effluent into the river. Wessex Water also operates 55 storm overflows that can discharge partially or untreated sewage effluent into the river when WRCs are unable to treat the total volume of sewage effluent (typically during large rainfall events)[6].

[4] https://environment.data.gov.uk/catchment-planning/ManagementCatchment/3006

[5] CFMP_Hamp Avon_6 (publishing.service.gov.uk)
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/294189/Hampshire_Avon_Catchment_Flood_Management_Plan.pdf

[6] https://www.wessexwater.co.uk/-/media/files/wessexwater/environment/catchments/hampshire/127-hampshire-avon-fact-sheet-september-2021.pdf

By 2020, Wessex Water had installed phosphorus removal at 19 of their WRCs, focussed on those serving the largest population centres including Salisbury, Warminster, Ringwood and Ratfyn[7].

Annex 4 of the Phosphorus in the Hampshire Avon Special Area of Conservation Technical Report (30 April 2015)[8] provides modelling outputs that identify the relative contribution of phosphorus loading to the Avon from natural, diffuse and point sources. Table 1 summarises the baseline scenario[9].

Table 1 Source Apportionment Modelling of Phosphorus Loads, Hampshire Avon

Phosphorus Source	**2011 (Baseline) Total Phosphorus Load To the Avon (tonnes/yr)**
Cumulative WRC	11.061
Cumulative Fish Farm & Water Cress	6.492
Total Point Source	17.553
Total Diffuse (including Natural)	15.070 – 30.237
Grand Total	**32.623 – 47.790**

Table 1 shows that WRCs are the largest point source contributor, but the total diffuse phosphorus load (from agricultural and natural sources) is substantially larger.

Table 2.3.2d of Annex 4 provides WRC mean flow, mean total phosphorus concentration, the 2011 phosphorus load and forecast phosphorus loads for 2025, 2030 and 2035. The data for 2011 and the forecast for 2025 (as the most relevant to the current day) are provided in Table 2.

[7] https://www.wessexwater.co.uk/-/media/files/wessexwater/environment/catchments/hampshire/127-hampshire-avon-fact-sheet-september-2021.pdf

[8] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/429216/Annex_4_River_Avon_Nutrient_Management_Plan_Technical_Annex_Final_30_April_2015.pdf

[9] Taken from Tables 2.3.2a and 2.3.2b of Annex 4 of the Phosphorus in the Hampshire Avon Special Area of Conservation Technical Report (30 April 2015).

Table 2 2011 and Forecast 2025 Wessex Water WRC Loads to the Avon (for WRCs with discharge >50m^3/day)

WRC	Mean Flow (megalitres/day)	Mean Total P Concentration (ug/l)	Total P Load (tonnes/year)	
			2011	2025
Salisbury	20.511	561	4.200	4.949
Warminster	4.312	608	0.957	1.090
Ringwood	4.49	542	0.888	1.158
Cannings	0.399	5,000 / 700	0.728	0.112
Hurdcott	3.297	575	0.537	0.551
Collingbourne Ducis	0.318	5,000	0.930	1.019
Pewsey	1.857	683	0.463	0.495
Fordingbridge	2.312	542	0.457	0.474
Downton	1.832	487	0.326	0.367
East Knoyle	0.161	5,000 / 700	0.294	0.043
Amesbury	1.199	606	0.265	0.379
Shrewton	1.104	517	0.208	0.231
Ratfyn	2.359	183	0.158	0.186
Great Wishford	1.153	342	0.144	0.165
Fovant	0.401	700	0.102	0.118
Marden	0.177	1,292	0.083	0.095
Upavon	0.438	462	0.074	0.088
Netheravon	0.423	469	0.072	0.076
Tisbury	0.844	208	0.064	0.077
Maiden Bradley	0.035	5,000	0.064	0.067
Barford St Martin	0.083	1,552	0.047	0.051
Total			**11.061**	**11.79**

Notes: Where two mean total P concentration values are provided these are for pre- and post-installation of phosphorus removal and are used in the load calculations for the 2011 and 2025 loads, respectively.

The forecast 2025 total phosphorus load discharged to the Avon by the largest WRCs in the catchment is 11.79 tonnes per year. It is notable that Christchurch WRC, which serves a population of 56,925[10], is not included in the Annex 4 assessment. This may indicate that the report authors (the Environment Agency and Natural England) may not have considered Christchurch WRC to have a significant adverse impact on the Avon SAC because it discharges effluent into the transitional zone (the estuary) and the SAC designation is for freshwater species and habitats.

River Avon Existing Phosphorus Load from Christchurch WRC

As detailed above, Christchurch WRC serves a population of 56,925. The total phosphorus load from sewage generated by this population, treated at Christchurch WRC and discharged to the Avon, has been calculated using:

- The WRC's mean effluent discharge total phosphorus concentration of 3.42mg/l, which was based on 646 measurements[11] spanning the period 8 January 2010 to 24 November 2020[12].
- The WRC's mean total daily effluent discharge volume of 9,343m^3/day based on 6,716 daily records spanning the period 1 January 2010 to 31 December 2019[13,14]. This has been multiplied by 1,000 to convert 9,343 m^3/day to 9,343,000 litres/day.
- 365.25 days in a year, accounting for leap years.

The existing foul flow TP load from Christchurch WRC has therefore been calculated as 11.671 tonnes/year based on:

(9,343,000 * 3.42 * 365.25) ÷ 1,000,000,000

This load is in addition to the load contributions detailed from the upstream catchment.

River Avon Existing Cumulative Total Phosphorus Load

The existing cumulative total phosphorus load discharged to the Avon is summarised in Table 3, which builds on Table 1 and incorporates the forecast 2025 WRC load plus the current load from Christchurch WRC.

[10] https://storymaps.arcgis.com/collections/8fa8080a882f41c5b621b34fc64e711a?item=5
[11] https://marketplace.wessexwater.co.uk/dataset/water-recycling-centre-influent-and-effluent-data
[12] The 2021 dataset, the latest available, does not include total phosphorus data.
[13] https://marketplace.wessexwater.co.uk/dataset/water-recycling-centre-flow-data
[14] This is the latest available data published by Wessex Water.

Table 3. Existing Total Phosphorus Load in the Hampshire Avon

Phosphorus Source	Existing Total Phosphorus Load To the Avon (tonnes/yr)
Cumulative WRC	11.790
Christchurch WRC	11.671
Cumulative Fish Farm & Water Cress	6.492
Total Point Source	29.953
Total Diffuse (including Natural)	15.070 – 30.237
Grand Total	**45.023 – 60.190**

Notes: Assumes that the values for fish and cress farms and diffuse sources remain unchanged from the Annex 4 assessment.

The existing total phosphorus load discharged to the Avon from the upstream catchment and from the existing Christchurch WRC discharge, ranges from 45 tonnes/year to 60 tonnes/year.

2.3 Nature Conservation

2.4 Designated sites and qualifying features of interest

The following are the sites and qualifying features considered in this review (the Joint Nature Conservation Committee (JNCC) codes are given in brackets). Also see Figure 1 for location.

National Sites Network (European and International sites of nature conservation importance)

The River Avon SAC[15] includes qualifying features:

Annex I habitats: Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260)

Annex II species: Desmoulins whorl snail *Vertigo moulinsiana* (1016)

sea Lamprey *Petromyzon marinus* (1095)

[15] https://sac.jncc.gov.uk/site/UK0013016 and http://publications.naturalengland.org.uk/publication/6048472272732160

brook Lamprey *Lampetra planeri* (1096)

Atlantic salmon *Salmo salar* (1106)

bullhead *Cottus gobio* (1163)

Avon Valley Special Protection Area (SPA)[16] includes qualifying features:

Annex I species: Bewick's swan *Cygnus columbianus bewickii* (A037) - non-breeding

gadwall *Anas strepera* (A051) - non-breeding

Avon Valley Ramsar Site[17] includes qualifying features:

Qualifying Species/populations: Species with peak counts in winter: gadwall.

Species/populations identified subsequent to designation for possible future consideration under criterion 6. Species with peak counts in winter: northern pintail *Anas acuta* and black-tailed godwit *Limosa limosa islandica*.

Solent and Dorset Coast SPA[18] includes qualifying features:

Annex I species: sandwich tern *Sterna sandvicensis* (A191) - breeding

common tern *Sterna hirundo* (A193) - breeding

little tern *Sternula albifrons* (A195) - breeding

National Nature Conservation Sites

Sites and Special Scientific Interest (SSSIs) are nationally important nature conservation sites and largely overlap with the NNS sites listed above. Two SSSIs are included here as these have been assessed for their Condition in the recent past and provide an insight into the ecological condition of the NNS sites.

The River Avon System SSSI[19]

The Avon Valley SSSI encompasses the lower River Avon valley between Bickton in the north and the estuary of Christchurch Harbour in the south. The following relevant features are noted in the citation:

The lower river and estuary are not noted in the SSSI citation, but the lower Avon Valley grasslands and the Blashford Lakes are of national and international importance for migratory wildfowl and wading birds. The valley grasslands act as winter feeding grounds for large flocks of European white-fronted geese *Anser albifrons*, Bewick's swans, wigeon

[16] http://publications.naturalengland.org.uk/publication/5741820348727296
[17] https://rsis.ramsar.org/ris/926
[18] http://publications.naturalengland.org.uk/publication/5294923917033472
[19] 1006622 (naturalengland.org.uk)

Anas penelope, teal *Anas crecca*, shoveler *Anas clypeata*, golden plover *Pluvialis apricaria* and black-tailed godwits.

The river has a very diverse fish fauna with at least 27 species of non-salmonid fish known to be present as well as important populations of Atlantic salmon, migratory and brown trout *Salma trutta*.

Christchurch Harbour SSSI[20]:

A number of relevant species and habitat features are mentioned in the citation including: saltmarsh, clubrush *Schoenoplectus spp.* on margins of water bodies and estuary, and the River Stour grazed fields with varying saline influence.

The *Foraminiferida* of the Harbour have been the subject of detailed study[21] and the Harbour waters are believed to be important as a breeding and nursery area for several fish including bass *Dicentrarchus labrax*, thick-lipped mullet *Mugil labrosus* and thin-lipped mullet *M. capito*, and pollack *Pollachius pollachius*. There is however limited information on the presence of specific phyto and zooplankton species in the estuary, however it is assumed that these groups exist in significant abundance.

Wintering birds – shelduck *Tadorna tadorna.*

2.5 Habitats and Plant Communities

***River Avon SAC Annex I habitat: Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation**

The River Avon is a large, lowland river system that includes sections running through chalk and clay, with transitions between the two. Five aquatic *Ranunculus* species occur in the river system, but stream water-crowfoot *Ranunculus penicillatus* ssp. *Pseudofluitans* and river water-crowfoot *R. fluitans* are the main dominants. Some winterbourne reaches, where *R. peltatus* is the dominant water-crowfoot species, are included in the SAC[22].

There is limited information available on the distribution of this plant community in the River Avon, however Mainstone (1999) notes that in the River Avon *Ranunculus penicillatus ssp. pseudofluitans* is dominant in the shallowest stretches where there is a combination of gravel beds and fast current velocities. Indeed, one of the factors that appears to determine the maximum standing crop formed by the plant and distribution of the Ranunculus plant community generally is the rate of water flow, particularly in spring; a positive correlation between standing crop and water velocity was found in the River Wye over several years

[20] https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=s1002678
[21] The source of this statement in the SSSI citation is unknown and much of this information is historical.
[22] River Avon - Special Areas of Conservation (jncc.gov.uk)

(Edwards & Brooker 1982)[23]. However particularly in chalk streams where discharge is less variable and cutting is frequent other factors such as the cutting regime, turbidity and insolation may be more important than discharge (Westlake & Dawson 1982)[24].

Priority Habitats

A number of Priority Habitats are located in the River Avon estuary and Christchurch Harbour (these are also referred to as Habitats of Principal Importance as listed in Section 41 of the Natural Environment and Rural Communities Act 2006) (Figure 2)

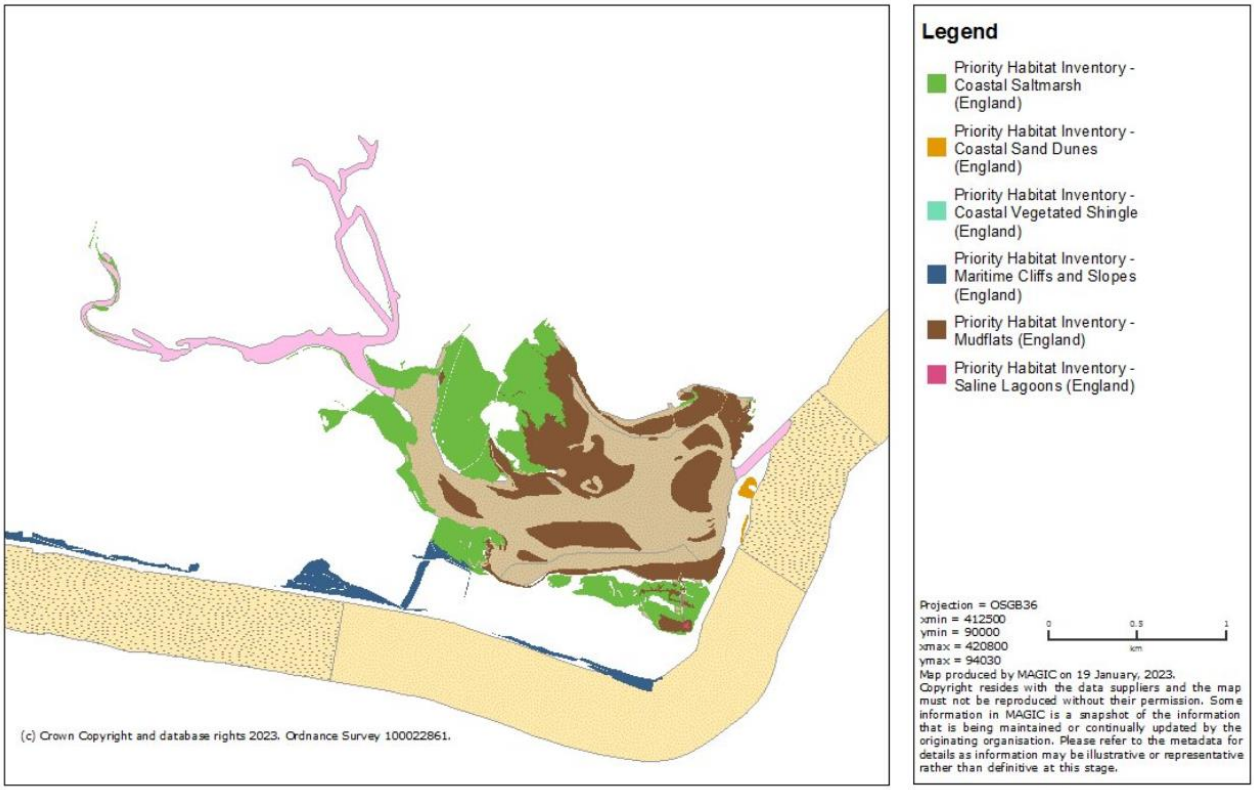

Figure 2. Habitats of Principal Importance in Christchurch Harbour.

[23] Edwards R.W. & Brooker M.P. 1982 The Ecology of the Wye. W. Junk, The Hague

[24] Westlake D.F., Dawson F.H. 1982 Thirty years of weed cutting on a chalk stream. Proceedings of the European Weed Research Society 6th Symposium on Aquatic Weeds 1982, 132 - 140.

3 The review of findings

3.1 Water quality - phosphorus

River Avon Additional Phosphorus Load from New Dwellings at Christchurch

BCP has provided a table detailing the proposed net number of new residential units that may be approved and developed prior to the year ending in April 2024. The list was provided with the following caveat:

> *'These application details represent residential planning applications in Christchurch in October 2022. The total numbers indicated are essentially a maximum figure covering those applications as we do not know how many of the applications will be approved and how the totals for the approved sites might be affected by negotiation which would normally result in a reduction in numbers.'*

The table indicates a net increase of 35 units associated with 20 minor planning applications, and a further net increase of up to 215 units for six major applications, giving a total increase of up to 250 new units.

Of the total of 250 units, 138 are proposed for sites with existing land uses described as 'undeveloped wooded land', 'amenity land' or 'livery stables'. The conversion of the existing land uses to residential development may contribute a small total phosphorus load in addition to the foul flow load estimated below. However, given the scope of this assessment it is not possible to calculate this contribution, and it is anticipated to be insignificant compared to the associated foul flow load.

The remaining units are proposed for sites with existing land uses described individually or in combination as, 'residential', 'commercial', 'retail', 'office', 'warehouse', 'light industrial' or 'residential care home'. As these sites are already urbanised, it is likely that there will be no additional total phosphorus load contribution from the developments.

On balance, the total phosphorus load potentially contributed by land use change is considered likely to be minimal compared to the foul flow loads and has therefore been excluded from further consideration.

The foul flow phosphorus load associated with the 250 new units has been calculated using two methods:

1. The *theoretical load* has been calculated using Natural England's Nutrient Neutrality Budget Calculator for the River Avon SAC[25] and the supporting Nutrient Budget

[25] https://www.wiltshire.gov.uk/media/9024/Avon-Nutrient-Budget-Calculator/excel/Avon_Nutrient_Budget_Calculator.xlsx?m=637847683051870000

Calculator Guidance Document[26]. This method is specified by Natural England for use in the Avon catchment for new housing phosphorus load calculations. The method specifies:

- A default treated effluent total phosphorus (TP) concentration of 8mg/l (because Christchurch WRC does not have a TP permit limit).
- A daily water usage of 120 litres per person per day (lpd).
- An average occupancy rate of 2.4 people per property.
- The addition of a 20% precautionary buffer on top of the final calculated TP load.

2. The *actual load* has been calculated based on the actual total phosphorus performance of Christchurch WRC which, as detailed above based on 2010 – 2020 data, achieves a mean effluent TP concentration of 3.42mg/l despite not having a TP permit limit.

The method 1 *theoretical* TP load is calculated as **0.252 tonnes/year** based on:

((250 * 2.4 * 120 * 8 * 365.25) ÷ 1,000,000,000) * 1.2

The method 2 *actual* TP load is calculated as **0.108 tonnes/year** based on:

((250 * 2.4 * 120 * 3.42 * 365.25) ÷ 1,000,000,000) * 1.2

Compared to the total phosphorus load discharged to the Avon by the upstream catchment and existing Christchurch WRC discharge of 45.023 – 60.190 tonnes/year:

- The *theoretical* TP load of 0.252 tonnes/year is 0.42% – 0.56% of the total.
- The *actual* TP load of 0.108 tonnes/year is just 0.18% – 0.24% of the total.

It is considered that the very small additional *actual* load generated by the new dwellings in Christchurch represents an insignificant impact to the Avon. This is based on consideration of the magnitude of the existing loads from the upstream catchment and Christchurch WRC, and the discharge being into the estuary rather than the freshwater extent of the SAC.

Dilution of the Additional Phosphorus Load

The additional phosphorus load will be discharged into the estuary of the Avon where it will be mixed with river water and brackish / saline water during different phases of the tidal cycle. The impact of the additional phosphorus load on the concentration of total phosphorus in the estuary is considered below.

[26] https://www.wiltshire.gov.uk/media/9028/Avon-SAC-Nutrient-Budget-Calculator-Guidance/pdf/Nutrient_Budget_Calculator_Guidance_Document_Hampshire_Avon_Issue1.pdf?m=637848415816830000

The Avon mean daily flow is 18.89m^3/s. Converting this to litres per day and annualising it results in an annual river discharge of 596,123,064,000 litres/year.

The additional total phosphorus load from new dwellings is 0.108 tonnes/year, which is equivalent to 108,000,000mg/year. The impact of the additional total phosphorus load from the new dwellings on the mean total phosphorus concentration in the river / estuary water is therefore 0.00018mg/l based on:

108,000,000 / 596,123,064,000.

This impact is clearly nugatory and excludes any consideration of further dilution available from the River Stour flows and from tidal flushing – the volume of which can be up to 1.4Mm^3 on a spring tide[27].

3.2 Ecology

Details of the data review are given in Tables 4, 5 and 6 in Appendix A and in the text below.

A number of qualifying features were discounted at an early stage of the review due to their likely lack of presence in the zone of influence and indeed in upper estuarine or lower river locations generally or obvious lack of sensitivity towards this potential impact. Further notes on the screening out of these species are given in Appendix A. These species are:

- Desmoulin's whorl snail;
- sea lamprey ;
- Brook lamprey;
- bullhead;
- Bewick's swan; and
- gadwall

The qualifying features considered further for discussion and those with potential to be impacted (either directly or indirectly) by enhanced phosphate loading in the lower river and upper estuary are given below. Included here are those features which are supporting habitats or species of the qualifying features, proxies for the general health of the estuarine system or those related to the Condition Assessment process of the lower River Avon units of the SSSI.

- Atlantic salmon;
- estuarine wading birds, e.g. black-tailed godwit;
- duck species, e.g. shelduck and pintail; and

[27] https://www.twobays.net/SMP2%20Final/Appendices/Appendix%20I%20-%20Estuary%20Assessment1.pdf

- tern species, including estuarine and harbour fish species, e.g. mullet species and sea bass (these were considered due to the potential in their juvenile stage as prey/food sources for terns).

Atlantic salmon

An anadromous migratory species which is in decline in the river and nationally. Its presence in the river and estuary is confirmed, but numbers of salmon migrating past the Knapp Mill fish counter vary each year (see Figure 3).

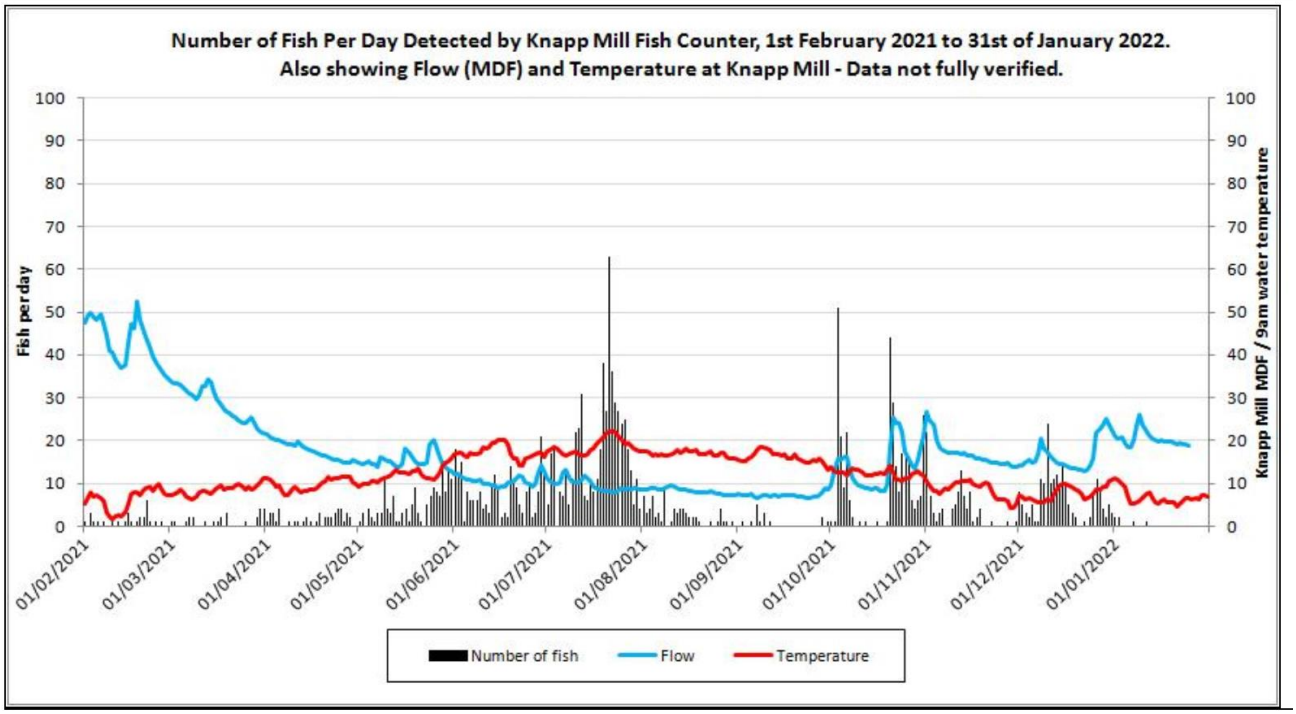

Figure 3. Salmon and sea trout passes at Knapp Mill in 2021 and up to 31 January 2022 (source Environment Agency counter)

The reasons for the flux in population and decline are related primarily to “out of river” external factors, but also to the suitability of spawning ground freshwater habitats within the River and the presence of natural and synthetic hormones arising from fish farm effluent and Sewage Treatment Works (STWs)[28].

This species will move through the estuary rapidly and into the river triggered by high flows. It tends not to feed in the estuary and lower river. It is considered therefore that effects of slight increases in phosphate loading over background levels in the lower river are likely to be insignificant to this species.

[28] Site Improvement Plan: Avon River and Valley - SIP185 (naturalengland.org.uk)

Wading birds and other shorebirds

Evidence suggests that in upper estuary areas small aquatic crustaceans and invertebrates are tolerant (high resistance and resilience) of nutrient enrichment and can provide abundant food resources to shorebirds[29]. In some cases, shorebirds benefit from human influenced nutrient inputs[30]. However, excessive algal blooms if the mats persist, whilst providing a short-term flush of food for shorebirds, can result in invertebrate abundance declining severely and the food supply will be reduced in the long term. The population trends in black-tailed godwit numbers however suggest no such decline in interest in the Harbour. The 2021 SSSI Condition Assessment mentions that the number of bird species both breeding and over-wintering are stable and increasing, and as such this feature of interest is in favourable condition[31]. It is considered therefore that effects of slight increases in phosphate loading over background levels in the lower river are likely to be insignificant to this group.

Duck species

Similar to waders some research suggests that prey species for shelduck benefit from algal mats on mudflats. Although they may lead to an impoverished infaunal community in the long term, mats of algae can support moderate numbers of amphipods and crustaceans such as *Peringia ulvae (Hydrobia ulvae*), the latter being an important food source for shelduck, pintail and dunlin. Enteromorpha is also itself grazed by wigeon. Teal and wigeon are found in significant numbers during winter in the estuary and Harbour suggesting no decline in interest and as such it is considered that effects of slight increases in phosphate loading over background levels in the lower river are likely to be insignificant to this group.

Tern species and fish prey

Sandwich and common terns are recorded from the Harbour (larger numbers of the former), but little tern is a very infrequent visitor. This shallow water Harbour is a good feeding ground for this group, but likely not to be a critical one. It is noted in the SSSI citation that the Harbour is a nursery area for a range of fish species, in particular mullet species and sea bass and juveniles of these species and others are likely to be prey items for terns.

The WFD assessment for fish has fluctuated between good and moderate status. Fish in turn will be feeding on zooplankton and other invertebrates and the phytoplankton populations will be a significant factor in the suitability of the Harbour for juvenile fish. Phytoplankton levels flux in the Harbour as a result of estuarine hydrodynamics including

[29] MarLIN - The Marine Life Information Network - Hediste diversicolor and oligochaetes in littoral mud
[30] MacDonald, M.A. (2006) The indirect effects of increased nutrient inputs on birds in the UK: a review RSPB Research Report 21 ISBN Number 1 901930 77 7
[31] SSSI detail (naturalengland.org.uk)

residence times, river flows, nutrient levels and temperature, but limited information exists to enable informed decisions on impacts etc.

In general terms estuaries and coastal waters are better flushed through with water than freshwater lakes so the effects of eutrophication are generally less persistent, e.g. the Harbour (due to the tidal harmonics in the English Channel) has a double high water on each tide. However, residence or flushing times change in the Harbour spatially and in relation to river flows - as long as 132 hours to flush when river flow is low, or as short as 12 hours when riverine input is exceptionally high[32]. Valiela et al. (1997)[33] proposed that water residence time may play an important role in controlling the biological response of different primary producers to nutrient enrichment. They hypothesised that under high nutrient conditions phytoplankton growth is likely to be limited when water residence times are shorter, while macroalgae are likely to become the dominant primary producers. Under high nutrient conditions and longer residence times, phytoplankton are likely to become dominant, displacing the eelgrasses and macroalgae. The same study demonstrated that the response of macrophytes in particular to nutrient loading may be significantly modified by the presence of fringing salt marsh, due to reductions in nutrient loading through processes such as denitrification or nutrient retention.

The extensive and varied estuarine habitat mosaic in the Harbour would likely have a significant positive benefit in reducing the impact of phosphates and nitrates in the water column. Juvenile fish and hence tern species will likely benefit from short term enhanced phytoplankton and subsequent zooplankton levels and initial increased abundance of fish prey during early to mid-summer in the Harbour. Terns may however also be negatively affected as water transparency tends to be reduced. Nutrient enrichment may also alter the size class of fish prey over time, reducing the abundance of suitable (small) individuals over time[34]. There is no evidence to suggest that phytoplankton levels are a permanent summer issue in the Harbour however, but blooms have been reported during low summer river flows in the estuary[35].

The potential additional phosphate loading is not anticipated to have a significant impact on tern species foraging in the Harbour.

[32] Huggett, R. D., Purdie, D. A., and Haigh I. D. (2021) Modelling the Influence of Riverine Inputs on the Circulation and Flushing Times of Small Shallow Estuaries, Estuaries and Coasts (2021) 44:54–69

[33] I. Valiela, G. Collins, J. Kremer, K. Lajtha, M. Geist, B. Seely, J. Brawley, C. H. Sham (1997) Nitrogen loading from coastal watersheds to receiving estuaries: new method and application Ecological Applications, Ecol. Soc. Am.

[34] MacDonald, M.A. (2006) The indirect effects of increased nutrient inputs on birds in the UK: a review RSPB Research Report 21 ISBN Number 1 901930 77 7

[35] During 2013, Christchurch Harbour was characterized by a major spring bloom up to 44 µg L-1 of Chlorophyl a from Amani Ebraheem Alshatti (2017) Investigation of the environmental control on the phytoplankton and bacterioplankton in two contrasting temperate estuaries University of Southampton faculty of natural and environmental sciences Ocean and Earth Sciences By Thesis for the degree of Doctor of Philosophy May 2017

Priority Habitats in the lower river and estuary

The Harbour supports varied habitats including large areas of saltmarsh and wet meadow. There is no reported evidence of significant losses or dieback of these habitats in the Harbour, indeed it seems that any loss of saltmarsh seems to have been counterbalanced by its re-colonisation of abandoned artificial salt pans[36]. Extensive *Phragmites* reed beds occupy tidal creek margins and areas of elevated marsh, where they front wet grazing meadows. These estuarine habitats have a role in reducing nutrient loading through processes such as denitrification or nutrient retention within sediments (see above). No likely significant effects are anticipated therefore.

The Annex I *Ranunculus-Callitriche* macrophyte community can be affected in a number of ways by elevated phosphate loading within the river (after Mainstone, 1999)[37], but, in the location in question, it is likely to be the salinity concentration and the tidal flux are the limiting factors determining their presence. This macrophyte community is unlikely to be found in the tidal lower reaches of the river and below the WRC outflow.

[36] Christchurch Bay (scopac.org.uk)

[37] Mainstone, C.P. (1999) Chalk Rivers – nature conservation and management. EA and English Nature publication

4 Conclusions and recommendations for discussion

Estuaries comprise ecologically diverse and complex systems. They support characteristic plant and animal communities and each has a unique combination of features derived from its shape, the river catchment serving them, their connection to the sea, tidal regime and exposure and the hydrodynamics of the estuary itself. Estuaries are transitional environments subject to both marine and riverine influences and as such are considered to be resilient and relatively robust systems, but they are also sensitive to increasing disturbances, including changes in water quality and pollution. Their complexity also makes the study of change and impact of man-induced activities on these estuaries challenging and problematical.

Christchurch Harbour and the lower River Avon / estuary head are indeed complex systems, the result of the cumulative range of factors acting within the River Avon catchment and the marine environment. Separating out any one factor, in this case total phosphorus, in assessing impacts will always be difficult and there is a lack of specific published data and information on how these impacts can be quantified and assessed. The lower River Avon is itself home to a multitude of activities both recreational and commercial, including marinas and extensive swinging moorings, as well as the outflow from the Christchurch WRC, compounding the problems in concluding a judgement on the impact of a single factor.

Estuaries are naturally productive systems where nutrients and sediments accumulate. These eutrophic systems experience fluxes in the nutrient loading depending on the tidal regime, the topographical character of the estuary, in this case a shallow water system, and the range of processes acting on the catchment. Nitrogen and phosphorus are the key elements in driving eutrophication, but research has shown that most estuaries are phosphorus-limited and this will be the case in Christchurch Harbour. The nutrient predicting the smallest biomass increase, and therefore the lowest rate of primary production, is considered to be the limiting one. The inherent impact of total phosphorus loading therefore will always be less than that of nitrogen.

The assessment of changes associated with planned development in the short term indicates that the additional phosphorus load of 0.108 tonnes/year associated with foul flows from new dwellings in Christchurch represents a very small proportion (0.18% – 0.24%) of the existing total phosphorus load discharged to the river by point and diffuse sources throughout the catchment. Analysis of annual mean flows from the River Avon indicates that the impact of the additional phosphorus load on the mean total phosphorus concentration in the river / estuary would be approximately 0.00018mg/l. This value excludes further dilution available from inflows from the River Stour and considerable tidal flushing. It is therefore considered that the additional load from the new dwellings would have a negligible impact on the water quality of the river and estuary. This review has shown a general lack of records and data on the distribution of species and characteristic

habitats in the estuary and also studies of specific impacts, for example of nutrient loading in the estuary and Harbour. The presence and ecology of qualifying features of the River Avon SAC have been reviewed and this was widened to consider other designated sites which potentially could be impacted by increased total phosphorus loads, as well supporting habitats and species (fish prey for example). Broad assumptions have been made based on available evidence base and professional judgement.

A number of qualifying features were discounted at an early stage being dependent on freshwater and/or the middle and upper areas of the catchment and therefore would not be impacted by this issue within a zone of influence. Other qualifying features have been recorded in the zone of influence but are transitory in their behaviour and are not dependent upon the conditions within the tidal estuary head. A small group of species and supporting habitats are found within the upper estuary and Harbour and these were considered in more detail in the review.

This group utilise the estuarine habitats in Christchurch Harbour at varying times of the year. Wading birds and duck species primarily use these areas during the winter months, but there is no evidence of a decline or negative trend in numbers of these populations. Indeed there is some evidence to suggest that these groups benefit from enhanced nutrient conditions. Tern species will use the Harbour in summer for feeding purposes and are therefore reliant upon the juvenile fish populations, which in turn feed upon zooplankton. There is evidence of phytoplankton and algal blooms in the Harbour in recent years (2013), but there is no evidence to suggest that terns will be detrimentally affected by temporary blooms such as this. Water residence times and river flows into the Harbour appear to determine the extent of nutrient enrichment and hence phytoplankton blooms in this situation. There is also no evidence to suggest that such blooms would not occur naturally in this shallow water estuary during summer, low river flows.

There is a lack of specific information on impacts and likely effects of small increases in total phosphorus loading on receptors in the estuary and lower river. Broad assumptions have been made, but based on available evidence base and professional judgement.

The review also set out to identify possible bio-indicators which could be applied to assess and monitor changes in total phosphorus loading in the future. The review however has shown that there is a lack of such data and records which could assist in identifying a useful indicator of change in the lower river/estuary head. Diatoms are an obvious group given their potential as indicators of water quality and this should be investigated further as a recommendation.

Based on the water quality review, the likely increase in total phosphorus load from potential housing in Christchurch is just 0.18% - 0.24% of the total phosphorus load to the river (depending on calculation method). It is acknowledged however, that the lower River Avon SSSI Unit is currently failing its Condition Assessment on the grounds of phosphate loads

exceeding the JNCC Common Standards Monitoring Guidance (CSMG) for rivers [38]. This Unit fails on several indicators, but specifically the three-year mean concentration (2017-2019) for reactive phosphorus along the river is widely elevated above the maximum for favourable condition (50 µg/l) (values from two sample points are 67ug/P and 68µg/l P). Whilst the small increase in total phosphorus loading could be seen as exacerbating this situation, it is considered unlikely that the reactive phosphorus levels would change as a result. The ecology of the qualifying features also suggests that it will also make little difference to their behaviour and the impact will be de minimis.

In summary therefore, given this relatively small increase, the effect on qualifying features of the SAC and other designated sites with supporting features, is unlikely to be significant and in HRA terms the effect is considered to be nugatory. Therefore, the integrity of the SAC will be maintained and no adverse effect of the small increase in TP can be anticipated.

Recommendations

Following the review a number of recommendations are given for discussion:

- A meeting with Natural England to discuss these findings should be programmed as soon as possible to allow a confirmed approach to be agreed.
- The conclusion from this review is that no adverse effect on integrity is anticipated as a result of the small increase in total phosphorus loading due to the proposed housing developments on the River Avon SAC.
- Investigate the potential of bio-indicators of water quality change in the lower river/estuary head, in particular diatoms through consultation with Bournemouth and Southampton Universities.
- Every housing development application should be viewed on its merits and if necessary, project level HRAs should be undertaken.
- BCP Council's approach of setting aside the required amount of CIL to provide mitigation in the event that it is required is welcomed. If the announced improvements at the sewage treatment works is not forthcoming, or delayed, then the Council will ensure appropriate phosphorus offsetting measures are in place to ensure that nutrient neutrality is secured by the occupation of any permissions granted.

[38] Common Standards Monitoring Guidance for Rivers (jncc.gov.uk)

Conclusions

This section builds on the initial recommendations set out above which addressed the understanding of issues as presented in Section 1.2, as updated by the response received from Natural England dated 25 April 2023 (Appendix B).

The position of exploration of effects which led to this work is amended by the position set out by Natural England in the Appendix B correspondence, which confirmed that a specific link between local development, impacts and effects should instead be considered through a consistent approach with national principles on Nutrient Neutrality. This was described in Appendix B as follows; "*Natural England has previously provided local advice to the Council concerning the need to carry out a full assessment of the impacts of nutrients on the River Avon SAC in relation to the forthcoming Local Plan. This advice was effectively superseded by the national guidance as well as in our response to the recent statutory appeal consultation by the Planning Inspectorate. Both national and local advice is consistent that new development should be nutrient neutral with respect to phosphorus".*

It is worth noting that across the catchment and for other authority areas the advice of Natural England is that a single additional dwelling within the catchment needs to demonstrate phosphorous neutrality in order to reach a conclusion of no likely significant effect.

The final position of this report is therefore that the opinion of Natural England carries great weight in coming to a conclusion under the Habitats Regulations and the manner in which in-combination effects are considered within the catchment have had a notable bearing on the scope and interpretation of this work over the lifespan of the project. In light of this opinion from Natural England, the initial conclusion from this review that no adverse effect on integrity is anticipated cannot be fully adopted by BCP Council.

Figure 1 Habitats sites designations and planning applications distribution

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Key

- Waste Water Treatment Works
- Waste Water Treatment Works Outflow
- Avon Planning Applications

Designated Sites

- Special Area of Conservation
- Special Protection Area

wsp

Client: BCP Council

Project: River Avon Phosphates Review

Title: Habitats sites designations and planning applications distribution

Drawing No:	Layers	Drawn:	AH
Date:	14/12/2022	Checked:	OP
Scale:	27,000 @ A3	Approved:	OP

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Appendix A

Ecological data review

Table 4. Environment Agency Fish Data for the River Avon (source online EA Ecology and Fish Data Explorer)

			EA Survey Location 1	EA Survey Location 2	EA Survey Location 3				
Common name	**Species**	**Qualifying feature from designation**	**2011**	**2011**	**2019**	**2022**	**Comments on lifecycle**	**Comments on supporting habitat/species**	**Potential impact from elevated phosphate loading?**
Sea lamprey	*Petromyzon marinus*	River Avon SAC	1	0	0	0	Sea lamprey[39] are a migratory fish laying their eggs in clean, sandy gravels in rivers. Sea lamprey spawn in June/July, laying their eggs in shallow depressions in suitable gravels. After hatching, the ammocoetes swim or drift downstream to areas of silt in freshwater in which they burrow. Ammocoetes can remain in their	Adult sea lamprey feed on a range of fish on their journey downstream to the sea. They remain at sea for one–two years, growing dramatically by feeding on fish such as cod, herring, haddock and salmon, and are often seen attached to basking sharks. During the migration back to the river to breed they don't feed and focus their energy on getting to suitable spawning grounds.	Not considered further in this review as migratory adults will move through the lower river and estuary rapidly before feeding parasitically on other marine fish or finding spawning areas upstream. The breeding adults then die in the river. The ammocoetes are more likely to be exposed to elevated phosphate levels in riverine silt and other sediments, but it is considered unlikely that they will be present in

[39] Ecology of the River Brook and Sea Lamprey - IN104 (naturalengland.org.uk)

			EA Survey Location 1	EA Survey Location 2	EA Survey Location 3				
Common name	**Species**	**Qualifying feature from designation**	**2011**	**2011**	**2019**	**2022**	**Comments on lifecycle**	**Comments on supporting habitat/species**	**Potential impact from elevated phosphate loading?**
							nursery habitat for up to four years before metamorphosis and emergence as adults and migration to the sea.	Research[40] suggests that, although ammocoetes could be found among plant debris and macrophytes, in general they preferred a plant-free substrate. Therefore they are likely to avoid sediments covered in algal blooms in the freshwater riverine environment.	the estuary down stream of the WRC No LSE is concluded.

[40] Ryapolova NI (1972). Some regularities of migrations of river lamprey (Lampetra fluviatilis) into the Latvian rivers. ICES Baltic-Belt Seas Committee 18, 1–3.

			EA Survey Location 1	EA Survey Location 2	EA Survey Location 3				
Common name	**Species**	**Qualifying feature from designation**	**2011**	**2011**	**2019**	**2022**	**Comments on lifecycle**	**Comments on supporting habitat/species**	**Potential impact from elevated phosphate loading?**
Brook lamprey	*Lampetra planeri*	River Avon SAC	0	0	0	0	Brook lamprey[41] spawn in March/April. They lay their eggs in shallow depressions in suitable gravels. After hatching, the ammocoetes swim or drift downstream to areas of silt in still water, in which they burrow. Ammocoetes can remain in their nursery habitat for up to seven years before metamorphosis and emergence as adults. This species does not need to undertake	*Lampetra planeri* is a purely freshwater species occurring in streams and occasionally in lakes	The brook lamprey is regarded as being sensitive to pollution, but few data appear to be available. Some pollution in the lower reaches of quite a number of rivers in Britain appears to be tolerated. In the absence of specific tolerance data for this species it must be assumed that conditions in all parts of any river where brook lampreys occur, or pass through on migration, are at least Moderate. However, this species is unlikely to be found in the lower reaches

[41] Ecology of the River Brook and Sea Lamprey - IN104 (naturalengland.org.uk)

			EA Survey Location 1	EA Survey Location 2	EA Survey Location 3				
Common name	**Species**	**Qualifying feature from designation**	**2011**	**2011**	**2019**	**2022**	**Comments on lifecycle**	**Comments on supporting habitat/species**	**Potential impact from elevated phosphate loading?**
							the long migrations of river and sea lamprey from estuaries and the sea. Most adults migrate upstream, sometimes for considerable distances, to find suitable spawning substrates rather than downstream into eutrophicated stretches.		and estuary so not considered further. No LSE is concluded.
Atlantic salmon	*Salmo salar*	River Avon SAC	1		2	1	Anadromous species – adults migrate from the sea to spawn in freshwaters	Salmon eggs laid in a depression in riverbed gravels. Hatch as alevins, which remain in the gravel for several weeks before emerging as fry. Fry become parr with fish able to remain as parr for up to four years (but usually one, and occasionally two years in the Avon)	Considered further in text of report

			EA Survey Location 1	EA Survey Location 2	EA Survey Location 3				
Common name	**Species**	**Qualifying feature from designation**	**2011**	**2011**	**2019**	**2022**	**Comments on lifecycle**	**Comments on supporting habitat/species**	**Potential impact from elevated phosphate loading?**
								before undergoing smoltification, when they turn silver and migrate to the sea. Atlantic salmon utilise all the main tributaries of the SAC The Avon salmon population has suffered a severe decline over the last 10 years, with a crash occurring in the late 1980s–early 1990s, during four years of exceptionally dry weather. The population decline on the Avon can be divided into two components, a long-term.	

			EA Survey Location 1	EA Survey Location 2	EA Survey Location 3				
Common name	**Species**	**Qualifying feature from designation**	**2011**	**2011**	**2019**	**2022**	**Comments on lifecycle**	**Comments on supporting habitat/species**	**Potential impact from elevated phosphate loading?**
Bullhead	*Cottus gobio*	River Avon SAC		Present	2	6	Bullhead spawn from February to June - eggs hatch after 20 to 30 days. Bullhead need a coarse, hard substrate of clean gravel and stones to complete their reproductive cycle	Bullhead predominantly occur in stony streams and rivers where the flow is moderate and the water is cool and oxygen rich. Bullhead are retiring fish, actively hiding from light under stones or any other available objects. For this reason, shade and cover are important components of their preferred habitat. Adults are territorial. Benthic invertebrates comprise the bulk of the diet	Elevated levels of nutrients are likely to be detrimental to bullhead if resulting in the growth of filamentous algae, which coat coarse hard substrates, thereby influencing the number and type of invertebrate food sources available. Appears that bullhead are more tolerant to pollution than previously thought. Utzinger et al. (1998) found bullheads present directly downstream of sewage treatment works, although in lower densities compared to upstream. Provided oxygen saturation remains high, bullhead can tolerate high concentrations of nitrogen compounds.

			EA Survey Location 1	EA Survey Location 2	EA Survey Location 3				
Common name	**Species**	**Qualifying feature from designation**	**2011**	**2011**	**2019**	**2022**	**Comments on lifecycle**	**Comments on supporting habitat/species**	**Potential impact from elevated phosphate loading?**
									No LSE considered in the estuary due to unsuitable conditions for this species.

Table 5. IFCA catch monitoring data for Christchurch Harbour (source ?)

Common name	*Species*	Qualifying feature from designation	2017 (Presence/ absence)	Count 2021	Count 2022	Comments on feeding etc	Comments on supporting habitat	Potential impact from elevated phosphate loading
Bass	*Dicentrarchus labrax*	Christchurch Harbour SSSI	Present	3	10	Demersal species Mainly feed on shrimp and molluscs	Bass are able to tolerate a range of salinities - occupy shallow waters, estuaries and out into deeper waters Adults spend winter in deeper water, shoal in early summer and move into coastal waters and estuaries Young fish school in shallow waters for at least one year before joining adults and moving offshore in the winter Their distribution is thought to be highly affected by water temperature.	

Common name	*Species*	Qualifying feature from designation	2017 (Presence/ absence)	Count 2021	Count 2022	Comments on feeding etc	Comments on supporting habitat	Potential impact from elevated phosphate loading
Thick-lipped grey mullet	*Chelon labrosus*	Christchurch Harbour SSSI	Present	5	1	Adults feed primarily on benthic diatoms, algae, small invertebrates and detritus Juveniles feed primarily on zooplankton	Prefers soft substrates such as sand and mud but do occur over hard substrates as well	
Thin-lipped grey mullet	*Chelon Ramada*	Christchurch Harbour SSSI	Present	60	45	Adults feed primarily on benthic diatoms, algae, small invertebrates and detritus Juveniles feed primarily on zooplankton	Prefers soft substrates such as sand and mud	

Common name	*Species*	Qualifying feature from designation	2017 (Presence/ absence)	Count 2021	Count 2022	Comments on feeding etc	Comments on supporting habitat	Potential impact from elevated phosphate loading
European eel	*Anguilla anguilla*		Present			Adult European eels have a broad diet that includes fish, molluscs and crustaceans. They also scavenge on dead fish. The eel is also reported to leave the water and enter fields to feed on slugs and worms. Small eels feed on insect larvae and worms as well as molluscs and crustaceans	European eel spawn in Sargasso Sea. Unlike salmon, they have no homing instinct and the river they return to is dictated by currents.	

Table 6. Bird qualifying features presence and WeBS count trends for Christchurch Harbour (source WeBS count online reports summary)

Common name	Species	Qualifying feature from designation	15/16	16/17	17/18	18/19	19/20	Month in which the annual maxima occurred in the last year	5 year average 15/16-19/20	Comments on feeding etc	Comments on supporting habitat	Potential impact from elevated phosphate loading?
Gadwall	*Anas strepera strepera*	Avon Valley SPA	2	5	0	6	0		3	Wintering. Gadwalls are herbivorous, consuming a diverse range of various aquatic plants, but also small aquatic invertebrates consumed incidentally.	Eutrophic lakes	Not considered further, small numbers recorded in the estuary and largely a freshwater inhabiting species in the middle to upper valley.
Bewicks swan	*Cygnus columbianus bewickii*	Avon Valley SPA	0	0	0	0	0		0	Wintering. In the UK, their diet consists mainly of leftover grain and potatoes. They eat grass and aquatic plants when they are in their breeding grounds.	Floodplain grasslands	Not considered further, largely absent from the estuary and lower river.
Northern pintail	*Anas acuta*	Avon Valley Ramsar Site	9	23	25	9	16	Feb	16	Wintering. Their diets consist of plants and invertebrates	Sheltered coastal waters and estuaries	Considered further in this review as present in the estuary.

Common name	Species	Qualifying feature from designation	15/16	16/17	17/18	18/19	19/20	Month in which the annual maxima occurred in the last year	5 year average 15/16-19/20	Comments on feeding etc	Comments on supporting habitat	Potential impact from elevated phosphate loading?
Black-tailed godwit	*Limosa limosa islandica*	Avon Valley Ramsar Site	87	84	425	177	260	Dec	207	Wintering. Black-tailed godwits eat a variety of insects and insect larvae, molluscs, spawn and tadpoles, seeds, berries.	Estuarine mudflats	Considered further in this review as present in the estuary in significant numbers.
Sandwich tern	*Sterna sandvicensis*	Solent and Dorset Coast SPA	3	2	13		33	Sep	13	Breeding only. Their diets consist of fish.	Estuarine open waters	Considered further in this review as present in the estuary in significant numbers.
Common tern	*Sterna hirundo*	Solent and Dorset Coast SPA	1	0	0		0		0	Breeding only. Predominantly a fish eater, the common tern will also feed on molluscs, crustaceans and insects.	Common terns generally inhabit coastal regions although, unlike most members of the tern family, during the breeding season they can also be found great	Considered further in this review as tern species present in small numbers.

Common name	Species	Qualifying feature from designation	15/16	16/17	17/18	18/19	19/20	Month in which the annual maxima occurred in the last year	5 year average 15/16-19/20	Comments on feeding etc	Comments on supporting habitat	Potential impact from elevated phosphate loading?
											distances inland provided they have close access to rivers, lakes and reservoirs	
Little tern	*Sternula albifrons*	Solent and Dorset Coast SPA	0	0	0		0		0	Breeding only Their diets consist of fish.	Estuarine open water	Considered further in this review as tern species present in small numbers.
Shelduck	*Tadorna tadorna*	Christchurch Harbour SSSI/Avon Valley SSSI	5	11	14	1	13	Feb	9	Wintering only Invertebrates, small shellfish and aquatic snails.	Estuarine habitats, mudflats, open water, lakes and gravel pits	Considered further in this review as present in small numbers.
Wigeon	*Anas penelope*	Avon Valley SSSI	847	745	799	813	796	Mar	800	Aquatic plants, grasses, roots.	Large numbers of wigeons winter in coastal areas.	Considered further in this as present in the estuary in significant numbers.
Teal	*Anas crecca*	Avon Valley SSSI	189	230	104	127	84	Nov	158	Seeds and small invertebrates	Estuarine habitats, mudflats, open water, lakes and gravel pits	Considered further in this as present in the estuary in significant numbers.

Common name	Species	Qualifying feature from designation	15/16	16/17	17/18	18/19	19/20	Month in which the annual maxima occurred in the last year	5 year average 15/16-19/20	Comments on feeding etc	Comments on supporting habitat	Potential impact from elevated phosphate loading?
Shoveler	*Anas clypeata*	Avon Valley SSSI	6	12	14	4	2	Nov	8	Small insects and plant matter sifted from the water.	In the UK they breed in southern and eastern England, present in winter.	Considered further in this as tern species present in small numbers.
Golden plover	*Pluvialis apricaria*	Avon Valley SSSI	0	0	5	1	0		1	Worms, beetles and insects.	In winter they move to lowland fields, forming large flocks, often in the company of lapwings. Present in estuaries in winter.	Not considered further, largely absent from the estuary and lower river.

Appendix B

Correspondence received from Natural England

Date: 25 April 2023
Our ref: Click here to enter text.
Your ref: Click here to enter text.

Click here to enter text.

BY EMAIL ONLY

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T 0300 060 3900

Dear Mr Dring

Report into Phosphate effects on the River Avon Special Area of Conservation at Christchurch : Draft River Avon Phosphates Technical Report WSP

Natural England is a non-departmental public body. Our statutory purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development.

Thank you for send in Natural England a copy of the report. I have consulted a number of local and national colleagues about the information submitted.

The Council were advised through a national statement by Natural England on 16 March 2022 and on 20 July 2022 through a Ministerial announcement that nutrient neutrality would be required across the catchments of a number of rivers which are Habitats Sites (SAC, SPA and by virtue of government policy, Ramsar sites). The specific advice to BCP included the River Avon SAC catchment and Christchurch Waste Water Treatment Works (WwTW). The nutrient budget calculator provided a total phosphorus figure per litre for the WwTW.

In our earlier advice to the Council, Natural England drew attention to the issue of nutrient neutrality as well as the complexity of determining that additional inputs would not have a likely significant effect on the SAC in the river below Knapp Mill, which includes river channels where there is a tidal influence.

Natural England has previously provided local advice to the Council concerning the need to carry out a full assessment of the impacts of nutrients on the River Avon SAC in relation to the forthcoming Local Plan. This advice was effectively superseded by the national guidance as well as in our response to the recent statutory appeal consultation by the Planning Inspectorate. Both national and local advice is consistent that new development should be nutrient neutral with respect to phosphorus.

The Report

The report incorrectly relates our advice concerning the processes of nutrient transport in the river. To clarify, the nutrient phosphorus concentrations in the lower reaches are a reflection of elevated inputs from sources in the upstream catchment that are held in solution but are also likely to be stored (and released) by the river biology and in particulate matter (silt) carried and deposited by the river. Additional nutrient inputs therefore act to increase the load to the system. Natural England has no specific local evidence of the phosphorous concentrations in the river directly above or below the Christchurch WwTW outfall. There is also the tidal influence that regularly backs up the river flow. However, we are not aware of any data to demonstrate the extent of any saline influence. We also note that the plant communities in the inner Christchurch Harbour indicate that there is still a significant freshwater influence.

In the short term it is clear that there is an excess of phosphorus in the SAC. A phosphorus load standstill or point source (mainly WwTWs) reductions alone are unlikely to result in achieving the site's conservation objectives and hence the requirement for a long term strategy and avoidance of projects which result in additional phosphorus input into the river.

The report also concludes that there is no means to offset adverse impacts from phosphorus because of the distance from the waste water outfall to the SAC boundary. Firstly Natural England do not agree with the length of SAC affected as stated in the report, the length affected should be at least 1.7km because water from the works will reach up to the tidal limit. Based solely on the length of the River Avon SAC affected it cannot be simply be concluded that there is no Likely Significant Effect (LSE).

Secondly the report suggests mitigation measures downstream of the WwTW which would not be effective but there are mitigation measures (apart from upgrading the Christchurch WwTW) which are now available to applicants. These are upstream of the WwTW and because phosphorus is not broken down in the water environment, these would be effective in reducing the phosphorus load in the lower river thereby securing nutrient neutrality for new development.

Without nutrient neutrality there would be an ongoing addition of phosphorus from new development through the WwTW and there is no plan in place that would secure adequate reduction of phosphorus to the requirements for favourable condition for the SAC. In other words this would be contrary to achieving the site Conservation Objectives.

The report details an effluent concentration of 3.42mg/l (page 9) which, whilst based on the available effluent data. However no attempt has been made to take account of the impacts of future growth on future effluent concentrations. Natural England is currently undertaking a review of WWTW effluent data with a view to recommending a standard methodology for determining a suitably precautionary concentration for WWTWs that have sufficient monitoring data, but are not operating to a permit level. Once this methodology is available it may be used to determine an appropriate effluent concentration for the Christchurch WwTWs. It will however remain important for development to provide mitigation for additional nutrients at the appropriate rate.

It is worth noting that across the catchment and for other authority areas the advice of Natural England is that a single additional dwelling within the catchment needs to demonstrate phosphorous neutrality in order to reach a conclusion of no likely significant effect.

The report has not considered projects elsewhere in the catchment such as the New Forest District and Wiltshire in-combination with the developments identified within BCP. This work is particularly important as the new Local Plan comes forward where the issue will need to Natural England addressed.

It is therefore our advice that the report has not carried out a sufficiently robust assessment of the in-combination/cumulative effects of other plans and projects. The report should consider the additional phosphorous loading in relation to the target load for SAC (50 µg/l) rather than against the current elevated load in the river.

River Avon SAC Conservation Objectives

The report has focussed incorrectly on a narrow consideration of the features of the SAC affected i.e. simply the vegetation communities.

The full objectives are provided at Annex 2 below. The key feature which is required to be considered is the river habitat itself described as:

> *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation*

The SAC feature constitutes the whole river including the overall structure and function of the habitats – this includes all the typical species for the habitats and the supporting processes for the habitats which include the rivers water quality. It is not simply the specified plant communities

characterising the river habitats.

In addition, the river as the basic habitat feature supports a range of typical species, including fish, macrophytes, diatoms, invertebrates etc.

The evidence supporting the adverse effects in the SAC arising from phosphorus exceedance in the river is detailed in NERR 034, *An evidence base for setting nutrient targets to protect river Habitat*.

Natural England advise the authority that the report does therefore not provide a sound basis on which to determine that developments which are not nutrient neutral can be concluded to have no LSE and therefore be authorised.

Next steps
Natural England advise that there are a number of aspects which will require further consideration and which may best be taken forward through a meeting. These include:

- The delivery of phosphorus neutrality for live planning applications and those coming forward during the period up to the new Local Plan adoption.
- A methodology for calculating a precautionary figure for the concentration of phosphorus in the waste water to inform the load reduction required by new development to achieve phosphorus neutrality.
- Additional technical information eg phosphate levels above and below the WWTW, salinity and some ecological survey required to assess the condition and impacts (existing and potential) on the SAC.

Natural England will aim to take a pragmatic approach to open discussions with the authority to assist in clarifying the issues and moving development forward.

Yours sincerely

Nick Squirrell
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Annex 1
Detailed comments:

Natural England do not agree with the distance of the SAC likely to be influenced by additional phosphates detailed as 500m in the report (page 2, point 2). The distance from the downstream boundary of the SAC to the *indicated* normal tidal limit (NTL) is 1.74km. It is a further 1km up to physical barriers in the river at Knapp Mill.

The report gives a mean effluent discharge of 3.42mg/l which is significantly lower that the figure provided in the guidance set out in March 2022 of 8 mg/l. Whilst the attempt to make use of the existing effluent discharge data is useful, Natural England is currently considering the most appropriate methodology for deriving a valid estimate of total phosphorous concentration. The existing data is considered unfit for this purpose because of the inherent variability of flows in a river as well as the variability in effluent due to a number of factors including dilution from surface water/groundwater egress into sewer pipes etc. This work is being carried out by a national Natural England advisor at this time.

It would be more appropriate to replace the term “foul flows” with waste water.

The occupancy rate per dwelling should be 2.42 not 2.4 in order to be consistent with other Council SPDs.

<u>Dilution effect</u>
It is difficult to draw any firm conclusions about effluent dilution which will be very variable depending on background river levels and water quality, tidal conditions and day by day variation in effluent discharge. Phosphorous will however still be present in levels which are elevated above the SAC target levels and available for uptake into biological systems or storage in sediments with additional loading making a negative contribution.

The work carried out to deliver the original River Avon Nutrient Management Plan was led by the Environment Agency for whom the component River Avon water body catchments (as set out in the South West River Basin Catchment Plan) extend only as far as the NTL which therefore excluded consideration of the effects of Christchurch WwTW on the SAC.

<u>Christchurch Harbour SSSI component of the Solent and Dorset Coast SPA</u>
Natural England note that there is potential for increased turbidity from greater micro-algal concentrations in the Harbour to reduce the feeding opportunity for the three tern species all of which can take fish via plunge diving. The balance of effects from silt load vs micro algae is not understood at this time. If this was confirmed there may be a LSE on the SPA for this aspect.

Annexe 2
River Avon Conservation Objectives

European Site Conservation Objectives for River Avon Special Area of Conservation Site Code: UK0013016

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

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

S1016. *Vertigo moulinsiana*; Desmoulin`s whorl snail

S1095. *Petromyzon marinus*; Sea lamprey

S1096. *Lampetra planeri*; Brook lamprey

S1106. *Salmo salar*; Atlantic salmon

S1163. *Cottus gobio*; Bullhead

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the “Habitats Regulations”). They must be considered when a competent authority is required to make a ‘Habitats Regulations Assessment’, including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term ‘favourable conservation status’ is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

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