

River Avon SAC – Site Action Plan

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Revision History

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SECTION A STAGE 3 OVERVIEW

A1 Summary of outcomes of Appropriate Assessment

Table A1.1 Stage 3 conclusions for River Avon SAC

| Function | No adverse effect on site integrity can be shown. | No adverse effect on site integrity cannot be shown |
|-----------------------------------|---|---|
| Water Quality | 202 | 37 |
| Water Resources | 47 | 13 |
| Radioactive Substances Regulation | 0 | 1 |

A2 Background

The River Avon is a large, lowland chalk river system that runs through chalk and clay. It is designated for its habitat and for five species. Table A2.1 below show the interest features of the site. The Stage 3 Appropriate Assessment for this site was completed in November 2009.

Table A2.1 Features List

| | |
|------------|---|
| 1.3 | Riverine Habitats Watercourses of plain to montane levels with the <i>Ranunculus fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation. |
| 2.2 | Vascular Plants, lower plants and invertebrates, wet habitats Desmoulin's whorl snail <i>Vertigo moulinsiana</i> |
| 2.5 | Anadromous fish Atlantic salmon <i>Salmo salar</i> Sea Lamprey <i>Petromyzon marinus</i> |
| 2.6 | Non-migratory fish & invertebrates of rivers Bullhead <i>Cottus gobio</i> Brook Lamprey <i>Lampetra planeri</i> |

A3 Teams involved in the production of the Site Action Plan

A number of teams have been involved in writing the Stage 4 Site Action Plan. They are shown below in Table A3.1.

Table A3.1 Teams involved in the production of the Site Action Plan

| Teams involved | Area, Regional, National |
|---|---------------------------------|
| FRB | Area |
| Water quality/Area Environment Planning | Area, Regional, National |
| Water resources/Area Environment Planning | Area, Regional, National |
| Radioactive Substances Regulation | Area, Regional, National |
| Hydrology | Area |
| Regional Environmental Planning | Regional |
| Legal | Regional, National |

Please note this document has also been subject to a rigorous QA process involving area, regional and national staff covering the following aspects of the work:

- Habitats Directive policy and process
- Functional/technical work and decisions
- Legal compliance
- Consistency, consultation and areas of best practice

A4 Map of site, showing location of permissions in stage 4

See following page.

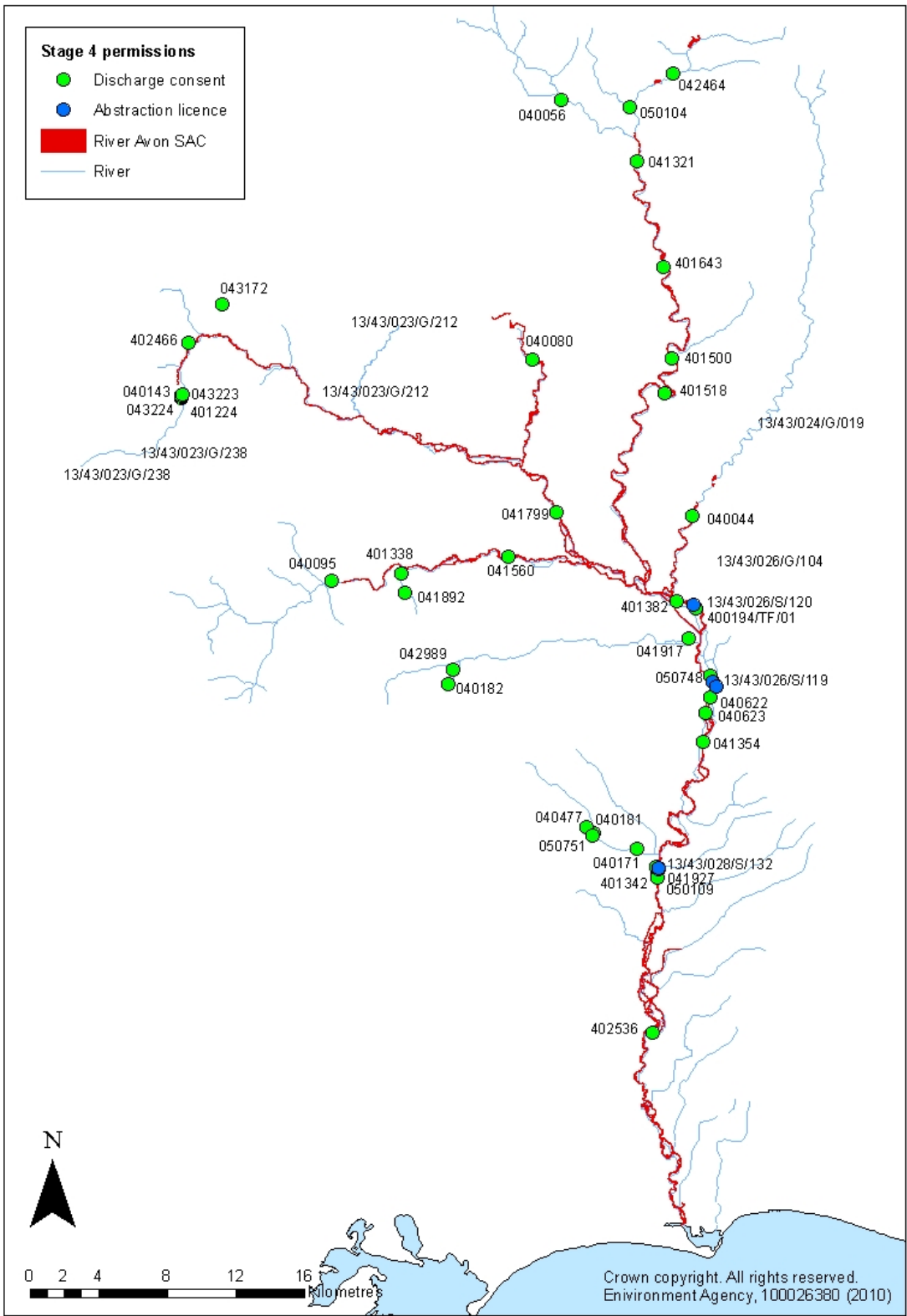


Figure A4.1 Map of site, showing location of permissions in stage 4

A5 Functional specific stage 3 outcomes

A5.1 Water Quality

Table A5.1.1 Outcomes of stage 3 Appropriate Assessment and issues identified for the River Avon SAC

| Permission No. | Site Name | Adverse effect on site integrity can be shown | | No adverse effect on site integrity cannot be shown | | Impact (I) or a Risk (R) if cannot conclude there is no impact. | Impact type:- Actual (A) Modelled (M) or Suspected (S) | Nature of Impact on particular species (see SAC Interest Features below table) | Known effects from other sources eg. CA's?* | Permission relevant to another site? If Yes list site. |
|----------------|---|---|----------------|---|----------------|---|---|--|---|---|
| | | Alone | In Combination | Alone | In Combination | | | | | |
| 401382 | Salisbury (Petersfinger) | | | Y | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 402466 | Warminster Sewage Treatment Works (STW) | | | Y | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 401342 | Fordingbridge STW | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 402536 | Ringwood STW | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 401643 | Netheravon STW | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 401518 | Amesbury STW | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 401500 | Ratfyn STW | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 041354 | Downton | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 042464 | Pewsey STW | | | Y | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 041799 | Great Wishford | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040095 | Tisbury | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040044 | Hurdcott | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040080 | Shrewton | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 043172 | Warminster Garrison | | | Y | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 401338 | Fovant | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040056 | Marden | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 041321 | Upavon | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 041560 | Barford St Martin | | | | Y | R | M | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040143 | Deverills Fish Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040171 | Ashford Water Fish Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040181 | Damerham Fisheries Ltd | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |

| Permission No. | Site Name | Adverse effect on site integrity can be shown | | No adverse effect on site integrity cannot be shown | | Impact (I) or a Risk (R) if cannot conclude there is no impact. | Impact type:- Actual (A) Modelled (M) or Suspected (S) | Nature of Impact on particular species (see SAC Interest Features below table) | Known effects from other sources eg. CA's?* | Permission relevant to another site? If Yes list site. |
|----------------|---|---|----------------|---|----------------|---|---|--|---|---|
| | | Alone | In Combination | Alone | In Combination | | | | | |
| 040182 | Chalke Valley Fish Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040477 | The Cress Beds (Damerham Fisheries Fish Farm) | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 042989 | Riverside Trout Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 041892 | Millbrook Fish Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 041917 | Longford Mill Fish Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 043223 | Hill Deverill Watercress Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 043224 | Hill Deverill Watercress Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 401224 | Hill Deverill Watercress Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 050104 | Manningford Trout Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 050748 | Waterways Hatchery | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 050751 | Crystal Springs Trout Farm | | | | Y | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040622 | Barford Fish Farm | | | Y | | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 040623 | Barford Fish Farm | | | Y | | R | S | Nutrient enrichment – 1, 4, 5, 5 | A | No |
| 050109 | Bickton Fish Farm | | | Y | | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 041927 | Bickton Fish Farm | | | Y | | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |
| 400194/TF/01 | Britford Trout Farm | | | Y | | R | S | Nutrient enrichment – 1, 4, 5, 6 | A | No |

* CA = Competent Authority

SAC Interest Features

1 = *Cottus Gobio* (Bullhead), 2 = *Lampetra planeri* (Brook Lamprey), 3= *Petromyzon marinus* (Sea Lamprey), 4 = *Salmo salar* (Salmon), 5 = *Vertigo moulinsiana* (Desmoulin's whorl snail), 6 = Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation.

Table A5.1.2 Known effects from other sources

| Reference to Table A5.1.1 | Known effects | Another CA* responsible | No other CA* responsible, future regulation/management realistically achievable | No other CA* responsible, future regulation/management <u>not</u> realistically achievable |
|---------------------------|--|------------------------------------|---|--|
| A | Nutrient enrichment from phosphate input | Natural England, Local Authorities | n/a | n/a |
| | | | | |
| | | | | |
| | | | | |

* CA = Competent Authority

A5.2 Water Resources

Table A5.2.1 Outcomes of stage 3 Appropriate Assessment and issues identified for the River Avon SAC

| Permission No. | Site Name | Adverse effect on site integrity can be shown | | No adverse effect on site integrity cannot be shown | | Impact (I) or a Risk (R) if cannot conclude there is no impact. | Impact type:- Actual (A) Modelled (M) or Suspected (S) | Nature of Impact on particular species (see SAC Interest Features below table) | Known effects from other sources eg. CA's?* | Permission relevant to another site? If Yes list site. |
|------------------|---|---|----------------|---|----------------|---|--|--|---|---|
| | | Alone | In Combination | Alone | In Combination | | | | | |
| 13/43/023/G/212 | Codford & Chitterne Boreholes | | | Y | | R | M | Various impacts with potential to affect – 4 & 6 | No | No |
| | | | | Y | | R | M | | | |
| 13/43/023/G/238† | Brixton Deverill Boreholes Kingston Deverill Boreholes | | | Y | Y | R | M | Various impacts with potential to affect – 4 & 6 | No | No |
| | | | | | Y | R | M | | | |
| 13/43/024/G/019 | Newton Toney Boreholes | | | Y | | R | M | Various impacts with potential to affect – 4 & 6 | No | No |
| 13/43/026/G/104 | Clarendon Park Borehole A&B and C&D | | | Y | | R | M | Various impacts with potential to affect – 4 & 6 | No | No |
| 13/43/026/S/119 | Barford Fish Farm | | | Y | Y | R | M, S | Various impacts with potential to affect – 4 | No | No |
| 13/43/026/S/120 | Britford Fish Farm | | | Y | Y | R | M, S | Potential to entrain parr – 4 | No | No |
| 13/43/028/S/132 | Bickton Fish Farm | | | Y | Y | R | M, S | Various impacts with potential to affect – 4 | No | No |
| Exempt | Bulford Camp | | | Y | | R | M | Various impacts with potential to affect – 1, 2, 3, 4, 5, 6 | A | n/a |
| Exempt | CBDE Idmiston | | | | Y | R | S | Various impacts with potential to affect – 1, 2, 3, 4, 5, 6 | A | n/a |

| Permission No. | Site Name | Adverse effect on site integrity can be shown | | No adverse effect on site integrity cannot be shown | | Impact (I) or a Risk (R) if cannot conclude there is no impact. | Impact type:- Actual (A) Modelled (M) or Suspected (S) | Nature of Impact on particular species (see SAC Interest Features below table) | Known effects from other sources eg. CA's?* | Permission relevant to another site? If Yes list site. |
|----------------|-----------------------|---|----------------|---|----------------|---|--|--|---|---|
| | | Alone | In Combination | Alone | In Combination | | | | | |
| Exempt | CBDE Porton | | | | Y | R | S | Various impacts with potential to affect – 1, 2, 3, 4, 5, 6 | A | n/a |
| Exempt | Winterbourne Gunner 2 | | | | Y | R | S | Various impacts with potential to affect – 1, 2, 3, 4, 5, 6 | A | n/a |

* CA = Competent Authority

† Three different PWS abstraction sites are linked to this single licence number. Heytesbury PWS was not of concern but two others listed are in Stage 4 for consideration.

SAC Interest Features

1 = *Cottus Gobio* (Bullhead), 2 = *Lampetra planeri* (Brook Lamprey), 3= *Petromyzon marinus* (Sea Lamprey), 4 = *Salmo salar* (Salmon), 5 = *Vertigo moulinsiana* (Desmoulin's whorl snail), 6 = Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation.

Table A5.2.2 Known effects from other sources

| Reference to Table A5.2.1 | Known effects | Another CA* responsible | No other CA* responsible, future regulation/management realistically achievable | No other CA* responsible, future regulation/management <u>not</u> realistically achievable |
|---------------------------|--|--|---|--|
| A | Likely effect on upper Avon and localised issues on River Bourne | MOD but currently licences exempt until new licence regime is in place. See B3.1 | n/a | n/a |
| | | | | |
| | | | | |
| | | | | |

- CA = Competent Authority

A5.3 Radioactive Substances

A5.3.1 Outcomes of stage 3 Appropriate Assessment and issues identified for the River Avon SAC

| Permission No. | Site Name | Adverse effect on site integrity can be shown | | No adverse effect on site integrity cannot be shown | | Impact (I) or a Risk (R) if cannot conclude there is no impact. | Impact type:- Actual (A) Modelled (M) or Suspected (S) | Nature of Impact on particular species (see SAC Interest Features below table) | Known effects from other sources eg. CA's?* | Permission relevant to another site? If Yes list site. |
|----------------|------------------|---|----------------|---|----------------|---|--|--|---|---|
| | | Alone | In Combination | Alone | In Combination | | | | | |
| CC3727 | Dstl Porton Down | | | Y | | R | M | Potential impact on all interest features – 1, 2, 3, 4, 5, 6 | No | No |

* CA = Competent Authority

SAC Interest Features

1 = *Cottus Gobio* (Bullhead), 2 = *Lampetra planeri* (Brook Lamprey), 3= *Petromyzon marinus* (Sea Lamprey), 4 = *Salmo salar* (Salmon), 5 = *Vertigo moulinsiana* (Desmoulin's whorl snail), 6 = Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.

SECTION B OUTCOMES REQUIRED FOR RIVER AVON SAC

B1 Overall environmental outcome statement

The following statement regarding conservation objectives has been taken from Natural England's 'River Avon System conservation objectives and definitions of favourable condition for designated features of interest'¹ document. This was produced in 2008 and covers all designated features on the River Avon, whether designated as SSSI, SPA, SAC or Ramsar features.

Conservation objectives statement for the River Avon:

"The Conservation Objectives for this site are, subject to natural change, to maintain the following habitats and geological features in favourable condition (or restored to favourable condition if features are judged to be unfavourable), with particular reference to any dependent component special interest features (habitats, vegetation types, species, species assemblages etc.) for which the land is designated (SSSI, SAC, SPA, Ramsar) as individually listed."

Natural England's guidance was sought via a meeting and written correspondence in October 2009, in relation to devising specific environmental outcomes for this Site Action Plan. They advised that the above document was used as a guide and the environmental outcomes have been produced with this in mind. The main concerns from the permissions that are in stage 4 are focused on water quality and water resource issues.

¹ River Avon System conservation objectives and definitions of favourable condition for designated features of interest, Natural England, 2008.

B2 Water Quality

We have used the conservation objectives provided by Natural England and developed them further to deal with the specific issues identified in the stage 3 work. These are listed in the following table which also includes the outcome most likely to protect integrity of the site.

Features at risk of being impacted are:

- Bullhead
- Atlantic salmon
- Desmoulin's whorl snail
- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation

Table B2.1 Appropriate environmental outcome required

| Site issue | Discharge | Environmental outcome |
|---|--|---|
| Potential nutrient enrichment from discharge of phosphate into watercourse. | Sewage Treatment Works Fish Farms Watercress Farms | Phosphate levels in the river should be improved to contribute towards achieving the phosphate targets*. Environment Agency permissions will be regulated to ensure there is no adverse effect on the interest features of the SAC. |

* taken from WQTAG048b

B3 Water Resources

Features at risk of being impacted are:

- Atlantic salmon
- Water courses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation*

Table B3.1 Appropriate environmental outcomes required

| Site issues | Abstraction | Environmental outcomes |
|---|-----------------|---|
| Deprived reaches Barriers to fish passage Inadequate screening | Fish Farms | To ensure that the Environment Agency permissions in Stage 4 do not have an adverse effect on the overall integrity of the River Avon SAC, the following outcomes should be achieved within the areas relevant to the permissions: ➤ An appropriate flow regime ➤ Unimpeded movement of salmon at all life stages |
| Flows (particularly between low flows and average flow periods) diverge unacceptably from natural conditions due to anthropogenic influences. | Water companies | |

B3.1 Ministry of Defence (MoD) abstractions (Crown exempt) – New information/other management requirements

At this stage, the probable impact of the MoD abstractions on the SAC has been modelled using the Hampshire Avon groundwater model (HAM), but this work has not been progressed further, as the MOD abstractions are outside of the regulatory control of the Environment Agency until the Crown Immunity is lifted. This exemption should be removed once the relevant provisions of the Environment Act 1995 are commenced, and the Environment Agency is awaiting guidance on the final timetable for this process from Defra. Indications are that the guidance on the timetable will not start before the 1st October 2010. It has been suggested to run the removal of exemptions under the Environment Act in parallel with exemptions being removed under changes brought about by the Water Act 2003 such as trickle irrigation, quarry dewatering, but this is to be confirmed.

There are small localised impacts on the River Bourne from the abstractions at Idmiston, Porton and Winterbourne Gunner. These will need careful review for possible in-combination effects once the exemption is lifted. Of greater concern, is the impact of the abstraction at Bulford camp on the Nine Mile River, itself undesignated but an important tributary of the upper Avon and possible impacts on a section of the upper Avon itself. Abstraction data needs to be carefully reviewed and remodelled once this site enters the licensing process.

Potential concerns will be addressed through the new authorisation process once established.

* The habitat suitable for this vegetation type could be impacted over time by excessive abstraction leading to reduced levels and flow. This can contribute to impacts such as increased siltation and reduced dilution of consented and diffuse inputs. The macrophyte community may therefore be exposed to increased periods of sub-optimal conditions.

B4 Radioactive Substances – New information

Since the stage 3 appropriate assessment was completed, a further assessment of the potential impact of the discharge to groundwater has been carried out for the Porton Down permission (CC3727). The results of the new assessment have shown that we can now conclude no adverse effect on site integrity for this permission.

See Appendix A for the full groundwater assessment.

SECTION C OPTIONS AVAILABLE

C1 Water Quality – Options Appraisal

C.1.1 Introduction

This section aims to appraise a range of options for stage 4 action for water quality impacts. A summary of the assessment of principles for consents where options have been appraised is shown in table C1.3.5.

C.1.2 Phosphate - Introduction

It is recognised that increased freshwater phosphate concentration can have detrimental effects on the ecology and biodiversity of river systems. Negative effects include increased growth rate and abundance of individual plant species (algae and higher plants), which can lead to eutrophication. Changes in the competitive balance of plant communities have potential knock-on effects for the associated animal life populations, as well as altering the chemical and physical properties of the water.

Guideline phosphate standards for SAC rivers were agreed between the Environment Agency, Natural England and Countryside Council for Wales¹. The standards are based on catchment geology and river size. In the River Avon SAC, the guideline standard is mainly 60µg/l with some reaches having a guideline standard of 40µg/l total reactive phosphorus as an annual average (referred to as phosphate). This guideline standard is not statutory but is an agreed threshold derived to assist judging the ecological condition of the river. Natural England consider that the site is currently in unfavourable condition due to the exceedance of the P guideline standard.

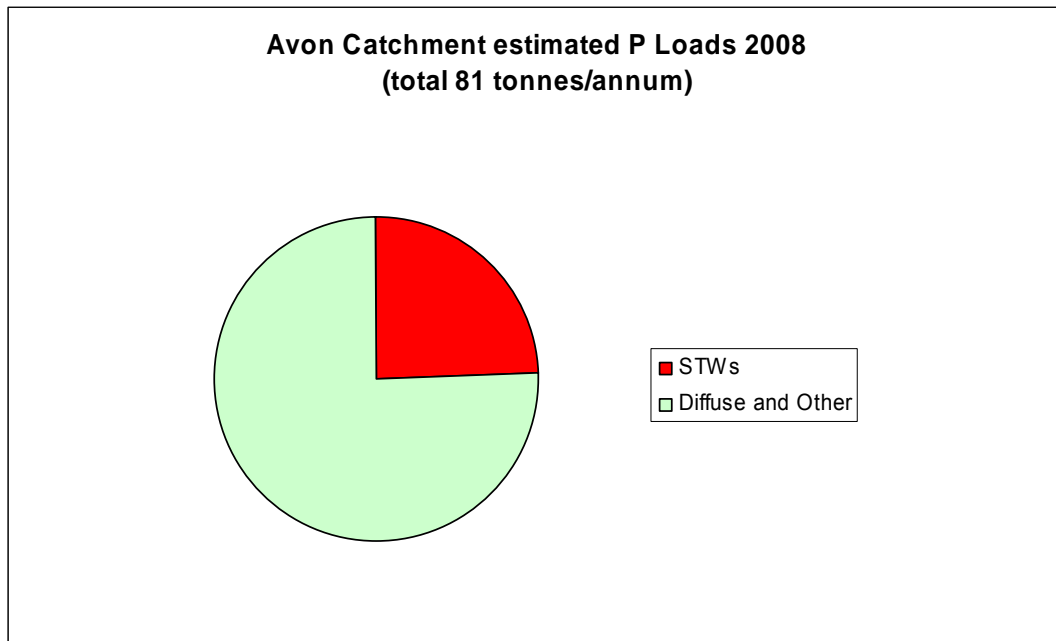
Figures C1.3.1 and C1.3.2 show improving conditions for the site. More information on the current biological status of the site and biological evidence available is described later in this section.

Sources of phosphate in this catchment are characterised as point, diffuse, consented and unconsented. A summary of recent percentage contribution is shown in figure C1.2.1.

Where the text refers to “diffuse “ this should not be interpreted as implying a specific delivery mechanism; rather it implies that the source is not resolvable at the catchment scale but may be discrete. Potential sources of diffuse phosphate pollution include agriculture and (small) unconsented discharges.

¹ WQTAG048b Guideline Phosphate Standards for SAC Rivers (WQTAG, 2002)

Figure C1.2.1 Estimated sources of P loads 2008



Proportional contribution to the reduction of phosphate

The principle of proportionality has been used when considering the emission reductions for discharges. For example if a discharge contributes 70% of the modelled in river concentration then the discharge target of 70% of the relevant SAC phosphate guideline standard should be assigned. If the downstream SAC phosphate guideline standard was 60µg/l then the target would be 70% of 60µg/l, that is 42 µg/l.

Some of the discharges have been subject to AMP improvements, or will have improvements in place by March 2010 (marked with a * in table C1.3.1).

C1.3 Point sources

Point sources were assessed with the help of SIMCAT – a water quality catchment model recommended by the Water Quality Technical Advisory Group (WQTAG) and also the nationally accepted model for river catchment modelling. The point source discharges were ranked and ordered by load and those contributing to 98% of the total load were considered for modelling by SIMCAT, these included 23 Sewage Treatment Works (STWs).

The Environment Agency did not individually model the remaining 2% of the point source discharges (217 discharges) as these were considered to be trivial, however their input will be represented in the model as part of the “diffuse” load which includes all other sources of phosphate. Table C1.3.1 shows the 23 discharges considered for modelling by SIMCAT although only 18 are being considered in Stage 4, as 5 were thought to have no adverse effect on site integrity at Stage 3.

Table C1.3.1 Estimated phosphate loads from modelled discharges prior to improvements.

| Discharge | Load phosphate (tonnes per annum) Pre - AMP | Consent No. |
|---|--|--------------------|
| Salisbury STW* | 40.3 | 401382 |
| Warminster STW* | 9.4 | 402466 |
| Fordingbridge STW* | 8.2 | 401342 |
| Ringwood STW* | 6.2 | 402536 |
| Netheravon STW* | 5.9 | 401643 |
| Amesbury STW* | 5.7 | 401518 |
| Ratfyn STW* | 5.0 | 401500 |
| Downton STW* | 3.3 | 041354 |
| Pewsey STW* | 2.6 | 042464 |
| Great Wishford STW* | 2.5 | 041799 |
| Tisbury STW* | 2.4 | 040095 |
| Hurdcott STW* | 1.3 | 040044 |
| Warminster Garrison | 1.2 | 043172 |
| Shrewton STW* | 1.1 | 040080 |
| Fovant STW* | 1.0 | 401338 |
| Marden STW* | 0.7 | 040056 |
| Upavon STW* | 0.5 | 041321 |
| Barford St Martin STW* | 0.3 | 041560 |
| Sites below this point in this table not considered in Stage 4 | | |
| Nunton STW (Ebbleside Villas) | 0.1 | 400579 |
| The Red Shoot Inn | 0.1 | 041493 |
| Trenchard Lines | 1.2 | 043264 |
| Little Down View | 0.1 | 400838 |
| Heytesbury HouseCaravan Park | 0.1 | |
| Total | 99.4 | |

* All these STWs will have had AMP improvements by March 2010

Other point source discharges contributing to phosphate (alone)

In addition to the point sources contributing to the 98% of the load there are five fish farm consents (see table C1.3.7) where it was not possible to reach a conclusion of no adverse effect alone at Stage 3 for the input of phosphate. These were discussed in a supplementary report at Stage 3. Options for how to deal with these consents are discussed on page 37.

Asset Management Programme (AMP) 4 improvement schemes

17 of the 18 discharges identified in table C1.3.1 are water company discharges and were identified for improvement schemes in AMP 4, driven by known Urban Waste Water Treatment Directive and Habitats Directive requirements. While all Habitats Directive schemes included in AMP were subject to confirmation pending the outcome of the Review of Consents, for this site

there was sufficient certainty in the required design performance to allow these schemes to be delivered prior to finalising stage 4.

For these consents, phosphate stripping has been secured at all STWs through the AMP and will be in place by March 2010. The reduced emission levels comply with Review of Consents guidance (WQTAG048b) for discharges, which sets out an emission limit of 1mg/l total phosphorus for discharges with population equivalents greater than 1000, and 2 mg/l total phosphorus for population equivalents from 250 to 1000. An emission limit of 1mg/l total phosphorus is currently considered to represent Best Available Technology (BAT)².

The effect of the AMP programme improvements, described above, at the 17 STWs on SAC phosphate concentrations were examined using the SIMCAT model and concentrations were compared against proportional phosphate concentration targets. Table C1.3.2 below lists the targets and the SIMCAT predictions for each of the modelled 17 Works.

Table C1.3.2 Proportional Targets for Discharges and Predicted Concentrations (from SIMCAT)

| Discharge | Target Concentration (phosphate) (µg/l) | Predicted Concentrations (phosphate) (SIMCAT) (µg/l) |
|-----------------------|--|--|
| Pewsey STW | 43 | 44 |
| Marden STW | 17 | 14 |
| Upavon STW | 24 | 14 |
| Netheravon STW | 34 | 24 |
| Ratfyn STW | 41 | 33 |
| Amesbury STW | 42 | 37 |
| Tisbury STW | 16 | 11 |
| Fovant STW | 25 | 13 |
| Barford STW | 16 | 9 |
| Warminster STW | 47 | 91 |
| Shrewton STW | 8 | 6 |
| Great Wishford STW | 31 | 25 |
| Hurdcott STW | 43 | 38 |
| Salisbury STW | 44 | 47 |
| Downton STW | 44 | 43 |
| Fordingbridge STW | 45 | 43 |
| Ringwood STW | 46 | 43 |

² At present, BAT is considered to be 2 mg/l for discharges with population equivalents from 250 to 1000 and 1mg/l for population equivalents greater than 1000.

The implementation schedule for the phosphate reduction at these 17 works is shown in table C1.3.3. AMP3 reductions were driven by the requirements of the Urban Waste Water Treatment Directive and some of the improvements were perceived to be needed under the forthcoming (at the time) Review of Consents process. In AMP 3 reductions were to 2mg/l total phosphorus. In AMP 4 all of the works are to be treated to BAT and a number of additional discharges improved. As the table shows the larger discharges have had their consents tightened from 2 mg/l to 1 mg/l with the resulting reduction of P shown in figure C1.3.2. Averaged across all water company improvements the proportional reduction in phosphate is met.

Table C1.3.3 Proposed and undertaken P stripping under the AMP programme (December 2009)

| AMP 3 | Proposed | Undertaken | Total phosphorus limit (mg/l) |
|-----------------------|-----------------|-------------------|--------------------------------------|
| SalisburySTW | | ✓ | 2 |
| Pewsey STW | | ✓ | 2 |
| Warminster STW | | ✓ | 2 |
| Ratfyn STW | | ✓ | 2 |
| Amesbury STW | | ✓ | 2 |
| Ringwood STW | | ✓ | 2 |
| Netheravon STW | | ✓ | 2 |
| AMP 4 | Proposed | Undertaken | Total phosphorus limit (mg/l) |
| Salisbury STW | ✓ | | 1 |
| Warminster STW | | ✓ | 1 |
| Pewsey STW | | ✓ | 1 |
| Ratfyn STW | | ✓ | 1 |
| Amesbury STW | | ✓ | 1 |
| Ringwood STW | | ✓ | 1 |
| Netheravon STW | | ✓ | 1 |
| Fordingbridge STW | | ✓ | 1 |
| Fovant STW | ✓ | | 1 |
| Great Wishford STW | ✓ | | 1 |
| Hurdcott STW | | ✓ | 1 |
| Shrewton STW | | ✓ | 1 |
| Tisbury STW | ✓ | | 1 |
| Downton STW | ✓ | | 1 |
| Upavon STW | ✓ | | 1 |
| Marden STW | ✓ | | 2 |
| Barford St Martin STW | ✓ | | 2 |

For 14 of these STWs (table C1.3.4) installation of new treatment technology to BAT has resulted in modelled improvements equal to or in excess of those required to remove the individual discharge's proportional contribution to the adverse effect. A conclusion of no adverse effect on the integrity of the site has been reached for these discharges alone and in-combination.

Due to the timing of these improvements the modelling and assessment focussed on whether these improvements were sufficient to meet the requirements of the Habitats Regulations.

Table C1.3.4 Table of STWs with a conclusion of no adverse effect on site integrity in combination

| Discharge | Consent No. |
|-----------------------|--------------------|
| Fordingbridge STW | 401342 |
| Ringwood STW | 402536 |
| Netheravon STW | 401643 |
| Amesbury STW | 401518 |
| Ratfyn STW | 401500 |
| Downton STW | 041354 |
| Great Wishford STW | 041799 |
| Tisbury STW | 040095 |
| Hurdcott STW | 040044 |
| Shrewton STW | 040080 |
| Fovant STW | 401338 |
| Marden STW | 040056 |
| Upavon STW | 041321 |
| Barford St Martin STW | 041560 |

For two of the three remaining water company licences (Salisbury STW, 401382 and Pewsey STW, 042464) treating to BAT moves a significant way to removing the individual discharges proportional contribution but does not remove it completely. The non-compliance is within the bounds of uncertainty of the modelling and a conclusion of no adverse effect on integrity has been reached for these discharges. The third consent in these three was slightly different and this is discussed below.

CONSENT NUMBER 402466 (Warminster STW)

The river downstream is modelled to exceed the guideline standard for phosphate alone. The proportional contribution has not been met, in this instance, after the improvement works have been carried out and table C1.3.5 shows the summary of options considered to address this consent. More detail on each option is described in text following the table. Doing nothing is not an option and this is therefore excluded from any further discussion.

Options appraisal for Warminster STW

RAvon_WQ_WSTW_OP01: Revoke Consent

Background levels of phosphate would remain in non-compliance of the guideline standard for phosphate. Other implication would be a significant impact on the development of the large conurbation. **This is not considered further.**

RAvon_WQ_WSTW_OP02: Move location of discharge within or outside of catchment

Relocating the discharge within or out of the catchment is not possible as it would require a significant amount of infrastructure and energy. There would be significant adverse environmental consequences. The background levels of phosphate would remain exceeding the guideline standard. **This is not considered further.**

RAvon_WQ_WSTW_OP02a: Transfer some / all effluent to another STW (within or to another catchment)

Transfer of effluent within or out of the catchment would require a significant amount of infrastructure and energy. There would be significant adverse environmental consequences. The background levels of phosphate would remain exceeding the guideline standard. **This is not considered further.**

RAvon_WQ_WSTW_OP03: Treatment to BAT (Affirm post AMP consent), but remove headroom

Modelling work at stage 3 demonstrates that reducing flow (and amending the consent to BAT) would make little difference to levels of P. Without biological evidence of adverse impact in this instance we are unable to demonstrate adverse effect on the site integrity. This option was not chosen as we do not consider it reasonable to impose a P level tighter than BAT when there is no demonstrable biological effect and the river will continue to exceed the P threshold. **This is not considered further.**

RAvon_WQ_WSTW_OP04: Treatment to BAT (ie affirm post AMP consent) and address other sources of phosphate

The high levels of background/diffuse phosphate input to the River Avon SAC means that despite the very large improvements that can be achieved through phosphate stripping at all the significant STW discharges regulated by the Environment Agency, the guideline standard will still not be reached.

The modelling indicates that the guideline standard would still be exceeded even if all the Water company discharges were revoked. This option considers addressing other sources of phosphate and the need for other work before further changes are made to this consent.

Prior to any of the phosphate reduction measures, approximately 92% of the River Avon SAC exceeded the guideline phosphate levels. This is indicated in figure C1.3.1. Within the SAC the majority of the points were three to four times the SAC guideline target of 60 µg/l. Figure C1.3.2 shows the reduction in phosphate in the River Avon system after the implementation of the AMP scheme works. The reduction is greater than the modelling predictions which were conservative in approach. The contribution from the STW, inferred, is less than the 60ug target.

Figure C1.3.1 Annual mean phosphate concentrations 1997-99

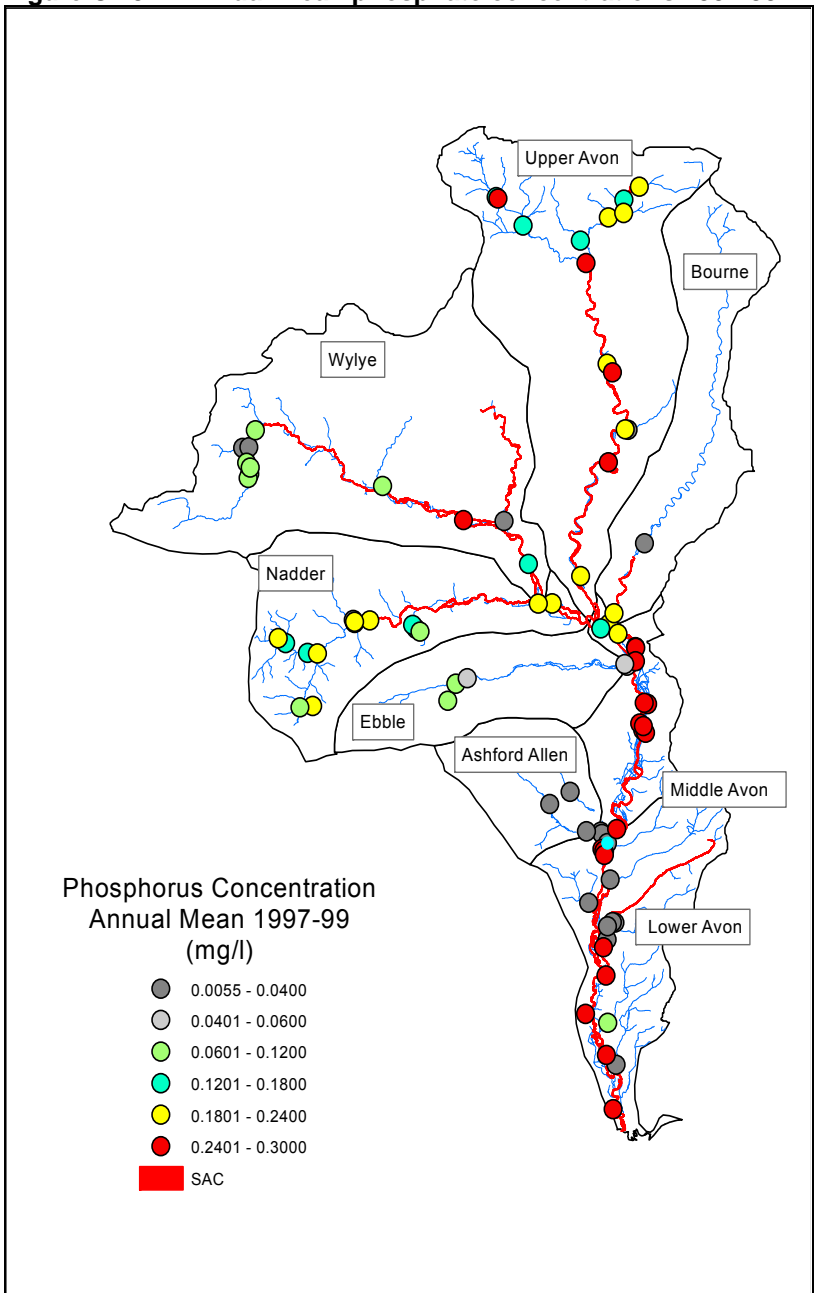
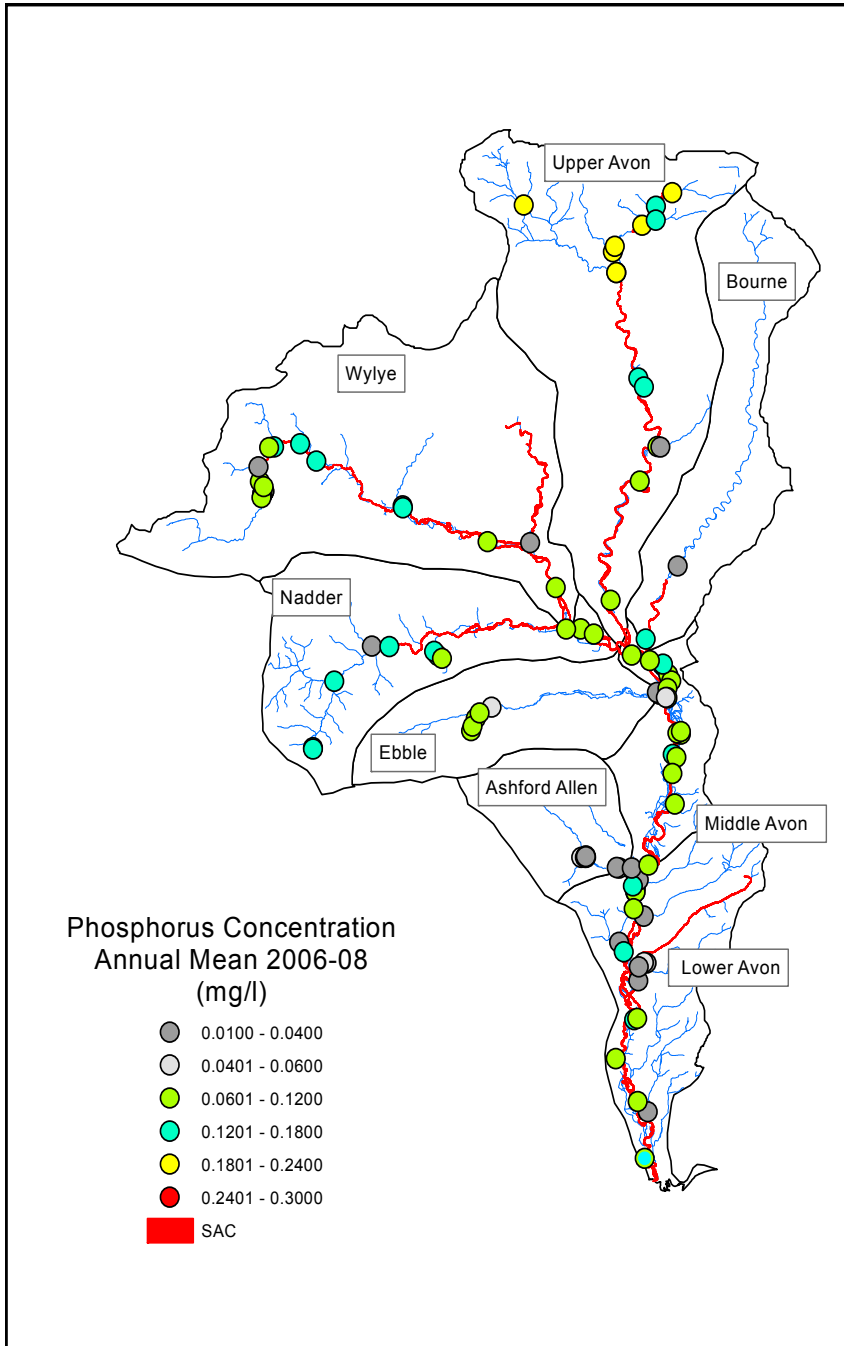


Figure C1.3.2 below shows the recent phosphate sampled concentrations in the catchment. The effect of the AMP improvements, so far, is clear, with concentrations significantly reduced.

Figure C1.3.2 Annual mean phosphate concentrations 2005-08 following the implementation of the majority of the AMP schemes.



As improvements that will be in place by March 2010 will reduce the phosphate load to the river from 99.5t/a to 19.9t/a, an 80% reduction. Modelling indicates that the guideline standard would still be exceeded even if all the Environment Agency authorised discharges were revoked.

The river will still fail to meet the guideline standard if Warminster is removed from the equation. Figures C1.3.3 and C1.3.4 further indicate the input of Warminster in comparison to other sources of P and the reduction as a result of AMP improvements.

Figure C1.3.3 Levels Concentrations of P 1997-1999 from River Wylfe.

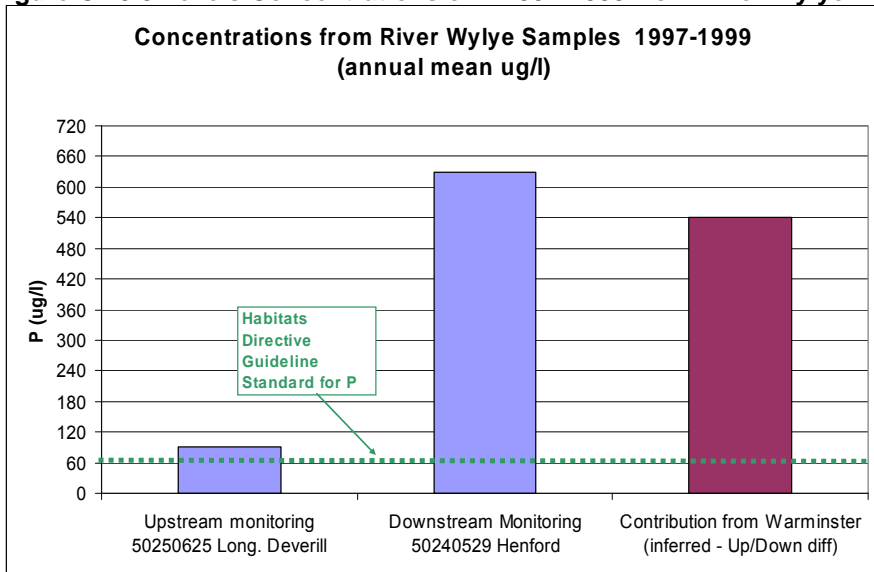
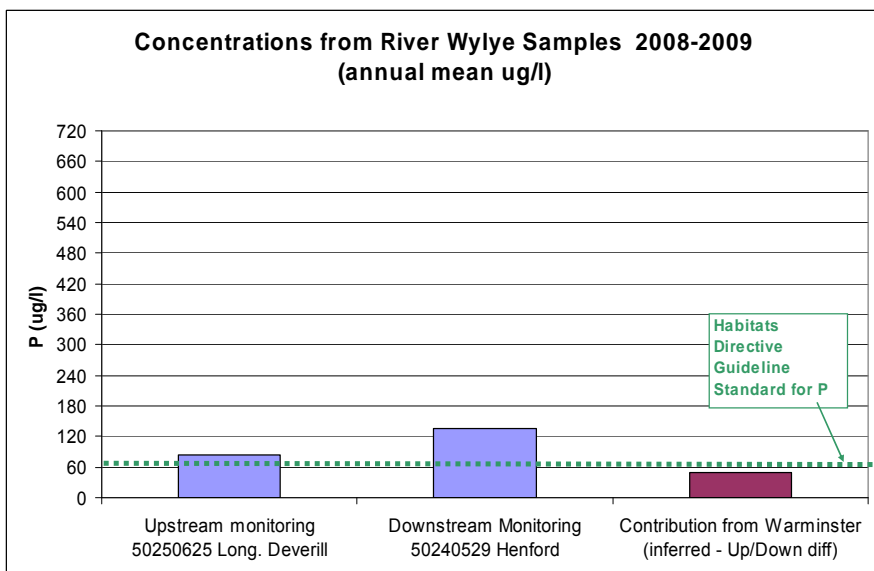
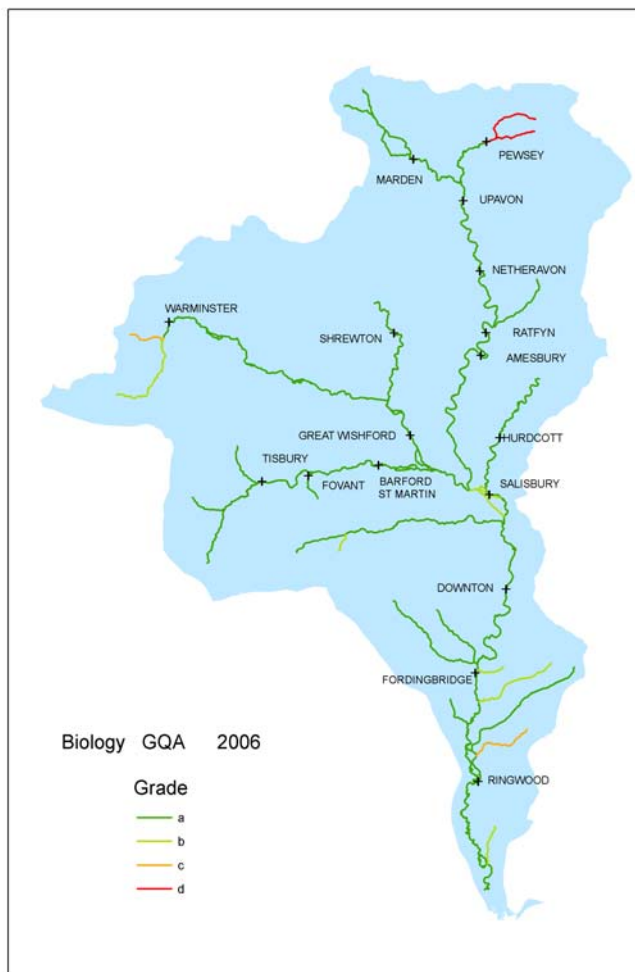


Figure C1.3.4 Concentrations of P 2008-2009 from River Wylfe



GQA biological quality assessment shows that downstream of this consent the river is classed as “good”, (see figure C1.3.5). Other than the exceedance of the guideline standard for P no further information has been presented to indicate that the conditions are not suitable for macrophytes (eg no survey showing uncharacteristic flora or observations of excess algae). More recent monitoring for the Water Framework Directive (WFD) does not indicate any failure of biological elements. The WFD applies a standard of 120 mg/l P to achieve good ecological status.

Figure C1.3.5 Biological GQA for the River Wylfe and Avon



Further information:

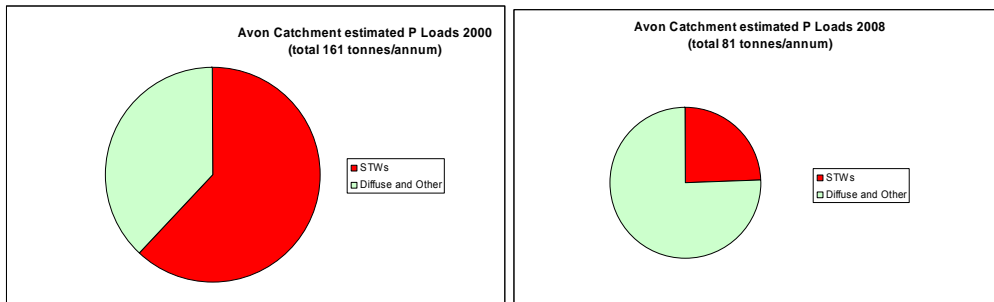
It is acknowledged that this option leaves the consent not meeting its proportionate contribution however Defra advised that it was “appropriate to use water quality targets within conservation objectives as part of a weight of evidence approach to assessing site condition and that existing methods would continue to apply for the review of consents. However, an exceedance of a nutrient target would not prevent a conclusion of no adverse effect in the absence of supporting biological evidence. Taking this approach should provide a more robust and defensible assessment of the impact of a consent application under consideration”³.

Part of this option would also include the production and implementation of a Phosphate Management Plan to address diffuse sources of phosphate such as farming and unconsented point sources. Details of this plan are described below.

Phosphate Management Plan

The Environment Agency and Natural England have agreed that a Nutrient Management Plan for the Hampshire Avon SAC will be written looking at other sources of phosphate such as farming, groundwater and unconsented point sources and the appropriate action needed to address these. These diffuse sources (see figure C1.3.6) will be detailed further in the proposed plan. The implementation of this nutrient management plan fulfils Regulation 51(3) of the Habitats Regulations 1994 and supports a conclusion of no adverse effect for this consent on the basis of other action being taken. The Environment Agency has agreed that if biological evidence of adverse effect for this consent has been identified after other sources of phosphate have been addressed then the consent will be re-visited.

Figure C1.3.6 Summary illustration of reduction in P load & other source contribution as a result of AMP 3 and 4 improvements



Some historic contamination from groundwater may be beyond the control of any competent authority.

³ Letter from Chris Ryder, DEFRA head of water quality to John Fraser, EA Head of water quality (27 August 2007).

| | |
|---|---|
| Regulation 51(3) ACTION: | |
| Nutrient Management Plan to address diffuse sources of phosphate to the River Avon SAC | |
| Objective | To ensure that diffuse sources of phosphate to the River SAC are addressed |
| Who ? | Environment Agency, Natural England and other competent authorities. |
| What ? | Plan for implementation |
| Measure Secured ? | Yes. A Phosphate management plan will be written to address other sources of P (Natural England, Environment Agency and other relevant parties). |
| When ? | The plan is agreed and will be produced by end December 2010 with implementation as soon as reasonable practicable |

Checklist : Action taken or to be taken by the Environment Agency and other bodies

| Summary of the action : | Yes or No |
|---|---|
| 1. Will the action taken offset identified adverse effects arising from the consented activity to secure no adverse effect on the integrity of the European site concerned? If no, the answer to Q 2 must be yes. | No |
| 2. Will the action, taken in conjunction with other actions, offset identified adverse effects arising from the consented activity to secure no adverse effect on the integrity of the European site concerned? | Yes in combination with RAvon_WQ_WSTW_OP 04 |
| 3. Is this action clearly defined? | Yes |
| 4. Is the action sustainable? | Yes |
| 5. Can the action and its effectiveness be measured? How? | Yes - combination of modelling & monitoring |
| 6. Has a mechanism for achieving the action been defined? What? | Catchment Sensitive Farming + other actions of competent authorities. |
| 7. Is it realistic to assume such action will be taken? | Yes |
| 8. Is the action time bound in terms of start date, duration and end date? Define. | Yes - Plan to be written by end Dec 2010. Plan will detail current activity, timescale of future actions and expected outcomes. |
| 9. Is the action scientifically and technically feasible? | Yes for actions within control of competent authorities. |
| 10. Is the action cost effective, taking into consideration the degree of threat and rarity of the habitat or species population concerned? | Yes (not quantified) |
| 11. Is there an available delivery mechanism? | Yes |
| 12. Is budget / funding, available / committed? | Yes – to be defined |
| 13. Will the proposed action have adverse effects on other features of this or other Natura 2000 sites or features of nature conservation importance? | No |
| 14. Have targets for the action and monitoring protocols been agreed? | No |
| 15. Are contingency measures and mechanisms in place that would be implemented in the event of agreed targets not being met or action not being undertaken? | No |

| | |
|--|---|
| 16. Are legal agreements in place to secure the necessary action to be taken including funding, monitoring and contingency measures? | No |
| 17. Did Stage 3 appropriate assessment demonstrate the consented activity was having an adverse effect on site integrity or conclude that it could not show no adverse effect? | Conclusion was that it could not show no adverse effect. |
| 18. Will the action, in conjunction with the affirmation/modification of the Environment Agency consent, secure the integrity of the Natura 2000 site? | Unclear due to the nature of the site. See "further information" above. |
| 19. Is the European site currently in favourable condition (favourable conservation status)? | No |
| 20. Will the action maintain or restore the site to favourable conservation status? | It will contribute towards restoring Favourable condition status. It will address other sources of phosphate to ensure they meet their proportionate reduction. |
| 21. Is other action needed to maintain or restore the site to favourable conservation status? If so describe why, what action is needed and by which authorities. | Unknown. |

AMP Improvements

Proportionate action on other sources will be addressed through a Phosphate Management Plan. The reduction of phosphate must be equitable between all sources. All AMP improvements will impose consent limits to best available technology (BAT). Overall, across AMP improvements that will be made, the proportionate improvement for these permits is achieved.

Other significant works are also continuing within the River Avon catchment as summarised below:

Work with farmers (phosphate and sediment)

Since the mid-1990s, the Hampshire Avon catchment has been the focus of partnership working with farmers to promote best farming practices. It is now part of the England Catchment Sensitive Farming Delivery Initiative. Active engagement with farmers in the priority areas in the catchment focuses on nutrient and soil management. The use of sediment fingerprinting techniques will improve the understanding of sediment movement in the catchment and enable advice to be targeted more appropriately. Planned work to reduce connectivity such as by improving drainage from tracks should also help improve the status of some key sites which currently receive a lot of direct runoff via tracks.

Joint Hampshire Avon Next Steps group

In early 2009 a joint Next Steps group was set up with Natural England, Environment Agency and CSF to progress water quality issues on the Hampshire Avon. This organised, roundtable approach will enable integrated management of the catchment. This will enable focused actions and the delivery of more environmental outcomes.

Joint Hampshire Avon phosphate subgroup

As an outcome from the Next Steps group, a technical subgroup has been established to pull together information about the sources and impact of phosphate on the Hampshire Avon. This is to be completed by April 2010 to contribute to the integrated action plan being produced.

DEFRA Catchment Demonstration Project

The Hampshire Avon has been promoted as part of DEFRA's Catchment Demonstration project. This project will scale up knowledge on diffuse pollution, ecological impact and flood risk, gained at the plot, field and farm scale in the catchment. It will also trial new approaches to source and pathway control. The outputs from this project will identify new opportunities and approaches to tackle diffuse pollution problems in the Hampshire Avon catchment as part of the voluntary approach.

Conclusion for CONSENT NUMBER 402466 (Warminster STW)

RAvon_WQ_WSTW_OP04 Treatment to BAT (affirm post AMP consent) and address other sources of Phosphate is considered the most appropriate option as described in detail above.

Table C1.3.5 Summary of Options Appraisal for Warminster STW

| Option | Risk (will option meet environmental objective?) | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|---|--|---|--|--|--|----------------|--|
| Impact – Phosphate levels | | | | | | | |
| RAvon_WQ_WSTW_OPO 1: Revoke Consent | Would meet proportional contribution for consent “alone”, but phosphate guideline standard still in exceedance due to unconsented and diffuse sources of phosphate. Consent holder has right of appeal. | Cost to consent holder. Not quantified but likely to be very high if sewage has to be pumped to a new/different STW elsewhere. | Without development of alternatives there would be no sewage treatment for the existing residents in Warminster area. Development of new treatment would be very costly – these costs would have to be passed to customers. | Major impact on consent holder and knock on effect on customer bills. Major impact on Warminster growth in terms of businesses and population/housing growth. | Point source would be removed but the ecological threshold (the concentration below which an ecological response to changing phosphate levels can be expected) would still be exceeded. Currently no appropriate methods of waste water treatment so resulting pipelines to pump to another catchment would have environmental effects during construction and ongoing pumping needs would result in high carbon footprint. | None | No |

| Option | Risk (will option meet environmental objective?) | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|---|---|--|--|--|---|----------------|--|
| RAvon_WQ_WSTW_OPO 2: Move location of discharge within or out of catchment | Would meet proportional contribution for consent “alone” but phosphate guideline standard still in exceedance. Consent Holder has right of appeal. | Cost to consent holder. Not quantified but envisaged to be high. | Increased water bills. For “out of” adjoining catchment may not accept this action. | Major impact on consent holder. Major capital expenditure to replace the STW is not included within the licence holders business plans. Reduces licence holder profits and requirement to pass costs onto customers. | Point source would be reduced but the ecological threshold would still be exceeded. Wider environmental consequences e.g. increased carbon footprint from energy needed to remove phosphate, construction impact. | None | No |
| RAvon_WQ_WSTW_OPO 2a: Transfer some/all effluent to another STW (within or outside of catchment) | Would meet proportional contribution for consent “alone” but phosphate guideline standard still in exceedance. | Not quantified but likely to be very high if sewage has to be pumped to a new/different STW elsewhere. | Cost to consent holder. Not quantified but envisaged to be high. | Increased water bills. For “out of” adjoining catchment may not accept this action. | Point source would be reduced but the ecological threshold) would still be exceeded. Wider environmental consequences e.g. increased carbon footprint from energy needed to remove phosphate, construction impact. | None | No |
| RAvon_WQ_WSTW_OPO 3: Treatment to BAT, (affirm post AMP consent) but remove headroom. | Would meet proportional contribution for consent “alone”.but phosphate guideline standard still in exceedance. | Not quantified. | No future housing growth at Warminster. | Significant effect on consent holder. | Point source would be reduced but no change in exceedance of phosphate in River SAC. | None | Yes |

| Option | Risk (will option meet environmental objective?) | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|---|---|---|--|--|--|----------------|--|
| RAvon_WQ_WSTW_OPO 4: Treatment to BAT (affirm post AMP consent) and address other sources of phosphate. | Would not meet proportional contribution for consent "alone".but significant reduction in phosphate from other sources. | Further costs in maintaining and monitoring discharge. Cost for action on other phosphate sources. | No anticipated social consequences. Potential change in practice for other sources of phosphate eg farmers. | Potential impact on other sources of phosphate eg farmers. | Diffuse sources of phosphate would be reduced. Wider issue of phosphate may not be fully addressed. | None | Yes |

Risk: e.g. how likely is it that the objective will not be achieved by implementation of this option? Are there any other permissions which need to be gained before the solution can be implemented (e.g. planning permission).

Costs: what are the costs of implementing the option?

Social consequences: e.g. will implementing the option have a social cost such as loss of jobs?

Economic effects: e.g. will changes required in a business mean they are more or less profitable?

Environmental impact: e.g. what are the environmental consequences of implementing the option?

Sustainability: e.g. will the implementation of the option rely on further management or maintenance to achieve the objective? Does the solution depend on other permissions

Discussion of remaining point source consents in stage 4

Consent 043172 (Warminster Garrison) This discharge is not a water company site and hence was not eligible in the AMP process referred to in table C1.3.3.

We were unable to conclude no adverse effect both alone and in-combination for this consent. The discharge is from Warminster Garrison into a stream which feeds into the River Wylye. The current consented flow condition is 600m³/day maximum flow. At this flow the modelled impact concentration on the river is 49ug/l. Proportionally this is 10% of the total impact giving a proportional target of 6 ug/l. The modelled impact with an emission limit of 1mg/l is 10ug/l. An emission limit of 1mg/l is currently considered to represent Best Available Technology (BAT)⁴

Whilst the impact for the modified consent does exceed the proportional target, it is well within the Habitats Guideline standard of 60ug/l.

Options to address this consent are as follows:

RAvon_WQ_WG_OP01: Do nothing

This option would not deliver towards the environmental objectives for the site in relation to phosphates and so **will not be considered further**.

RAvon_WQ_WG_OP02: Revoke Licence, move discharge outside of catchment

Background levels of phosphate would mean that the river SAC would still not comply with the guideline standard of phosphate and so revocation would not meet environmental objectives.

In addition, costs to achieve this option would be impractical. Moving the discharge would not achieve the environmental objectives and so **this option is not considered further**.

RAvon_WQ_WG_OP03: Install phosphate stripping to 1mg/l as P

The application of phosphate stripping to 1mg/l would reduce the impact from a modelled estimate of 49ug/l to approximately 10ug/l. In practice it is likely to be less than this because of attenuation in the delivery stream.

Whilst the impact for the modified consent does exceed the proportional target, not taking into account attenuation, it is well within the Habitats Guideline standard of 60ug/l.

Conclusions for consent 043172 (Warminster Garrison)

Option **RAvon_WQ_WG_OP03** is considered the most appropriate to meet the discharges proportional reduction in phosphate and deliver the environmental objectives for phosphate in order to ensure no adverse effect on the integrity of the site.

⁴ At present, BAT is considered to be 2 mg/l for discharges with population equivalents from 250 to 1000 and 1mg/l for population equivalents greater than 1000.

Table C1.3.6 Summary of Options Appraisal for Warminster Garrison

| Option | Risk (will option meet environmental objective?) | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|---|--|--|--|---|--|---|--|
| Impact – Phosphate levels | | | | | | | |
| Option 1: RAvon_WQ_WG_OP01: Do nothing | No | None to consent holder but potential environmental costs in the longer term. | None | None | Potential effects on environment through nutrient enrichment. | Not sustainable due to environmental risks. | No |
| Option 2 RAvon_WQ_WG_OP02: Revoke consent or move discharge out of catchment | Yes, but overall phosphate guideline standard still in exceedance. Consent holder has right of appeal. | Cost to consent holder. Not quantified. | If revoked the current site use would not be sustainable. There is no feasible option to discharge to an alternative catchment. | Relocating the discharge would have economic costs to the current user and possible economic consequences for the local area. | Point source would be removed but the guideline standard still in exceedance. | No | No |
| Option 3 RAvon_WQ_WG_OP03: Install phosphate stripping to 1mg/l | Would not meet the proportional contribution for consent but modified consent falls within guideline standard of 60ug/l. | Cost to consent holder. Not quantified. | No anticipated social consequences. | No anticipated economic effects. | Point source would be reduced and help towards meeting guideline standard for phosphate. | Sustainable | Yes |

Fish Farms where a conclusion of no adverse effect could not be made at stage 3 (alone and in-combination)

The approach taken for the fish farm discharges was addressed taking into account the following:

- a) Using available information at the time there were no indications of significant impact on the river comparing upstream and downstream water quality data. This refers to the main river (i.e. not the intake to and from the fish farms)
- b) There are currently no limits for phosphate on these consents. The intention is to develop a differential consent for the discharges to protect the future integrity of the site. On best available data more recently collected by the Environment Agency the indication is that phosphate concentration is increased by approximately 0.02mg/l orthophosphate (as P) This relates to the intake to and from the fish farms and not the main river. This is detailed in the supplementary report on fish farms.

It was considered appropriate to determine limits for P to protect the future integrity of the site and ensure the conservation objectives for the site are met. A “river needs consent” was determined as an appropriate method of addressing these inputs from the discharges using the “Monte Carlo” modelling technique.

The application of a phosphate consent condition will ensure that the operator manages and controls the use of fish feed, and that phosphate concentration data is gathered to support future consent reviews in order to ensure no deterioration.

Table C1.3.7 (Cannot conclude no adverse effect alone)

| Discharge Site Name | Consent No |
|---------------------|--------------|
| BARFORD FISH FARM | 040622 |
| BARFORD FISH FARM | 040623 |
| BICKTON FISH FARM | 050109 |
| BICKTON FISH FARM | 041927 |
| BRITFORD TROUT FARM | 400194/TF/01 |

Table C1.3.8 (Cannot conclude no adverse effect in combination)

| Discharge Site Name | Consent No |
|---|------------|
| DEVERILLS FISH FARM | 040143 |
| ASHFORD WATER FISH FARM | 040171 |
| DAMERHAM FISHERIES LTD | 040181 |
| CHALKE VALLEY FISH FARM | 040182 |
| THE CRESS BEDS (DAMERHAM FISHERIES FISH FARM) | 040477 |
| RIVERSIDE TROUT FARM | 042989 |
| MILLBROOK FISH FARM | 041892 |
| LONGFORD MILL FISH FARM | 041917 |
| MANNINGFORD TROUT FARM | 050104 |
| WATERWAYS HATCHERY | 050748 |
| CRYSTAL SPRINGS TROUT FARM | 050751 |

Options to address these consents for both “alone” and “in-combination” effects are as follows:

RAvon_WQ_FF_OP01: Do nothing

This option would not deliver the environmental objectives for the site in relation to phosphates and so **will not be considered further**.

RAvon_WQ_FF_OP02: Revoke Licences

Revocation would remove phosphate input, however, there is a more reasonable method to achieve the environmental objectives for the site so **this option is not considered further**.

RAvon_WQ_FF_OP03: Modify consent by adding a differential phosphate condition

Based on flow data (provided in the stage 3 supplementary report) a differential consent limit for phosphate would be applied.

A differential value is taken to be equal to the ortho-phosphate guideline standard of the receiving water. This means that if the river meets 0.03mg/l P and the fish farm were to add 0.06mg/l P from site activities, then, with a 1:1 dilution the guideline standard of 0.06mg/l ortho-phosphate (as P) would be achieved downstream.

It is normal consenting practice to base fish farm consent limits setting on a dilution of not less than 1:1 of discharge to receiving water.

A limit of 0.06mg/l expressed as an annual average and based on the difference between the inlet and outlet will prevent these discharges from future deterioration of the site.

The application of a phosphate consent condition will ensure that the operator manages and controls the use of fish feed and that phosphate concentration data is gathered to support future assessments of the consent

Conclusions for consent numbers listed in table C1.3.7 and C1.3.8 (Fish Farms)

Option **RAvon_WQ_FF_OP03** is considered the most appropriate option to reach the environmental objectives for the site and protect future integrity of the site.

Table C1.3.9 Summary of Options Appraisal for Fish Farms

| Option | Risk (will option meet environmental objective?) | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|--|---|--|---|--|---|--|--|
| Impact – Phosphate levels | | | | | | | |
| Option 1: RAvon_WQ_FF_OP01: Do nothing | No | None to consent holder but potential environmental costs in the longer term. | None | None | Potential effects on environment through nutrient enrichment. | Not sustainable due to environmental risks. | No |
| Option 2 RAvon_WQ_FF_OP02: Revoke consent | Yes, but overall phosphate guideline standard still in exceedance. Consent holder has right of appeal. | Cost to consent holder. Not quantified. | Loss of local employment opportunities. | Reduced economic activity in local area. | Would reduce risks to the environment through reduction in phosphate contribution to river. | Not sustainable on social or economic grounds. | No |
| Option 3 RAvon_WQ_FF_OP03: Modify consent by adding a differential phosphate condition. | Would protect future integrity of the site. | None | None | None | Point source would be controlled and help towards meeting guideline standard for phosphate. | Sustainable | Yes |

Watercress Farms where a conclusion of no adverse effect could not be made at stage 3 (in combination)

It was not possible to reach a conclusion of no adverse effect in combination at Stage 3 for three cress bed consents (see table C1.3.10).

Table C1.3.10 (Cannot conclude no adverse effect in-combination)

| | |
|--|--------|
| HILL DEVERILL WATERCRESS FARM (East outlet) | 043223 |
| HILL DEVERILL WATERCRESS FARM (West outlet) | 043224 |
| HILL DEVERILL WATERCRESS FARM (North outlet) | 401224 |

Watercress is grown in shallow gravel beds fed by groundwater springs and bore-holes, providing a constant flow of relatively warm, pure, chalk-filtered spring water. Watercress is a marginal plant and derives most of its nutrients from the water through roots embedded in the gravel. It also uses aerial roots to enable it to absorb even more nutrients. Phosphate fertiliser is applied to the watercress beds to maintain growth rates and keep the crop looking in good condition. Nitrate is generally considered to be in excess in chalk stream environments and phosphate concentrations are the limiting nutrient to plant growth. The River Avon SAC is approximately 750m downstream of Hill Deverill Watercress farm and the river upstream of the site is currently failing to meet the guideline standard for P (0.06mg/l P) agreed for SAC's.

It was considered appropriate to determine limits for P to protect the future integrity of the site and ensure the conservation objectives for the site are met. A "river needs consent" was determined as an appropriate method of addressing these inputs from the discharges using the "Monte Carlo" modelling technique. The results of these calculations show that a phosphate limit will prevent deterioration and protect the future integrity of the site.

The approach taken for the watercress farms was addressed taking into account the following:

- a) The groundwater source concentration is stable.
- b) There are currently no limits for phosphate on these consents and BAT values are not published for watercress farm discharges. The intention is to develop an absolute consent for P the discharges to protect the future integrity of the site.

Options to address these consents for "in-combination" effects are as follows:

RAvon_WQ_WCF_OP01: Do nothing

This option would not protect the future integrity of the site or prevent deterioration in relation to phosphates and so **will not be considered further**.

RAvon_WQ_WCF_OP02: Revoke Licences

Revocation would remove phosphate input, however, there is a more reasonable method to achieve the environmental objectives for the site so **this option will not be considered further**.

RAvon_WQ_WCF_OP03: Modify consent by adding an absolute phosphate condition

In order to protect the future integrity of the site and to meet environmental objectives watercress farm consents will have a limit of 0.1mg/l P expressed as an annual average. Here an absolute consent rather than a differential consent is applied because of the relative stability of the groundwater source. The measure is in line with the precautionary requirements of the Habitats Directive in that the conditions are determined using the maximum consented flow for the discharge.

The application of a phosphate standard will ensure that the operator manages and controls the use of fertiliser and ortho-phosphate concentration data is gathered to support future consent reviews.

This is considered the most appropriate option for these discharges.

Table C1.3.11 Summary of Options Appraisal for Watercress Farms

| Option | Risk (will option meet environmental objective?) | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|--|--|--|---------------------------|--|--|--|--|
| Impact – Phosphate levels | | | | | | | |
| Option 1: RAvon_WQ_WC F_OP01: Do nothing | No. | None to consent holder but potential environmental costs in the longer term. | None | None | Potential effects on environment through nutrient enrichment. | Not sustainable due to environmental risks. | No |
| Option 2 RAvon_WQ_WC F_OP02: Revoke consents | Yes, but overall phosphate guideline standard still in exceedance. | Cost to consent holder. Not quantified. | Loss of local employment. | Reduced economic activity in local area. | Would reduce risk to environment through reduction in phosphate contribution to river. | Not sustainable on social or economic grounds. | No |
| Option 3 RAvon_WQ_WC F_OP03: Modify consent by adding an absolute phosphate condition | Would protect the future integrity of the site. | Minimal | None | None | Point source would be controlled and site integrity would be protected. Most effective measure for site integrity. | Sustainable | Yes |

C2 Water Resources – Options Appraisal

C2.1 Introduction to section

This section contains:

- An overview of the criteria against which the options have been appraised;
- background to salmon as a feature of interest in the SAC;
- appraisal of options for fish farm abstraction licences;
- appraisal of options for public water supply abstraction licences.

C2.2 Options appraisal

The Environment Agency's Stage 4 guidance outlines six main areas for consideration in the appraisal of options, listed below as follows. These topics will be considered in turn for each option.

Risk: e.g. how likely it is that the objective will not be achieved by the implementation of this option? Are there are other permissions which need to be obtained before the solution can be implemented? (e.g. Planning permission)

Costs: what are the costs of implementing the option?

For this report and stage of the process, the appraisal has used very basic and rough estimates at a high level.

Social consequences: e.g. will implementing the option have a social cost such as a loss of jobs?

Economic effects: e.g. will changes required in a business mean they are more or less profitable? The scale and loss of an existing resources and future resource potential could have consequences for the social and economic growth aspirations of the area/region.

Environmental Impact: e.g. what are the environmental consequences of implementing the option?

Sustainability: Is it sustainable? e.g. Will the implementation of the option rely on ongoing management or maintenance? Does the solution depend on other permissions?

C2.3 Salmon as a feature of interest in the SAC

Background

The Environment Agency's work in relation salmon stocks has fed into the decisions made around water resources consents in this review process. It is considered that in relation to the SAC any activity reducing the spawning success and the survival of salmon within the Avon is likely to be having an affect on the site integrity for this feature of interest.

The Environment Agency's principal method for assessing the Avon's current salmon stock is through an assessment of returning adult salmon numbers (using ratified fish counter data) and the conversion of these data into the number of eggs deposited each year. A figure for egg deposition is compared to the minimum desirable spawning stock, this is termed the conservation limit.

A failure of salmon stock to meet its conservation limit indicates that one or more in-river and/or homewater⁵ factors are limiting the stock.

Figure C2.3.1: Salmon egg deposition on the Hampshire Avon, 1979 - 2008

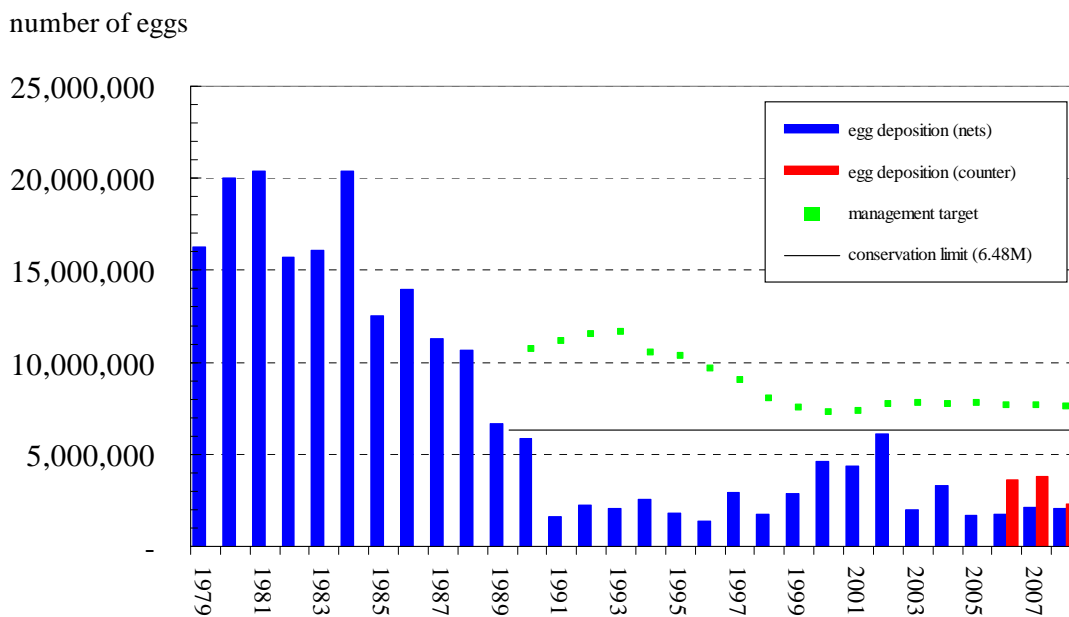


Figure C2.3.1 shows the Hampshire Avon's egg deposition rate for salmon and its compliance with the conservation limit. A management target is also shown which is the figure that should be met in order to achieve the objective of meeting or exceeding the conservation limit in at least four years out of five. It can be seen from these data that the Avon's salmon stock declined markedly towards the end of the 1980s and has since remained at a much reduced level. The stock fails to meet its conservation limit achieving between 35-60% of this figure over the past three years, and is predicted to fail to meet its conservation limit for the next five years.

⁵ Homewater factors are defined as those marine waters within the Environment Agency's jurisdiction for migratory salmonids and generally relate to exploitation.

In 2009 the Environment Agency published the Salmon Action Plan Review for the Hampshire Avon (Environment Agency 2009). This document defines those factors that are considered to be limiting the stocks performance and the actions needed to resolve them, as well as identifying areas of further work that are needed to better understand the key constraints acting on the salmon stock.

Refining the understanding of variations in salmon abundance

Over the last five years the Environment Agency has undertaken a number of pieces of work relating to the role of climatic variations on salmon abundance within the Avon. This has culminated in the production of a report to identify key environmental factors that have caused variations in the salmon stock over the last 130 years (Solomon and Lightfoot, in preparation). Of particular relevance to the integrity of the SAC is the identification that since the late 1980s, the time of the most recent decline, the number of returning adult salmon in each year directly affects the numbers returning in future years. The inference from this being that there is no spare production capacity currently within the Avon salmon's stock. Therefore any factor that reduces the number, and ability to survive, of smolts leaving the river and subsequently the number of returning adults has the potential to affect the integrity of this site for this feature of interest.

From this information the conclusion has been made that any activity reducing the spawning success and the survival of salmon within the Avon is likely to be having an affect on the future performance of the salmon stock. This would therefore affect the site integrity for this feature of interest in the SAC. In addition this would limit the stock's ability to reach its safe minimum level (the conservation limit).

The potential for abstraction to affect salmon populations

The Environment Agency considers that there are two main ways whereby the abstractions and their associated operations included in this stage 4 document could impact on salmon populations, and therefore site integrity, these are:

1. inhibiting salmon migration throughout their in-river life cycle;
2. adversely affecting the flow regime and the quantity of habitat suitable for parr.

Salmon migration

If, as a result of an abstraction or structures associated with that abstraction, adult salmon are constrained in their the ability to migrate upstream, then there is the potential to reduce salmon production. This reduction can be brought about via two mechanisms: firstly through salmon spawning in less than optimal locations resulting in the poor survival of intra-gravel life stages and secondly the over utilisation of the available spawning habitat resulting in increased competition for juvenile habitat and food and consequently poor survival. What is desired is for salmon to be able to freely migrate upstream so that they can fully utilise their whole spawning range and freely choose their desired spawning location.

Salmon undertake a number of critical downstream migrations as recently spawned adults, parr during the autumn (Pinder, A.C. *et al*, 2006) and smolts in the spring. It is therefore essential that to ensure the optimal survival from any one year's production these life stages are neither delayed in their migrations nor entrained into areas from which their migrations cannot be completed.

Flow regime

Where salmon do spawn in channels affected by abstractions the flow regime must not adversely affect salmon. This is particularly critical during the late summer and early autumn when river flows within the Avon system are typically at their lowest. The impact of reduced flows or an inappropriate flow regime is likely to reduce habitat availability and consequently increase salmon mortality. Work by Riley *et al* (Riley, W.D. *et al*, 2009) has demonstrated this within a manipulated chalkstream environment. Solomon and Lightfoot (in preparation) also indicate that since 1903 there has been a relationship between August flow during the parr year and numbers returning subsequently as adult salmon. Where reductions in flow have shown subsequent reductions in returning adult salmon.

Summary

Each of the Water Resource permissions and their associated operations within this stage 4 process has been assessed with regard to these potential impacts. Sections C2.4 - C2.7 detail this assessment and identify options where an impact has been found.

References

Environment Agency (2009). The Hampshire Avon's Action Plan for Salmon and Sea Trout. Wessex Area, South West Region.

Pinder A.C *et al* (2006) Evidence for an autumn downstream migration and the subsequent estuarine residence of 0+ juvenile Atlantic salmon *Salmo salar* in England.

Riley W.D *et al* (2009) The effects of low summer flow on wild salmon (*Salmo salar*), trout (*Salmon trutta*) and grayling (*Thymallus thymallus*) in a small stream.

Solomon D and Lightfoot G.L, Environment Agency (2010 – in preparation) Variations in Salmon Abundance on the Hampshire Avon – influences of climate throughout the life cycle.

C2.4 Abstraction licences acting alone - fish farms

Bickton fish farm 13/43/028/S/132

In cooperation with the fish farm owners a number of pieces of work have been undertaken to understand whether the fish farm abstraction at Bickton is having an impact on salmon at this site. These have included examination of existing and historic flow data, undertaking parr habitat surveys and comparisons with previous work, examination of redd count data and commissioning a review of fish screening. The findings are described below for each area of potential impact.

Salmon migration

There are two main structures associated with Bickton fish farm that salmon must navigate to continue their upstream migrations, these are Bickton hatches and the fixed crest weir feeding the Ley Stream. Both of the structures have purpose-built fish passes associated with them and there is no evidence to suggest that the operation of the fish farm is affecting the efficacy of these fish passes. In addition these facilities are considered adequate for the needs of salmon migrating downstream.

The review into fish screening at this site (Solomon D, 2007) found the fish farm's intake screens to be adequate in all respects for protecting downstream migrating salmon parr, smolts and kelts. The outlet screens from the Raceway Unit discharge channels were noted as being in a poor state of repair and vulnerable to overtopping. However it is known that subsequent modifications to these screens have resolved these issues. The screen for the Island Unit was also found to be adequate.

Flow regime

In September 2009 an Environment Agency specialist carried out an assessment of the current parr habitat and macrophyte growth in the channels associated with the fish farm site. This information has been compared with the parr habitat assessment carried out in 1997. The comparison can be seen in Appendix B, Map B1 and Report B2. This shows reductions in good parr habitat in both the Ley Stream and in the main channel. In addition the visual assessment of the macrophyte growth in the Ley Stream during the September 2009 survey found a predominance of emergent macrophytes which suggest low water velocities.

The parr habitat areas in the main channel identified in the 1997 survey are downstream of the Island Unit discharges. It is likely therefore that changes to abstraction rates would provide little benefit to these areas and, with respect to this, it has been concluded that no further action is needed.

However it has been concluded that the Ley Stream is affected by the fish farm abstractions and may benefit from additional flow during times when currently only the fish pass is flowing. It is estimated that the current 0.5 cumecs from the fish pass should be augmented by an additional flow of up to 1 cumec to achieve a minimum baseflow of 1.5 cumecs. The intended effect of this is to increase the area of potential good parr habitat which would be used by the young of salmon consistently spawning in this area (shown by the redd count data in Appendix B, Map B1) and provide conditions for submerged macrophytes with higher velocity preferences.

To achieve this a number of options have been considered, these are detailed below.

Options

1. Revoke the abstraction licence (RAvon WR BI OP01)

This option would not necessarily achieve the environmental outcome. Even if the fish farm were not operating, the flow split between the channels would have to be managed to ensure it would achieve the environmental outcome. In addition, the cost (both social and economic) of this option is high whilst protection and the environmental outcome can be achieved without revoking the licence. For this reason this option was **rejected**.

2. Reduce the abstraction licence volume to achieve the Natural England flow targets (RAvon WR BI OP02)

This option would reduce the abstraction licence volume to 15% of Q95 and 20% of Q50. This may achieve the environmental outcome, but the flow split between the channels would still need to be managed to ensure this. The environmental outcome can still be achieved without reducing the licence volume to these levels and this option is not sustainable due to additional social and economic cost. For these reasons this option was **rejected**.

3. Reduce the volume of water going under Bickton Mill and modify the operation of the site to ensure a minimum flow of 1.5 cumecs in the Ley stream and 0.3 cumecs through the fish pass at Bickton Mill hatches (RAvon WR BI OP03)

The SAC needs a consistent base flow of 1.5 cumecs to be maintained in the Ley stream. As river flows drop, and progressively less water enters the Ley Stream through the undershot hatches, the fish farm will need to augment the flow from a new discharge point (in the Ley stream just downstream of Bickton top weir) to achieve the minimum flow requirement. Therefore the maximum discharge from this new point will be up to 1 cumec to augment the current 0.5 cumecs from the existing fish pass. Under higher flows this discharge will revert back to the current arrangement. In addition, the flow under the Mill into the Raceway Unit will be reduced to 1.1 cumecs throughout the year and the additional 1 cumec redistributed through the hatches into Bickton main weir pool. This is to ensure that under low flows the existing water volumes entering the weir pool complex are maintained. A minimum flow of 0.3 cumecs (estimated) should also be maintained through the main weir pool fish pass. This option will not require a licence reduction but will impact the volume going under the Mill (controlled by a condition on the Island Unit discharge consent).

It is recognised that under extreme low flows the fish farm's abstractions reduce due to the physical nature of the site. In these situations it is acceptable that the discharge to the Ley Stream will also proportionally reduce.

This option would achieve the environmental outcome. However protection for the River Avon SAC can still be achieved without reducing the flow under the Mill (see option 4). This option is not sustainable due to additional social and economic cost. For these reasons this option was **rejected**.

4. Modify the operation of the site to ensure a minimum flow of 1.5 cumecs in the Ley stream and 0.3 cumecs through the fish pass at Bickton Mill hatches (RAvon WR BI OP04)

The SAC needs a consistent base flow of 1.5 cumecs to be maintained in the Ley stream. As river flows drop, and progressively less water enters the Ley Stream through the undershot hatches, the fish farm will need to augment the flow from a new discharge point (in the Ley stream just downstream of Bickton top weir) to achieve the minimum flow requirement. Therefore the maximum discharge from this new point will be 1 cumec to augment the current 0.5 cumecs from the existing fish pass. In addition a proportion of the discharge water from the

Raceway Unit will be piped into the Mill pool to replace flow lost by redistributing the Island Unit discharge to the Ley Stream. The existing flow through the Bickton main weir pool fish pass will be maintained at a minimum of 0.3 cumecs (estimated). Under higher flows the discharges will revert back to their current arrangement.

This option would achieve the environmental outcome and it is a sustainable option. It will not require licence reduction and allows the current abstraction of approx 2 cumecs through the Raceway Unit to continue. This option will provide the additional flow required for the Ley Stream whilst protecting the existing flow leaving the Bickton main weir pool. Thus protecting the existing habitat downstream of Bickton Weir pool.

It is recognised that under extreme low flows the fish farm's abstractions are reduced due to the physical nature of the site. In these situations it is acceptable that the discharge to the Ley Stream and Bickton Weir Pool will also proportionally reduce.

5. Do nothing (RAvon WR BI OP05)

At stage 3 it could not be proven that this abstraction licence does not have an adverse effect on site integrity. Therefore doing nothing will not achieve the environmental outcome and for this reason this option was **rejected**.

Table C2.4.1 Summary of Bickton Options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|---|--|--|---------------------------|---|---|--|--|
| Revoke the abstraction licence (RAvon_WR_BI_OP01) | Would not achieve environmental outcome unless channels still managed. | Compensation to licence holder for loss of the business. | Impact on jobs. | Closure of business at this site and possible impacts on other associated local businesses. | There would be a significant increase in flows in the currently deprived reaches if site managed to ensure this. | Would require site to be managed to achieve environmental outcome. | No |
| Reduce the abstraction licence volume to achieve the NE flow targets (RAvon_WR_BI_OP02) | Would not achieve environmental outcome unless channels still managed. | Compensation to licence holder for reduction in abstraction and therefore reduction in stock levels. | Impact on jobs. | Likely that this site would no longer be economically viable and this may also have impacts on other associated local businesses. | There would be a significant increase in flows in the currently deprived reaches if site managed to ensure this. | Would require site to be managed to achieve environmental outcome. | No |
| Reduce the volume of water going under Bickton Mill and modify the operation of the site to ensure a minimum flow of 1.5 cumecs in the Ley stream and 0.3 cumecs through the fish pass at Bickton Mill hatches (RAvon_WR_BI_OP03) | Would achieve environmental outcome. | Potential compensation to licence holder for capital works required. | Potential impact on jobs. | Reduction in output from the site and thus possible impact on other associated local businesses. | There would be an increase in flows through the Mill hatches. Would achieve an acceptable minimum flow in the Ley Stream and the length of the deprived reach will be significantly reduced at low flows. | Would require site to be managed to achieve minimum flow requirements. | Yes |
| Modify the operation of the site to ensure a minimum flow of 1.5 cumecs in the Ley stream and 0.3 cumecs through the fish pass at Bickton Mill hatches (RAvon_WR_BI_OP04) | Would achieve environmental outcome. | Potential compensation to licence holder for capital works required. | None | None | Would achieve an acceptable minimum flow in the deprived reaches and the length of the deprived reaches would be significantly reduced at low flows. | Would require site to be managed to achieve minimum flow requirements. | Yes |
| Do nothing (RAvon_WR_BI_OP05) | Would not achieve environmental outcome. | None | None | None | Current situation would continue and therefore we could not prove no adverse effect on site integrity. | None | Yes |

Selected option: (RAvon WR BI OP04)

The most appropriate option to achieve the required environmental outcome is to modify the operation of the site to ensure a minimum flow of 1.5 cumecs in the Ley stream and 0.3 cumecs through the fish pass at Bickton Mill hatches.

Implementing this option is likely to involve varying the abstraction licence to specify the new discharge points and the minimum flows required in the Ley stream and through the Bickton Mill fish pass. The condition on discharge consent 041927 controlling flow under Bickton Mill will also need to be varied.

Barford fish farm 13/43/026/S/119

In cooperation with the fish farm owners a number of pieces of work have been undertaken to understand whether the fish farm abstraction at Barford is having an impact on salmon at this site. These have included examination of existing and historic flow data, undertaking parr habitat surveys and comparisons with previous work, examination of redd count data and the commissioning a review of fish screening and fish passage. The findings are described below for each area of potential impact.

Salmon migration

There a number of structures associated with the Barford fish farm that salmon must navigate to continue their upstream migrations. All these structures, apart from the Chimney Hatches on the New Court Carrier, have purpose-built fish passes associated with them and there is no evidence to suggest that the operation of the fish farm is affecting the efficacy of these fish passes. In addition these facilities are considered adequate for the needs of salmon migrating downstream. A fish passage assessment of Chimney Hatches was carried out in November 2009 (Appendix B, Report B1) and identified difficulties with upstream fish passage. Options to resolve this are described below.

The review into fish screening at this site (Solomon D, 2007) found the majority of the fish farm's intake screens to be adequate in all respects for protecting downstream migrating salmon parr, smolts and kelts. There were a few older screens identified with a bar mesh size greater than 11mm (which is required to protect downstream migrating salmon parr). It is understood that all screens except one have been changed to 11mm since the Solomon report and this final screen is scheduled to be replaced in 2010. The outlet screens on all channels were considered to be adequate.

Salmon migration - options

The options assessed to achieve the outcome of 'unimpeded movement of salmon at all life stages' are as follows.

1. Revoke the abstraction licence (RAvon WR BA M OP01)

This option would achieve the environmental outcomes provided that the channels are maintained to ensure fish entrainment does not occur. The cost (both social and economic) is high, and protection for the River Avon SAC can still be achieved without revoking the licence. For this reason this option was **rejected**.

2. Modify Chimney Hatches on the New Court Carrier to ensure it is not a barrier to salmon migration and ensure all screens have a maximum gap of 11mm (RAvon WR BA M OP02)
Construction of an approved fish passage facility at Chimney Hatches to ensure unimpeded movement of salmon. Ensure all screens have a maximum gap of 11mm. This option would achieve the environmental outcome of unimpeded movement of salmon at all life stages.

3. Do nothing (RAvon WR BA M OP03)

At stage 3 it could not be proven that this abstraction licence does not have an adverse effect on site integrity. Therefore doing nothing will not achieve the environmental outcomes and for this reason this option was **rejected**.

Table C2.4.2 Summary of Barford salmon migration options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|--|--|--|---------------------|---|--|---|--|
| Revoke the abstraction licence (RAvon_WR_BA_M_OP01) | Would achieve environmental outcome provided that the channels are maintained to ensure free fish passage. | Compensation to licence holder for loss of business. | Impact on jobs. | Closure of business at this site and possible impacts on other associated local businesses. | Channels would need to be maintained to ensure free fish passage. | Would require management to ensure free fish passage. | No |
| Modify Chimney Hatches on the New Court Carrier to ensure it is not a barrier to salmon migration and ensure all screens have a maximum gap of 11mm (RAvon_WR_BA_M_OP02) | Would achieve environmental outcome. | Costs associated with screening and modifying structure. | None | None | Would remove potential barrier to migration and potential for parr entrainment. | Would require structure and screens to be maintained. | Yes |
| Do nothing (RAvon_WR_BA_M_OP03) | Would not achieve environmental outcome. | None | None | None | Current situation would continue and therefore we could not prove no adverse impact on site integrity. | None | Yes |

Salmon migration - selected option: (RAvon WR BA M OP02)

The most appropriate option to achieve the required environmental outcome is to modify Chimney Hatches on the New Court Carrier to ensure it is not a barrier to salmon migration and ensure all screens have a maximum gap of 11mm.

The screens and the structure at Chimney Hatches will need to be modified in line with Environment Agency requirements. This is required under the Salmon and Freshwater Fisheries Act 1975. All screening requirements must be met by 1st October 2010. It is

recognised that modifications for fish passage may take between one and three years to complete, however as a minimum the project must be started in 2010.

Flow regime

There are two channels into the two Barford fish farm units that have the potential to be affected by abstraction. These are the New Court Carrier and the main River Avon downstream of Standlynch Mill.

The New Court Carrier provides significant areas of good quality parr habitat and is consistently used by salmon as a spawning site (see Map B2 in Appendix B). During 2009 a flow logger was installed and the data from this is shown in Appendix B figure B1. This data show abrupt fluctuations in the base flow of this channel. A habitat assessment was carried out during one of these events (Appendix B, Report B2) and both marginal tree roots and areas of in-channel gravel banks were seen to be exposed. It is likely that these events are having a deleterious affect on salmon parr in this channel, by restricting the habitat available to them. Effects of this are expected to be similar to those demonstrated by Riley W.D. *et al* 2009. It is therefore recommended that a stable base flow be maintained in the New Court Carrier. From recent current meter gauging data the minimum required flow is calculated at 0.5 cumecs. Above this baseflow the channel should mirror natural variations experienced in the total river flow.

In August 2009 an Environment Agency specialist, accompanied by a principal ecologist from Scott Wilson, carried out an assessment of the current parr habitat and macrophyte growth in the channels associated with the fish farm site. This information has been compared with the parr habitat assessment carried out in 1997. The comparison can be seen in Appendix B, Map B2. This shows a change in good parr habitat in the New Court Carrier and possible reductions in the main River Avon downstream of Standlynch Mill (the latter potentially as a result of changes in discharge location).

The recommended minimum required flow of 0.5 cumecs, already discussed above, is considered adequate to achieve the flow regime environmental outcome in the New Court Carrier.

For the main river channel the ability to augment low flows is required to be put in place to achieve the flow regime environmental outcome. From discussions with Trafalgar Fisheries an option has been presented that would enable a proportion of the Western Unit's discharge to be returned to the main Avon channel in the vicinity of the existing fish farm bridge crossing. The infrastructure for this option should be put in place and further monitoring (principally to determine current low flow regime) must take place to define how this facility will be utilised and if it will achieve the environmental outcome. The aim is to achieve a minimum flow of 1.5 cumecs at the point of discharge (further monitoring is required to determine if this flow is sufficient). This flow will be to protect and improve the existing parr habitat downstream of the discharge point and potentially maintain fish passage under very low flows at Wild Weirs.

Flow regime - options

To achieve the outcome of 'an appropriate flow regime' a number of options have been considered, these are detailed below.

1. Revoke the abstraction licence (RAvon WR BA F OP01)

This option would not necessarily achieve the environmental outcome. Even if the fish farm were not operating the flow split between the channels would have to be managed to ensure it would achieve the environmental outcome. In addition, the cost (both social and economic) of this option is high and protection the environmental outcome can be achieved without revoking the licence. For this reason option 1 was **rejected**.

2. Reduce the abstraction licence volume to achieve the Natural England flow targets (RAvon WR BA F OP02)

This option would reduce the abstraction licence volume to 10% of Q95 and 15% of Q50. This may achieve the environmental outcome, but the flow split between the channels would still need to be managed to ensure this. The environmental outcome can still be achieved without reducing the licence volume to these levels and this option is not sustainable due to additional social and economic cost. For these reasons option 2 was **rejected**.

3. Reduce the abstraction licence volume to ensure a stable minimum flow of 0.5 cumecs in the New Court Carrier and 1.5 cumecs in the main River Avon at Standlynch (RAvon WR BA F OP03)

This option would achieve the environmental outcome. However the environmental outcome can still be achieved without reducing the licence volume (see option 4). This option is not sustainable due to additional social and economic cost. For these reasons this option was **rejected**.

4. Modify the operation of the site to ensure a stable minimum flow of 0.5 cumecs in the New Court Carrier and 1.5 cumecs in the main River Avon at Standlynch (RAvon WR BA F OP04)

From discussions with Trafalgar Fisheries a stable minimum flow of 0.5 cumecs in the New Court Carrier can be achieved by operational changes to their site. Currently the required minimum flow of 1.5 cumecs in the main Avon is thought to be achievable through the redistribution of a proportion of the Western Unit's discharge to the main Avon channel, in the vicinity of the existing fish farm bridge crossing, at low flows. The infrastructure for this is to be put in place and further monitoring work undertaken to ensure that the desired outcome can be achieved.

This option would achieve the environmental outcome. It will not require a licence reduction and allows the current operation of the site for the majority of the time. During periods of low flow this option will provide the additional flow required in the main Avon downstream of Standlynch. A benefit of this option is that the flow is only augmented at low flows and it does not influence distribution of water at high flows.

5. Do nothing (RAvon WR BA F OP05)

At stage 3 it could not be proven that this abstraction licence does not have an adverse effect on site integrity. Therefore doing nothing will not achieve the environmental outcome and for this reason this option was **rejected**.

Table C2.4.3 Summary of Barford flow regime options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|--|--|--|---------------------------|---|---|--|--|
| Revoke the abstraction licence (RAvon_WR_B A_F_OP01) | Would not achieve environmental outcome unless channels still managed. | Compensation to licence holder for loss of the business. | Impact on jobs. | Closure of business at this site and possible impacts on other associated local businesses. | There would be a significant increase in flows in the currently deprived reaches if site managed to ensure this. | Would require site to be managed to achieve environmental outcome. | No |
| Reduce the abstraction licence volume to achieve the NE flow targets (RAvon_WR_B A_F_OP02) | Would not achieve environmental outcome unless channels still managed. | Compensation to licence holder for reduction in licence and therefore reduction in stock levels. | Impact on jobs. | Likely that this site would no longer be economically viable and this may also have impacts on other associated local businesses. | There would be a significant increase in flows in the currently deprived reaches if site managed to ensure this. | Would require site to be managed to achieve environmental outcome. | No |
| Reduce the abstraction licence volume to ensure a stable minimum flow of 0.5 cumecs in the New Court Carrier and 1.5 cumecs in the main River Avon at Standlynch (RAvon_WR_B A_F_OP03) | Would achieve environmental outcome. | Compensation to licence holder for reduction in licence. | Potential impact on jobs. | Reduction in output from the site and thus possible impact on other associated local businesses. | Would achieve the acceptable minimum flow in the deprived reaches. | Would require site to be managed to achieve minimum flow requirements. | Yes |
| Modify the operation of the site to ensure a stable minimum flow of 0.5 cumecs in the New Court Carrier and 1.5 cumecs in the main River Avon at Standlynch (RAvon_WR_B A_F_OP04) | Would achieve environmental outcome. | Potential compensation to licence holder for capital works required. | None | None | Would achieve an acceptable minimum flow in the deprived reaches and the length of the Avon deprived reach would be significantly reduced at low flows. | Would require site to be managed to achieve minimum flow requirements. | Yes |
| Do nothing (RAvon_WR_B A_F_OP05) | Would not achieve environmental outcome. | None | None | None | Current situation would continue and therefore we could not prove no adverse effect on site integrity. | None | Yes |

Flow regime - selected option: (RAvon WR BA F OP04)

The most appropriate option to achieve the required environmental outcome is to modify the operation of the site to ensure a stable minimum flow of 0.5 cumecs in the New Court Carrier and 1.5 cumecs in the main River Avon at Standlynch.

Implementing this option is likely to involve varying the abstraction licence to specify the new discharge point into the Avon and the minimum flows required in both the New Court Carrier and the main Avon downstream of Standlynch.

In addition, the quantities are not actually being taken from sites as stated on the abstraction licence. Actual abstraction returns data shows that the larger quantities are abstracted from, and therefore discharged to, the Eastern Unit, rather than the Western unit. This is opposite to the volumes stated on the permissions. This will be rectified at the same time as the above licence variations are undertaken.

Further work needed:

- The infrastructure for the new discharge point on the main Avon is to be put in place and further monitoring work undertaken to ensure that the flow regime environmental outcome can be achieved.

Britford fish farm 13/43/026/S/120

In cooperation with the fish farm owners a number of pieces of work have been undertaken to understand whether the fish farm abstraction at Britford is having an impact on salmon at this site. These have included examination of existing and historic flow data and the commissioning of a review of fish screening and fish passage. The findings are described below for each area of potential impact.

Salmon migration

The commissioned review into fish screening at this site (Solomon D, 2007) found the fish farm's intake screen to be in good condition and with a bar size of 12.5mm. Although this is adequate to protect downstream migrating salmon smolts and kelts, it is not adequate to protect downstream migrating parr. A new screen is therefore required with a maximum bar spacing of 11mm to protect this life stage. As noted in the review it would also present the opportunity to reposition the screen at the entrance to the channel where a better bywash flow would be provided.

The review also found that no screen exists to prevent adult migrating salmon from entering into the fish farm's discharge channel. Early radio tracking studies (1985 – 1990) did not indicate that salmon were delayed by entering the discharge channel but recommendations have been previously made to undertake further work in this area. If evidence comes to light that salmon are being delayed then appropriate screens will be required under existing Fisheries' legislation.

Salmon migration - options

The options assessed to achieve the outcome of 'unimpeded movement of salmon at all life stages' are as follows.

1. Revoke the abstraction licence (RAvon WR BR OP01)

This option would achieve the environmental outcomes provided that the channels are maintained to ensure fish entrainment does not occur. The cost (both social and economic) is high, and the environmental outcome can still be achieved without revoking the licence. For this reason the option was **rejected**.

2. Ensure all screens have a maximum gap of 11mm (RAvon WR BR OP02)

Ensure all screens have a maximum gap of 11mm. This option would achieve the environmental outcome of unimpeded movement of salmon at all life stages.

3. Do nothing (RAvon WR BR OP03)

At stage 3 it could not be proven that this abstraction licence does not have an adverse effect on site integrity. Therefore doing nothing will not achieve the environmental outcome and for this reason the option was **rejected**.

Table C2.4.4 Summary of Britford salmon migration options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|--|---|--|---------------------|---|--|---|--|
| Revoke the abstraction licence (RAvon_WR_BR_OP01) | Would achieve environmental outcome provided that the channels were maintained to ensure free fish passage. | Compensation to licence holder for loss of business. | Impact on jobs. | Closure of business at this site and possible impacts on other associated local businesses. | Channels would need to be maintained to ensure free fish passage. | Would require management to ensure free fish passage. | No |
| Ensure all screens have a maximum gap of 11mm (RAvon_WR_BR_OP02) | Would achieve environmental outcome. | Costs involved in replacing inlet screen. | None | None | Would remove the potential for parr entrainment. | Would require screens to be maintained. | Yes |
| Do nothing (RAvon_WR_BR_OP03) | Would not achieve environmental outcome. | None | None | None | Current situation would continue and therefore we could not prove no adverse impact on site integrity. | None | Yes |

Salmon migration - selected option: (RAvon WR BR OP02)

The most appropriate option to achieve the environmental outcome is to ensure all screens have a maximum gap of 11mm.

The screens will need to be modified in line with Environment Agency requirements. This is required under the Salmon and Freshwater Fisheries Act 1975. All screening requirements must be met by 1st October 2010.

Flow regime

The River Avon splits into three distinct channels just downstream of Harnham Bridge in Salisbury - the Old River, the Main Carrier and the Navigation channel. The fish farm is fed from an inlet on the Main Carrier. Flow in the three main channels is largely controlled by Wire Hatches, Sluice House and Drawing Hatches. Flow apportionment between the three channels is deemed to be the most important factor in determining the health of the SAC in the area.

The Environment Agency Water Level Management Plan (WLMP) team are currently refurbishing hatches in the Britford area with the aim of restoring the East Harnham water meadow SSSI to favourable condition. The WLMP team are looking into the possibility of redistributing more flow to the Old River during low flows, which will benefit the SSSI by lowering levels in the Main Carrier and allowing a lowering of the water table in East Harnham. A hatch operating protocol will be developed for Wire Hatches, Sluice House and Drawing Hatches in 2010, but this will be after the Habitats Directive Review of Consents deadline of March 2010.

Other than the fish screening issue discussed above, it is not thought that the licence is having an adverse effect on site integrity. Once the WLMP work has finished, if local issues are found then the licence may be reassessed through the Restoring Sustainable Abstraction programme.

C2.5 Approach to public water supply abstraction

Although extensive ecological monitoring was undertaken by Wessex Water’s ecologists and their consultant APEM, they found no clear evidence of abstraction related impacts. This may have been due to the short nature of the survey as it was based on only two year’s worth of data and the second year was unusually wet. The Avon does not possess much long term data and a review of this also showed it to be inconclusive. It is likely that any changes due to abstraction are probably quite slow and incremental in nature. This means that the ecological assessment tools are unlikely to pick up these effects. This is even more likely, when the period of investigation is very limited in length. It was therefore decided that we needed to rely on the flow criteria for the river as this could at least estimate both actual and potential fully licensed impact. From this flow assessment, a judgement could be made on the possibility of detrimental ecological impact occurring.

The demand for public water supply from Wessex Water’s sources varies from day to day. Short-term periods of peak rate use are often reflected in the authorised abstraction quantities. These peak rates allow for this use and for periods of outage when pumps and infrastructure are temporarily out of action. Any changes to public water supply abstraction licences will take this into account though not at the expense of infringing the agreed river flow thresholds.

The outcome required therefore was to ensure that changes to permissions ensured that the flow in the Avon and its designated tributaries achieved the agreed flow criteria as shown in the table below.

Table C2.5.1 Habitats Directive agreed river flow thresholds for SAC rivers

| EW band (sensitivity) | HD ERF Maximum % reduction from daily naturalised flow | | |
|--------------------------|---|-----------|---------|
| | <Q50nat | Q50-95nat | >Q95nat |
| Very High | 10 | 10 | 1-5 |
| High† | 15 | 10 | 10 |
| Moderate‡ | 20 | 15 | 15 |
| Low | N/A | N/A | N/A |
| Very Low | 20 | 20 | 15 |

† This applies to the majority of the Avon SAC and its main tributaries, the Wylye, Bourne and Nadder.

‡ This applies to the section of the main Avon downstream of Fordingbridge

C2.6 Abstraction licences acting alone – public water supply

Newton Toney Boreholes (Wessex Water Services Ltd) Licence 13/43/024/G/019

This groundwater source is located on the Bourne above the SAC boundary. The geology in this part of the catchment is quite complex and impacts are therefore not simple to quantify. The River Bourne itself is mainly winterbourne acting as a ‘high-level’ drain for the aquifer. Therefore much of the water abstracted at this source would not naturally have supported flows in the Bourne. Groundwater modelling calculates that only about a third of this water would have emerged in the Bourne catchment itself, whilst the rest would either have supported flows on the main stem of the Upper Avon or travelled south east and supported flows in the River Test. This means that any amendments to abstraction at this site have to be sensitive to this flow relationship.

This abstraction causes the upper section of the SAC on the Bourne to fail its flow targets. Ecological data identifies clearly that salmon no longer spawn at the base of the Bourne and

although this abstraction is upstream of the SAC boundary it does contribute to the unacceptable impacts on the watercourse, which may in turn have made this watercourse unfavourable for salmon. The modelling identified impacts of approximately 20% at Q95nat at the start of the SAC due to this abstraction. Flows are also non compliant at Q70nat and marginal at Q50nat. This comprehensively fails the flow targets for the SAC. This abstraction also has contributory impacts on the Nine Mile river and no agreed solution should increase impact on this watercourse.

Options:

1. Revoke: (RAvon WR NT OP01)

This option is **rejected** because there is no case to support this as modelling shows that abstraction can be tailored to comply with the flow criteria and to revoke this abstraction would not be fair and equitable to the licence holder.

2. Reduce the licence to modelled sustainable levels: (RAvon WR NT OP02)

Under most circumstance this would be an appropriate approach to employ but because of the unusual hydrogeological patterns present at this location, it is not deemed as being fair and equitable to the licence holder. Only about a third of the abstracted water would ever have emerged into the Bourne, the remaining two thirds flowing either to the Avon or the River Test. To achieve the desired flows in the upper section of the SAC in the Bourne, abstraction would have to be reduced to about 1.5MI/d from a licensed maximum of 6.5MI/d. This would ensure that about 1.5MI/d of additional flow remained in the Bourne. This option is therefore **rejected** at this stage.

3. Augmentation: (RAvon WR NT OP03)

Generally Natural England does not favour augmentation as a sustainable solution to restore flows and habitat. Although sustainable augmentation schemes are in place in the South West there is insufficient evidence that it would be sustainable for this site and augmentation alone as a solution was therefore **rejected**.

4. Reduced abstraction and targeted augmentation: (RAvon WR NT OP04)

To achieve the desired outcome for the watercourse and to ensure impacts beyond the Bourne are not increased, then the selected option is to maintain the current licensed limit of 6.5MI/d but to adjust this so that 5MI/d is available for public water supply whilst the remaining 1.5MI/d are used when required to augment flows upstream of the SAC boundary around Porton. This satisfies the flow requirements in the SAC; it doesn't extend the drawdown from Newton Toney and should have no detrimental impacts on the winterbourne section of the River Bourne. It must be noted that stream augmentation at this stage is untested and only modelled through the Hampshire Avon model as being suitable. The water company are now required to test this option to ensure it delivers the desired outcomes. Should this solution be found not to be fully effective, then the licence will need to be reviewed to ensure the SAC is not compromised.

5. Do nothing: (RAvon WR NT OP05)

This option would not protect flows at the start of the SAC and is therefore **rejected**.

Table C2.6.1 Summary of Newton Toney options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|---|---|---|--|------------------------------------|--|---|--|
| Revoke: (RAvon_WR_NT_OP01) | Would achieve environmental outcomes. | Would require the water company to locate and develop alternative resource. | Would affect water supply and therefore would be delayed until alternative supplies located. | Significant cost to water company. | Would return flows at start of SAC closest to natural. | No, as impacts would be shifted elsewhere. | No, this would be excessive as this level of reduction is not required. |
| Reduce the licence to modelled sustainable levels (RAvon_WR_NT_OP02) | Would achieve environmental outcomes. | Would require the water company to locate and develop alternative resource. | Would affect water supply and therefore would be delayed until alternative supplies located. | Significant cost to water company. | Would return flows at start of SAC closer to natural and within flow criteria. | Probably not as impacts would be shifted elsewhere although remains default position if option 4 fails. | No † |
| Augment flows (RAvon_WR_NT_OP03) | Would achieve environmental outcomes although possible detrimental effects elsewhere. | Relatively low cost option but would require the testing and development of augmentation around Porton. | Limited consequences. | Limited | Would compensate for abstraction when flows begin to recede but may propagate impacts elsewhere. | No this just masks hydrological effects of abstraction and propagates impacts elsewhere. | No |
| Reduce abstraction and targeted augmentation (RAvon_WR_NT_OP04) | Would achieve environmental outcomes. | Relatively low cost option but would require the testing and development of augmentation around Porton. | Limited consequences but may be timed to coincide with grid solution. | Limited | Would compensate for flows when they start to recede without propagating additional impacts elsewhere. | Yes as would be targeted to protect drier months and does not lead to developing a new resource elsewhere | Yes as it should minimise impact on water company and deliver required flow to satisfy flow criteria |
| Do nothing (RAvon_WR_NT_OP05) | Would not achieve flow targets. | No economic cost. | May maintain reduced range of salmon and affect fishing potential. | Limited | Ecology would remain under stress. | Not sustainable. | No |

† Note: option (RAvon_WR_NT_OP2) has been rejected at this stage but if selected option is not successful, then water company will be required to implement this solution

Selected option: (RAvon WR NT OP04)

Note: Due to water company business planning deadlines, this option once selected, was provided to the water company as a sustainability reduction and incorporated into their business plan. This change has been presented to OFWAT for approval and has been funded through the AMP process.

Table C2.6.2 Indicative licence changes for Newton Toney

| | Details | Daily Max | Annual Max |
|--------------------------------------|--|---|--|
| Current licence | 13/43/024/G/019 | 6.5643MI/d | 2395.963MI/a |
| Proposed licence | It has been agreed with the company that abstraction for PWS will be reduced at this site by 1.5MI/d. | PWS abstraction to be reduced to 5.0643MI/d. | Reduced to 1848.4695MI/a. |
| Additional licence conditions | Stream augmentation (to mitigate for Newton Toney) will be provided around Porton to support flows. Prescribed flow triggers, to initiate stream augmentation, will be refined and agreed. They are likely to be in the range of Q40-Q60. | 2.5MI/d (Linked to ⁽¹⁾ below) although under normal conditions of mitigating for Newton Toney operation, this is expected to amount to no more than a rate of 1.5MI/d. | 547.4935MI/a. |
| Additional licence conditions | ⁽¹⁾ Constrained, limited peak rate abstraction at Clarendon downstream, is likely to continue. Levels of stream augmentation driven by the prescribed flow condition trigger therefore might be required to rise above the normal 1.5MI/d rate, potentially this could equate to operation for a period of up to 40 days. (Note: Use of these limited short-term peak provisions will not infringe the agreed river flow thresholds and these arrangements for limited use for water supply will be refined and agreed with the water company). | If augmentation is required to rise above 1.5MI/d, a maximum of 2.5MI/d is proposed. When Stream augmentation is operating at a rate above 1.5MI/d the volume permitted for PWS abstraction will be reduced by 1MI/d to 4.0643MI/d for the whole of the period of operation higher than 1.5MI/d to ensure daily maximum abstraction for the two purposes in aggregate does not exceed 6.5643MI/d. | This will not affect the annual quantities permitted for either purpose. |

Further information needed:

- The effectiveness of the proposed augmentation at Porton will need to be shown to be as effective as modelled. If augmentation is found to be more complex then the water company have been advised that this solution is at their own risk. If augmentation is ineffective then the base licence will need to be reduced significantly to a level deemed acceptable.

- On going monitoring of flow and ecology will be required to ensure proposed solution is effective.

Clarendon Park Boreholes (Wessex Water Services Ltd) Licence 13/43/026/G/104

The abstraction is located near the base of the Bourne and the confluence with the main Avon. Impacts at this source affect the lower designated section of the Bourne and may through reducing flows, reduce the suitability of this watercourse to migrating salmon. This section of the main Avon is also multi-channelled in nature and it is likely that this abstraction has an additional effect at this location. This though is harder to identify because the groundwater model treats the river as being single channel in nature.

Abstraction from Clarendon also has an impact on the River Test in addition to impacts on the River Bourne and River Avon. The Bourne study found historic (recent actual) impact on the Bourne at Laverstock of 16% on Q95nat and 7% at Q50nat.

Along with the abstraction at Newton Toney, Clarendon was found to account for the majority of the abstraction impact in the perennial section of the Bourne. This was felt to be detrimental to the habitat for salmon and trout populations.

Further work using the Hampshire Avon groundwater model confirmed excessive levels of hydrological impact due to this abstraction with impacts of up to 20% at Q95nat predicted. In combination with other Wessex abstractions in the catchment, impacts ranged from 34% at Q95nat, 22% at Q70nat and 14% at Q50nat.

Options:

1. Revoke option: (RAvon WR CP OP01)

To achieve the required levels of abstraction reduction and ensure flow criteria are achieved, this could be undertaken by a total revocation. This though would remove the possibility of this site being available for short-term peak rate use within the agreed river flow thresholds. In addition, the water company have invested heavily in this site so a total revocation may be deemed unnecessarily harsh. This option has therefore been **rejected**.

2. Reduce daily abstraction: (RAvon WR CP OP02)

To achieve the desired flow criteria, abstraction from this site needs to reduce by up to the equivalent of an average of 11MI/d. Although this means that the site will only operate occasionally, at least this option provides the water company with a degree of flexibility.

3. Augmentation: (RAvon WR CP OP03)

This option is not felt to be viable as the augmentation would need to be released inside the SAC boundary against NE guidance. This approach would also lead to the propagation of greater impacts to neighbouring water courses such as the River Test. This means this option is **rejected**.

4. Do nothing: (RAvon WR CP OP04)

This option does not protect the SAC and does not achieve the flow criteria therefore it is **rejected**.

Table C2.6.3 Summary of Clarendon Park options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|--|--|--|--|---|---|--|---|
| Revoke: (RAvon_WR_CP_OP01) | Would achieve environmental outcomes. | High cost as would require the water company to locate and develop major alternative resource or amend supply network. | Would affect water supply and therefore would be delayed until alternative supplies located. | Significant cost to water company (passed on to customers). | Should reduce flow change at the base of the Bourne so it is within agreed flow criteria. | Sustainable if supply grid is developed as it allows best use of sources but no possibility of using this resource. | No, this is excessive as total cessation at this site is unduly onerous on the water company. |
| Reduce daily abstraction by 11ML/d (RAvon_WR_CP_OP02) | Would achieve environmental outcomes. | High cost as would require the water company to locate and develop major alternative resource or amend supply network. | Would affect water supply and therefore would be delayed until alternative supplies located. | Significant cost to water company (passed on to customers). | Should reduce flow change at the base of the Bourne so it is within agreed flow criteria. | Most sustainable if supply grid is developed as site is retained if required whilst grid allows best use of sources. | Yes |
| Augment flows (RAvon_WR_CP_OP03) | Probably wouldn't achieve objective and would further propagate impacts. | Relatively low cost option. | Limited consequences. | Limited | May extend impacts of abstraction by increasing impacts on aquifer. | No this just masks hydrological effects of abstraction and is not supported by NE. | No, ineffective option. |
| Do nothing (RAvon_WR_CP_OP04) | Would not achieve flow targets. | No economic cost. | May maintain reduced suitability of salmon in this part of SAC. | None | Ecology would remain under stress. | Not sustainable as impacts would be ignored. | No |

Selected option: (RAvon WR CP OP02)

Note: Due to water company business planning deadlines, this option once selected, was provided to the water company as a sustainability reduction and incorporated into their business plan. This change has been presented to OFWAT for approval and has been funded through the AMP process.

Table C2.6.4 Indicative licence changes for Clarendon Park

| | Details | Daily Max | Annual Max |
|--------------------------------------|---|---|---|
| Current licence | 13/43/026/G/104 | 14MI/d | 4000MI/a (linked to ⁽²⁾ below) |
| Proposed licence | Source will not be used for public water supply except for short term peak rate use which will be constrained and limited at rates which do not infringe the river flow thresholds. | This will be reduced to 11MI/d. | Reduced to 220-250MI/a (a final value in this range to be agreed between the Environment Agency and Wessex Water) (linked to ⁽³⁾ below). |
| Additional licence conditions | ⁽³⁾ Peak rate use at this site will be available up to the annual maximum. Peak rate use at this site is being refined through further discussions with the company. | 11MI/d | Reduced to a maximum of 220MI/a for the PWS component. |
| Additional licence conditions | To allow the site to become operational immediately the need arises, a sweetening flow will be required to be periodically run through the on site plant. The quantity of the sweetening flow is being finalised. Note: all water abstracted for this purpose will be returned to ground locally in a controlled manner and the aquifer will not be impacted detrimentally and river flow thresholds will not be infringed. | Still under discussion but not to exceed a rate of 11MI/d and not to operate at the same time as public water supply abstraction. | Will form an additional volume on top of the base 220MI/a required for the short-term peak rate public water supply use. |
| Additional licence conditions | ⁽²⁾ At present this licence's annual abstraction volume is in conjunction with 13/43/23/G/093 Ditchampton (unused in the last 10 years) & 13/43/22/G/079 Devizes Road (used 24% of the time in last 10 years). It is proposed to remove this aggregate condition and for Wessex Water to revoke Ditchampton. | Devizes Road licence to have its daily peak reduced to 4MI/d to protect flow criteria but annual volume to be unaffected. | - |

Further information needed:

- On going monitoring of flow and ecology is required to ensure the proposed solution is effective. At this site additional monitoring will help to provide a robust dataset to compare against once the option has been implemented.

Chitterne Boreholes (Wessex Water Services Ltd) Licence 13/43/023/G/212

This PWS abstraction, which runs in conjunction with Codford, allows up to 20 MI to be abstracted daily, which equates to an annual maximum potential abstraction of 7300MI/year. The aggregate abstraction with Codford allows a maximum abstraction of 9500 MI/year.

This groundwater source is based in the upper reaches of the Chitterne brook which flows into the River Wylfe. It has always been assumed that some of this abstraction would be at the expense of the neighbouring rivers but that most of the abstraction would come out of groundwater storage.

This abstraction had already been identified as being of concern in earlier rounds of AMP, and had been operating under a Statement of Intent (SOI) since 2002. A reduction in the annual licensed volume had already been agreed, although not yet implemented on the licence, from 7300MI/a to 2072MI/a.

The Original SOI and the Revised SOI which came into force in 2007, were focussed on the possible effect of the re-profiled but constrained abstraction on the SAC, most notably the River Till and lower section of the River Wylfe. A revised abstraction profile was trialled, equating to 2MI/d for eight months a year and up to 13MI/d for the remaining four months targeted as occurring during potentially the more sensitive hydrological and hydrogeological periods and when demand is likely to be higher. This is known as the 2-13-2 scenario.

To resolve this issue the site has been tested for a number of years using this revised pumping profile. Results have been compromised during some of this period due to wet summer conditions but 2009 has been much drier and much more favourable for assessing the impact of the differing abstraction rates. To help assist this investigation, a large number of new boreholes have also been drilled and monitored.

Based on the location of this site, it was expected that it would develop a large degree of groundwater storage and that impacts on the SAC would be limited. Interestingly the recorded data from testing showed that impacts propagate out very rapidly in some directions particularly south-easterly, suggesting the possibility that impacts could be felt quite rapidly through pumping. This groundwater effect though does not seem to be translated into any clearly identifiable steepening of the recession curve of the River Till. It has therefore been concluded that the geology is attenuating direct impact on the Till and that impacts appear to be within the river flow threshold criteria.

As the groundwater model is still perceived to be less reliable in this small catchment than elsewhere, decisions have been based on the results from the physical monitoring and an assessment of ecological wellbeing on the Till. Even though the Chitterne source has historically been pumped at consistently higher volumes than those tested, ecology is still deemed to be in excellent condition. It should also be noted, that impacts on the lower Wylfe are now calculated as being minimal.

The logic for using the ecological data at this site whereas elsewhere in the Avon the modelled impacts were used, is fully justifiable. At other sites any ecological monitoring was only assessing the state of the ecology at actual (contemporary) abstraction levels, leading to the risk that impacts might emerge should abstraction rise to fully licensed limits. Using the model we could model flows under a fully licensed scenario and use this for establishing a precautionary assessment. At Chitterne though, abstraction has been historically running at much higher actual levels than is being proposed under the 2-13-2 scenario. This means that any ecological impacts should have been directly observable. In addition a review of all the hydrogeological and hydrological data over

the past 40 years confirms the conceptual model that the geology is attenuating the direct impact on the flows in the River Till.

Options:

1. Reduce daily abstraction to 2MI/d (reduce annual accordingly): (RAvon WR CH OP01)

The data does not suggest ecological impact for the period of operation under the SOI/RSOI. This option would be unreasonable the abstraction is located on a sizeable aquifer. This option is therefore **rejected**.

2. Reduce daily abstraction normally to 2MI/d, with the flexibility of up to 6.5MI/d during low flows (reduce annual accordingly): (RAvon WR CH OP02)

This is a half way house between running the source at 2MI/d all year or the SOI/RSOI profile of 2-13-2 which has been under review. Ecological assessment of the Till does not support the need for this further reduction in abstraction at Chitterne. This option is **rejected**.

3. Reduce daily abstraction normally to 2MI/d, with the flexibility to raise abstraction up to 13MI/d (RAvon WR CH OP03)

This is the proposed new operation under the SOI/RSOI and the testing in 2009 clearly shows no discernible change to the recession curve of the River Till. This combined with the health of the designated ecology and habitat, leads this to be the selected option.

4. Do nothing: (RAvon WR CH OP04)

This option does not protect the SAC from the effects of the abstraction at its present fully licensed limits. A review of the historical data suggests increased recession during levels of high summer time pumping suggesting flow criteria would be breached. This option is **rejected**.

Table C2.6.5 Summary of Chitterne abstraction options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|--|--|--|--|---|---|--|--|
| Reduce daily abstraction to 2MI/d (RAvon_WR_CH_OP01) | No risk as this over achieves desired environmental protection. | Would require the water company to locate and develop major additional alternative resource. | Would affect water supply and therefore would be delayed until alternative supplies located. | Significant cost to water company (passed on to customers). | Would protect flows but extreme and would require development of a new source. Might extend impacts elsewhere. | No, as impacts would be shifted elsewhere. | No |
| Reduce daily abstraction to 2-6.5-2MI/d profile (RAvon_WR_CH_OP02) | Would achieve desired environmental protection (probably overly protective). | Would require the water company to locate and develop significant alternative resource. | Would affect water supply and therefore would be delayed until alternative supplies located. | Significant cost to water company (passed on to customers). | Would protect flows but overly precautionary and would require development of a new source. Might extend impacts elsewhere. | No, as impacts would be shifted elsewhere. | No |

| | | | | | | | |
|---|---|--|--|------------------|---|--|---|
| Reduce daily abstraction to 2-13-2MI/d profile (RAvon_WR_CH_OP03) | Would achieve desired environmental protection. | Already planned for as part of reorganisation of supply. | Limited consequences as already built into WRMP. | Already in WRMP. | Would deliver desired level of protection of SAC. | Already built into WRMP and provides a sustainable supply of summertime water. | Yes. This option would allow use of this source in the Summer when demand is greater. |
| Do nothing (RAvon_WR_CH_OP04) | Probably would not provide protection to SAC. | No economic cost. | Fisheries may be degraded. | No cost | Ecology would remain under stress. | Not sustainable as impacts would be ignored. | No |

Selected option: (RAvon WR CH OP03)

Note: This option had been identified in earlier rounds of AMP (though it was still being trialed through this period under the Original Statement of Intent and latterly under the revised Statement of Intent). This licence change has already been funded.

Table C2.6.6 Indicative licence changes for Chitterne

| | Details | Daily Max | Annual Max |
|--------------------------------------|--|-----------|---|
| Current licence | 13/43/023/G/212 (on the same licence as Codford). | 20MI/d | Under the terms of the present licence, 7300MI/a could be abstracted at this location. |
| Proposed licence | Agreement reached to restrict Chitterne to operational abstraction generally running at 2MI/d for local usage but with flexibility of a peak rate of 13MI/d if required. constrained by the maximum abstraction shown in the this table. | 13MI/d | This abstraction will be disaggregated from Codford with an annual maximum for Chitterne of 2072MI/a. |
| Additional licence conditions | Abstraction will be further restricted to no more than 1712MI between the 1 st of April and the 31 st of October inclusive in any year. | - | - |

Further information needed:

- Ongoing monitoring of flow and ecology required to ensure proposed solution is effective. At this site, additional monitoring will help to provide a robust dataset to ensure option is sustainable.

Codford Boreholes (Wessex Water Services Ltd) licence 13/43/023/G/212

This abstraction is very close to the Wylfe and it has virtually instantaneous impacts on flow whilst developing only a small amount of groundwater storage. PWS abstraction at this source is operated in conjunction with the Chitterne source as they have an aggregate annual condition of 9500 MI/a. Peak abstraction allows 26 MI/d, but this is constrained to 6MI/d when flows at Norton Bavant gauging station fall below 750l/s (approximately Q50).

Impacts of abstractions on the Wylfe follow a different pattern than those on the Bourne and are less significant at the low flows periods, but impacts then increase as flows increase and for Codford they peak around Q44. Taken in isolation, impacts are less than agreed river flow thresholds with the exception of a 13% impact at Q50nat. In combination with other abstractions, impacts rise to approximately 14% at Q95nat; 20% at Q70nat and 23% at Q50nat. Although this is difficult to correlate to any deterioration in habitat or impacts on designated species, it is likely that it would lead to slow deterioration of the SAC, so significant operational changes are required.

Options:

1. Revoke: (RAvon WR CO OP01)

Although the impact of this licence is notable at average flow 'alone' and contributes to unacceptable 'in combination' impacts, there is undoubtedly a resource at this location that could be abstracted without detrimental impact on the Wylfe. It is therefore unreasonable to revoke a licence under these conditions and this option is therefore **rejected**.

2. Cease summertime abstraction during lower than average flows: (RAvon WR CO OP02)

Using the groundwater model a range of scenarios were tested and it was concluded that the flow criteria could be achieved for virtually the entire flow range if the summer time reduced flow condition were amended. It is therefore proposed that the summer flow condition is amended so that: when flows fall below 750l/s over a 14 day mean during the period from the 15th April to the 31st Dec inclusive, abstraction will cease. This option has been agreed with the water company.

3. Augmentation: (RAvon WR CO OP03)

This was not an option at this site as abstraction for augmentation would be at the direct expense of the river and NE are not in favour augmentation as a sustainable option within the SAC. This option was **rejected**.

4. Do nothing: (RAvon WR CO OP04)

This option does not protect the agreed flow range for the river and was **rejected**.

Table C2.6.7 Summary of Codford abstraction options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|--|--|--|--|---|--|--|--|
| Revoke (RAvon_WR_CO_OP01) | Would achieve environmental protection but has major implications. | Would require the water company to locate and develop a major alternative resource. | Would affect water supply and therefore would be delayed until alternative supplies located. | Significant cost to water company (passed on to customers). | Would protect flows. | No, as major impacts would be shifted elsewhere. | No |
| Cease summertime abstraction at below average flows (RAvon_WR_CO_OP02) | Would achieve environmental protection. | Can be addressed through the development of a more integrated grid (Note discussions over constrained short-term peak rate abstraction (linked to ⁽⁴⁾ below). | Would affect water supply and therefore would be delayed until grid is developed. | Addressed in WRMP and funded through AMP. | Should deliver desired level of protection to SAC. | Has been factored into the companies business plans. | Yes |
| Augmentation (RAvon_WR_CO_OP03) | Not practical. | Relatively low cost but totally ineffective option. | No significant costs. | Limited | Untested and impractical. | Not sustainable and not acceptable to NE. | No, cheap but impractical. |
| Do nothing (RAvon_WR_CO_OP04) | Would not provide protection to SAC. | No economic cost. | Fisheries may be degraded and health of the SAC deteriorate. | No cost. | Ecology would remain under stress. | Not sustainable as impacts would be ignored. | No |

Selected option: (RAvon WR CO OP02)

Note: Due to water company business planning deadlines, this option once selected, was provided to the water company as a sustainability reduction and incorporated into their business plan. This change has been presented to OFWAT for approval and has been funded through the AMP process.

Table C2.6.8 Indicative licence changes for Codford

| | Details | Daily Max | Annual Max |
|------------------------|--|--|--|
| Current licence | 13/43/023/G/212 part of the same licence as Chitterne. | 26MI/d with abstraction reducing to 6MI/d when flows fall below a prescribed flow (pf) of 750l/s over a 14 day mean at Norton Bavant gauging station from the 15 th of April to the 31 st of December inclusive. | Under the terms of the present licence, 9490MI/a can be abstracted at this location. Note: the aggregate for the whole licence with Chitterne is 9500MI/a. |

| | | | |
|--------------------------------------|--|---|--|
| Proposed licence | The company have agreed to the amendment of the summertime prescribed flow abstraction clause and a change to the daily maximum limit to abstraction. | The daily maximum will now be reduced to 20MI/d with abstraction reducing to zero when flows fall below a prescribed flow of 750l/s over a 14 day mean at Norton Bavant Gauging Station from the 15 th of April to the 31 st of December inclusive. | The proposal is to disaggregate this site from Chitterne and to specify the annual maximum for Codford as 7300MI/a (ie an effective reduction from the theoretical value of 9490MI/a). |
| Additional licence conditions | ⁽⁴⁾ Constrained and limited peak rate abstraction at this site will be permitted during the period from the 15th of April to the 31st of December, irrespective of the flow at Norton Bavant, up to an annual maximum of 120MI. Note: Constrained and limited peak rate abstraction that does not infringe the river flow thresholds is being refined through further discussions with the company. | Provisionally up to 6MI/d irrespective of flows at Norton Bavant. | This will amount to an annual total of no greater than 120MI under these low flow conditions. Any water abstracted to meet these needs will come out of the agreed new annual maximum of 7300MI/a. |
| Additional licence conditions | If abstraction has ceased under normal pf conditions, then a small volume of sweetening water will be allowed to maintain the source. This water will be returned directly to the river and will not be detrimental to river flows. Details of sweetening volumes are being refined with Wessex Water. | Not to exceed a rate of 6MI/d (agreed rate still under discussion with Wessex Water). | Any sweetening volumes will come out of the agreed new annual maximum of 7300MI/a. |

Further info needed

- Ongoing monitoring of flow and ecology is required to ensure proposed solution is actually effective. At this site, additional monitoring will help to provide a robust dataset to compare against once the option has been implemented.

Brixton Deverill Boreholes (Wessex Water Services Ltd) Licence 13/43/023/G/238

This abstraction is upstream of the SAC boundary on the Wylfe tributary. The abstraction has been modified over time and now incorporates two sites of stream augmentation (see 'in combination section'). This stretch of the Wylfe is winterbourne in nature and has been affected by the introduction of public water supply abstraction. Without augmentation, this abstraction would dry out the river in addition to its effects on groundwater storage.

Total daily abstraction (for both purposes) cannot exceed 18 MI/d and total annual abstraction is 3300 MI/year.

Assessment in AMP 4 using the HAM identified hydrological change whilst the licensed augmentation was operating from Brixton and Kingston Deverill as follows: flows above natural at Q95nat at start of SAC, flows then reduced by about 20% at Q70nat and flows reduced in excess of 25% at Q50nat. This abstraction also contributes to unacceptable impacts in combination with Wessex's abstractions at Heytesbury and Codford further down the Wylfe. Significant operational changes are required which has led to sustainability reductions being provided to the water company.

Options:

1. Revoke: (RAvon WR BD OP01)

There is a resource at this location which can be abstracted without impacting the flow criteria for the SAC. Because this site is outside of the SAC boundary the assessment has been based on flow conditions from the SAC boundary downstream. It seems unreasonable for this licence to be revoked when a sustainable level of abstraction can be found therefore this option was **rejected**.

2. Provide additional augmentation: (RAvon WR BD OP02)

There is already considerable augmentation and there is evidence that this is creating a very unnatural flow regime. Any further abstraction for augmentation purposes would just increase impact on groundwater storage without resolving the issues. This option is also **rejected**.

3. Reduce the daily public water supply abstraction to the annual equivalent of 4MI/d: (RAvon WR BD OP03)

Reduce the daily abstraction: Modelling shows that suitable flow regimes can be achieved by reducing abstraction at this site and re-profiling augmentation. This will have the twin benefits of improving the flows for the SAC species and reducing the impact of abstraction on the aquifer.

4. Do nothing: (RAvon WR BD OP04)

This is not a viable option as it doesn't resolve the issues at the beginning of the SAC on the Wylfe. This option is **rejected**.

Table C2.6.9 Summary of Brixton Deverill abstraction options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|--|---|--|--|---|---|---|---|
| Revoke (RAvon_WR_CO_OP01) | Would achieve environmental protection. | Significant as it would require the water company to locate and develop an alternative resource. | Would affect water supply and therefore would be delayed until alternative supplies located. | Significant cost to water company (passed on to customers). | Would return flows to natural. | No, as unnecessary impacts would be shifted elsewhere. | No, this is excessive as this level of reduction is not required. |
| Provide additional augmentation (RAvon_WR_CO_OP02) | Might achieve environmental protection but by increasing augmentation it is also exacerbating unnaturalness of system . | Would increase pumping costs. | Might have implications for downstream abstractors and might derogate other licences. | Limited | Untested and would create an even more unnatural flow regime. Excessive augmentation possibly detrimental to diversity according to APEM's ecological assessment. | This would just be masking the problem and not addressing it. Additional pumping costs. | No. this is a cheap but unacceptable solution. |
| Reduce the daily abstraction to 4MI/d (RAvon_WR_CO_OP03) | Would achieve environmental protection. | Can be addressed through the development of a more integrated grid. | Can be addressed through grid. | Addressed in WRMP / business plan and funded through AMP. | Should deliver desired level of protection to SAC. | Best sustainable option. | Yes |
| Do nothing (RAvon_WR_BD_OP04) | Would not provide protection to SAC. | No economic cost. | Fisheries may be degraded and health of the SAC deteriorate. | No cost. | Ecology would remain under stress. | Not sustainable as impacts would be ignored. | No |

Selected option: (RAvon WR BD OP03)

Note: Due to water company business planning deadlines, this option once selected, was provided to the water company as a sustainability reduction and incorporated into their business plan. This change has been presented to OFWAT for approval and has been funded through the AMP process.

Table C2.6.10 Indicative licence changes for Brixton Deverill abstraction

| | Details | Daily Max | Annual Max |
|-------------------------|--|--|--|
| Current licence | 13/43/023/G/238 (linked to ⁽⁵⁾ below) | 18MI/d | 3300MI/a |
| Proposed licence | Wessex Water have accepted the PWS reduction and the need for re-profiling of the augmentation (see in-combination section). | Daily abstraction would be reduced to 13MI/d (when augmentation pf not triggered). With augmentation triggered, abstraction would be restricted to 4.36MI/d. | Annual abstraction for PWS to be reduced to 1474.6MI/a |

| | | | |
|--------------------------------------|--|--|--|
| Additional licence conditions | Constrained and limited peak rate abstraction at this site could increase by an additional 5MI/d up to an annual maximum of 100MI. Final values that do not infringe the river flow thresholds will be agreed with Wessex Water through further discussions. | 9.36MI/d under constrained and limited peak rate abstraction operation. | This additional volume will be sourced from the agreed new annual PWS total of 1474.6MI/a. |
| Additional licence conditions | ⁽⁵⁾ At present this licence is linked to Heytesbury PWS. The change will not alter daily or annual quantities and allows simpler regulation. | It is proposed therefore to disaggregate Heytesbury and remove the overarching daily link between these sites. | - |

Further information needed:

- Ongoing monitoring of flow and ecology is required to ensure the proposed solution is effective. At this site, additional monitoring will help to provide a robust dataset to compare against, once the option has been implemented.

C2.7 Abstraction licences acting in-combination:

Bickton fish farm 13/43/028/S/132

Barford fish farm 13/43/028/S/119

Britford fish farm 13/43/026/S/120

The actions described above will remove the 'alone' impacts, therefore it is not necessary to consider the 'in-combination' impacts further.

Brixton Deverill augmentation (Wessex Water Services Ltd) Licence 13/43/023/G/238

Impact from the Brixton Deverill public water supply abstraction is mitigated at low to medium/low flows by augmentation from this source and from Kingston Deverill. At average flows, stream support is less likely to be operational so the full impact of the PWS abstraction is felt.

Abstraction for stream augmentation of 8.64 MI/d is currently licensed to maintain flows at Brixton Deverill and Norton Bavant. Total daily abstraction (for both Public Water Supply and Stream augmentation purposes) cannot exceed 18 MI/d and the total annual abstraction amounts to 3300 MI/year.

Assessment in AMP 4 using the HAM identified hydrological change whilst the licensed augmentation was operating from Brixton and Kingston Deverill as follows: flows above natural at Q95nat at the start of SAC due to the levels of augmentation, flows reduced by about 20% at Q70nat and flows reduced in excess of 25% at Q50nat. This abstraction also contributes to unacceptable impacts in combination with Wessex's abstractions at Heytesbury and Codford further down the Wylde. Significant operational changes are required which has led to sustainability reductions being provided to the water company. The degree of re-profiling of augmentation is still under discussion and will need to be trialled. At present, the augmentation is simplistic in nature. Modelling of more sympathetic augmentation needs to occur and new triggers and volumes will be explored and final values agreed with Wessex Water.

Options:

1. Review and adjust augmentation: (RAvon WR BDA OP01)

This would allow the most sympathetic operation of augmentation with the aim of achieving as natural as possible a flow regime. The aim is to avoid or reduce the level of over augmentation at low flows.

2. Leave augmentation arrangements as at present: (RAvon WR BDA OP02)

At present the operation of the augmentation is too simplistic and needs adjusting in line with the requirements of the SAC. The option not to address this issue is therefore **rejected**.

Table C2.7.1 Summary of Brixton Deverill augmentation options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|---|--|---|--|------------------|--|---|--|
| Review and adjust augmentation (RAvon_WR_BDA_OP01) | Would achieve environmental protection. | Would require a degree of remodelling and physical testing. Costs increase with variable speed pumping. | Should make downstream flows more natural. | Minimal | Should enhance flow regime at start of SAC. | All pumping has a cost but this augmentation would be as efficient as possible. | Yes, in line with agreed objectives. |
| Leave augmentation practice alone (RAvon_WR_BDA_OP02) | Would only partially achieve environmental protection. | Costs unchanged. | No change from present. | None | Would protect low flows but not across flow range. | Less profiled augmentation. | No, doesn't address issues with augmentation. |

Selected option: (RAvon WR BDA OP01)

Note: Due to water company business planning deadlines, this option once selected, was provided to the water company and incorporated into their business plan. This change has been presented to OFWAT for approval and has been funded through the AMP process.

Table C2.7.2 Indicative licence changes for Brixton Deverill augmentation

| | Details | Daily Max | Annual Max |
|-------------------------|---|---|---|
| Current licence | 13/43/023/G/238 (part of). | 8.64MI/d in conjunction with the 18 MI/d for public water supply. | Not specified. |
| Proposed licence | At this stage the flow triggers for augmentation have not been reviewed, but this will need to occur to ensure the flow duration curve (FDC) is made as natural as possible within the confines of the augmentation required to meet the river flow thresholds. | A revised augmentation value not greater than 8.64MI/d will be defined to protect the agreed river flow criteria. This helps compensate for the effect of the associated public water supply abstraction. | This will be derived from the daily maximum and the number of days of augmentation required to meet the river flow criteria affected by the associated public water supply abstraction. |

Further information needed:

- Ongoing monitoring of flow and ecology required to ensure proposed solution is actually effective. At this site, additional monitoring will help to provide a robust dataset to compare against once the option has been implemented.

Kingston Deverill augmentation (Wessex Water Services Ltd) Licence 13/43/023/G/238

Impact from the Brixton Deverill abstraction is mitigated at low to medium/low flows by augmentation from this source and from Brixton Deverill. At average flows, stream support is less likely to be operational so the full impact of the PWS abstraction is felt.

Abstraction of 10 Ml/d provides stream augmentation to maintain flows at Brixton Deverill and Norton Bavant. Operation is linked to Brixton Deverill and Heytesbury sources.

Operational changes are required to the public water supply abstraction which has led to sustainability reductions being provided to the water company. In addition to these reductions, the water company will need to re-profile stream augmentation to deliver a more natural flow regime.

Options:

1. **Review and adjust augmentation: (RAvon WR KDA OP01)**

This would allow the most sympathetic operation of augmentation with the aim of achieving as natural as possible a flow regime. It should aim to avoid or reduce the level of over augmentation at low flows.

2. **Leave augmentation arrangements as at present: (RAvon WR KDA OP02)**

At present the operation of the augmentation is too simplistic and needs adjusting in line with the requirements of the SAC. The option not to address this issue is therefore **rejected**.

Table C2.7.3 Summary of Kingston Deverill augmentation options

| Option | Risk | Cost | Social consequences | Economic effects | Environmental impact | Sustainability | Does the option pass the fair and reasonable test? |
|---|--|---|--|------------------|--|---|--|
| Review and adjust augmentation (RAvon_WR_KDA_OP01) | Would achieve environmental protection. | Would require a degree of remodelling and physical testing. Costs increase with variable speed pumping. | Should make downstream flows more natural. | Minimal | Should enhance flow regime at start of SAC. | All pumping has a cost but this augmentation would be as efficient as possible. | Yes, in line with agreed objectives. |
| Leave augmentation practice alone (RAvon_WR_KDA_OP02) | Would only partially achieve environmental protection. | Costs unchanged. | No change from present. | None | Would protect low flows but not across flow range. | Less profiled augmentation. | No, doesn't address issues with augmentation. |

Selected option: (RAvon WR KDA OP01)

Table C2.7.4 Indicative licence changes for Kingston Deverill augmentation

| | Details | Daily Max | Annual Max |
|-------------------------|---|--|---|
| Current licence | 13/43/023/G/238 (part of) | 10MI/d | Not specified |
| Proposed licence | At this stage the flow triggers for augmentation have not been reviewed, but this will need to occur to ensure the FDC is made as natural as possible within the confines of the augmentation required to meet the river flow criteria. | A revised augmentation value not greater than 10.0MI/d, will be defined to protect the agreed river flow criteria. This helps compensate for the effect of the associated public water supply abstraction. | This will be derived from the daily maximum and the number of days of augmentation required to meet the river flow criteria affected by the associated public water supply abstraction. |

Note: Due to water company business planning deadlines, this option once selected, was provided to the water company and incorporated into their business plan. This change has been presented to OFWAT for approval and has been funded through the AMP process.

Further information needed

- Ongoing monitoring of flow and ecology is required to ensure the proposed solution is actually effective. At this site, additional monitoring will help to provide a robust dataset to compare against once the option has been implemented.

C3 Summary of options for River Avon SAC

Table C3.1 Summary of options for River Avon SAC

| Option reference | Effect alone (A) or in-combination (I) | Adverse impact(s) | Modification proportional to impact? | Adverse impacts from other sources. | Option reviewed against principals' checklist? | Other sites to which the permission is relevant. | Links with plans /projects undertaken or authorised by EA or other *CAs as per Reg 51(3). | Details added to the Appendix 19? |
|--------------------|--|---|--------------------------------------|-------------------------------------|--|--|---|-----------------------------------|
| RAvon_WQ_WSTW_OP04 | A & I | Nutrient enrichment | Y | Y | Y | N | Y | Y |
| RAvon_WQ_WG_OP03 | A & I | Nutrient enrichment | Y | Y | Y | N | N | Y |
| RAvon_WQ_FF_OP03 | A & I | Nutrient enrichment | Y | Y | Y | N | N | Y |
| RAvon_WQ_WCF_OP03 | I | Nutrient enrichment | Y | Y | Y | N | N | Y |
| RAvon_WR_BI_OP04 | A | Flow in the Ley Stream | Y | N | Y | N | N | Y |
| RAvon_WR_BA_M_OP02 | A | Salmon migration | Y | N | Y | N | N | Y |
| RAvon_WR_BA_F_OP04 | A | Flow in main river Avon at Standlynch & New Court Carrier | Y | N | Y | N | N | Y |
| RAvon_WR_BR_OP02 | A | Salmon migration | Y | N | Y | N | Y - WLMP | Y |
| RAvon_WR_NT_OP04 | A | Flow regime | Y | Possible | Y | N | N | Y |
| RAvon_WR_CP_OP02 | A | Flow regime | Y | Possible | Y | N | N | Y |
| RAvon_WR_CH_OP03 | A | Flow regime | Y | N | Y | N | Y (SOI & RSOI) | Y |
| RAvon_WR_CO_OP02 | A | Flow regime | Y | N | Y | N | N | Y |
| RAvon_WR_BD_OP03 | A | Flow regime | Y | N | Y | N | N | Y |
| RAvon_WR_BDA_OP01 | I | Flow regime | Y | N | Y | N | N | Y |
| RAvon_WR_KDA_OP01 | I | Flow regime | Y | N | Y | N | N | Y |

* CA = Competent Authority

SECTION D CONSULTATION PROCESS (WITH LICENCE HOLDERS)

Table D1.1 Communications log

| Permission reference | Permission holders name | Contact format | Date | NE consulted | EA departments consulted | | | | | | | AHDC* contacted | RHDC ** contacted | Reply Requested? | If yes when? |
|------------------------|---|--------------------|----------------------|--------------|--------------------------|--------|-----|-------|-----|-----------|-------|-----------------|-------------------|------------------|--------------|
| | | | | | WQ/AEP | WR/AEP | REP | GW&CL | FRB | Hydrology | Legal | | | | |
| MoD (WQ) | | | | | | | | | | | | | | | |
| 043172 | Warminster Garrison | Letter | 20/01/10 | N | Y | N | Y | N | N | N | N | Y | Y | N | n/a |
| Fish farms (WQ) | | | | | | | | | | | | | | | |
| 040143 | Deverills Fish Farm | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 040171 | Ashford Water Fish Farm | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 040181 | Damerham Fisheries Ltd | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 040182 | Chalke Valley Fish Farm | Letter and meeting | 22/01/10 25/02/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 040477 | The Cress Beds (Damerham Fisheries Fish Farm) | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 042989 | Riverside Trout Farm | Letter and meeting | 22/01/10 25/02/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 041892 | Millbrook Fish Farm | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 041917 | Longford Mill Fish Farm | Letter and meeting | 22/01/10 25/02/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 050104 | Manningford Trout Farm | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 050748 | Waterways Hatchery | Meeting | 25/02/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 050751 | Crystal Springs Trout Farm | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |

| | | | | | | | | | | | | | | | |
|---|-------------------------------|--|----------|---|---|---|---|---|---|---|---|---|---|---|-----|
| 040622 | Barford Fish Farm | Meeting | 25/02/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 040623 | Barford Fish Farm | Meeting | 25/02/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 050109 | Bickton Fish Farm | Meeting | 25/02/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 041927 | Bickton Fish Farm | Meeting | 25/02/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| 400194/TF/01 | Britford Trout Farm | Meeting | 03/12/09 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| Watercress Farms (WQ) | | | | | | | | | | | | | | | |
| 043223 | Hill Deverill Watercress Farm | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| | | Phonecall | 25/01/10 | | | | | | | | | | | | |
| 043224 | Hill Deverill Watercress Farm | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| | | Phonecall | 25/01/10 | | | | | | | | | | | | |
| 401224 | Hill Deverill Watercress Farm | Letter | 22/01/10 | N | Y | N | N | N | N | N | N | Y | N | N | n/a |
| | | Phonecall | 25/01/10 | | | | | | | | | | | | |
| Water company (WR) ‡ | | | | | | | | | | | | | | | |
| 13/43/023/G/212 | Wessex Water | Meeting | 17/12/09 | N | N | Y | Y | Y | N | Y | N | N | N | N | n/a |
| 13/43/023/G/212 | Wessex Water | Meeting | 05/01/10 | N | N | Y | Y | Y | N | N | N | N | N | N | n/a |
| 13/43/023/G/212 | Wessex Water | Meeting with Wiltshire Fisheries Association | 26/01/10 | N | N | Y | N | N | N | N | N | N | N | N | n/a |
| 13/43/023/G/212, 13/43/023/G/238, 13/43/0236/G/104, 13/43/024/G/019 | Wessex Water | Meeting | 01/02/10 | N | N | Y | Y | N | Y | N | N | N | N | N | n/a |
| Fish farms (WR) † | | | | | | | | | | | | | | | |
| 13/43/026/S/119 13/43/028/S/132 | Trafalgar Fisheries | Meeting | 05/11/09 | N | Y | Y | N | N | Y | Y | N | Y | Y | N | n/a |
| 13/43/026/S/120 | Britford Trout Farm | Meeting | 03/12/09 | N | Y | Y | N | N | Y | N | N | Y | N | N | n/a |
| 13/43/026/S/119 13/43/028/S/132 | Trafalgar Fisheries | Meeting | 09/12/09 | N | Y | Y | N | N | Y | Y | N | Y | Y | N | n/a |
| 13/43/026/S/119 13/43/028/S/132 | Trafalgar Fisheries | Meeting | 25/02/10 | N | Y | Y | N | N | Y | Y | N | Y | Y | N | n/a |

† In addition to the above there have been numerous emails and phone calls between the Environment Agency and Trafalgar Fisheries. There have also been a number of site visits to undertake fixed point photography and current meter flow gaugings.

‡ In addition to the meeting with the water company, there have been a number of presentations and hydrological assessments produced

- * Area Habitats Directive Co-ordinator
- ** Regional Habitats Directive Co-ordinator

Principles checklist

- These options allow us to reach a conclusion of no adverse effect.
- They are fair and reasonable.
- The contribution from other sources has been assessed.
- The decision is consistent with the requirements of Regulation 48 and with other consents across other parts of the Environment Agency.
- These decisions are achievable within the current operating regime of the licence.

Appendix A

Stage 4 Assessment of Adverse Effect on Site Integrity - Groundwater assessment for Porton Down

Background

Stage 3 Assessment of Adverse Effect on Site Integrity – Review of Consents (River Avon SAC – High Priority Natura 2000 site [reviewed July 2009]) could not demonstrate no adverse effect on site integrity for permit CC3727 (approval document for DSTL Porton Down) because the approved aqueous disposal route is listed in the permit as via the premises only sewage treatment works which discharges effluent to groundwater.

It should be noted that the Environment Agency’s habitat stage 3 assessment indicated the following dose rates to the worst affected organism:

| | |
|-------------|--|
| Freshwater | – 8.9 E-01 \square Gyh ⁻¹ |
| Terrestrial | – 1.3 E+00 \square Gyh ⁻¹ |
| Coastal | – not assessed |
| Total | – 2.2 E+00 \square Gyh ⁻¹ |

These dose rates are well below the agreed (with English Nature, now Natural England) threshold of 40 \square Gyh⁻¹ below which we can conclude that there will be no adverse effect on site integrity.

This note describes a simplified assessment of the likely impact of the radionuclide discharge to groundwater biota and at the site of the groundwater return to the surface.

Porton Down Discharge to Groundwater

The following assessments (on freshwater biota present at the point where the groundwater rises to the surface and specifically to groundwater biota) have been conducted at the site permit discharge limit for the aqueous waste only. The assessment does account for radioactive decay and partitioning of the radionuclides released through the on-site sewage works but then conservatively does not account for radioactive decay. The activity concentration present in the sewage works effluent has been determined from the Environment Agency’s habitat assessment spreadsheets. The activity concentrations are reported in Table 1.

Table 1: Assessment input activity concentrations

| Radionuclide | Activity (Bq/y) released from sewer |
|--|-------------------------------------|
| H-3/C-14 ^A | 4.10E+09 |
| S-35 | 4.90E+08 |
| P-32 | 1.10E+08 |
| I-125 | 9.60E+07 |
| I-131 | 1.80E+07 |
| Cr-51 + all others except alpha ^B | 3.70E+09 |

^A Conservatively treated as C-14 in the assessment

^B Conservatively treated as Cs-137 in the biota assessment

A groundwater model was not available to determine the transfer and fate of the radionuclides to through the groundwater system under the Porton Down site but there is some radiological monitoring data taken from boreholes 150m away from the sewage treatment works and this has been used as the input into the groundwater biota assessment.

Groundwater assessment

a) Assessment to biota inhabiting surface waters

The stage 4 assessment of impact to biota inhabiting surface waters has been conducted using the ERICA (Environmental Risk from Ionising Contaminants: Assessment and Management) Assessment Tool developed with European funding. The ERICA Assessment Tool is available from <http://www.project.facilia.se/erica/download.html> and the associated documentation is available from <http://www.ceh.ac.uk/protect/ERICAdeliverables.html>.

Groundwater may discharge to surface waters in a number of different ways for example via a spring or river and any radionuclides present in the groundwater discharge may then enter, and thus expose wildlife, in a freshwater ecosystem such as the River Bourne which flows about 2 km from the Porton Down site.

To model this, a simple but conservative assessment has been conducted with the ERICA Tool. The assessment assumed that, instead of the discharge from Porton Down going to groundwater, it was discharged via surface waters into the River Bourne 2 km away. The assessment used the individual radionuclide permit limit as an input into the International Atomic Energy Agency (IAEA) SRS-19 freshwater river model to determine the activity concentrations for the radionuclides in the freshwater ecosystem. A number of inputs are required to run the SRS-19 model. Table 2 gives the values used in the freshwater assessment. The SRS-19 dispersion models were designed to minimise the possibility that the calculated results underestimate the real doses by more than a factor of 10 (i.e. is designed to be conservative in itself).

It should be noted that Dstl Porton Down have estimated doses to humans resulting from the disposal of radioactive wastes to groundwater via their sewage works and demonstrated through borehole pump tests conducted on site a transit time of 2500 days for water to travel the distance of 2km from the sewage treatment works to the River Bourne. Therefore the dispersion modelling undertaken is likely to be highly conservative. Despite this the dose rates to the biota living in the River Bourne are minimal and below concern as shown below.

The ERICA Tool was used to calculate the dose rate to the default reference organisms listed in the ERICA Tool for freshwater ecosystems (see Table 3 for list). The default reference organism list was selected to represent different trophic levels (parts of the food chain) and to represent different exposure scenarios. For example, the benthic fish reference organism is assumed to spend time at the water/sediment interface and therefore will be exposed to radionuclides accumulated in the sediment while the pelagic fish reference organism is assumed to spend all its time in the water column and therefore will be exposed primarily to those radionuclides being carried in the water column.

The calculated dose rates to the ERICA default freshwater reference organisms are given in Table 3. These are well below the 40 $\mu\text{Gy h}^{-1}$ value that has been agreed as a threshold for the Stage 4 assessments.

Table 2: SRS-19 River dispersion model parameters used

| | |
|--|------|
| Flow rate (m ³ s ⁻¹) ^c | 3.63 |
| Depth (m) ^c | 0.3 |
| Width (m) ^c | 18 |
| Distance from release point to receptor (m) | 2000 |

^c based from flow rate information for the River Avon (3.55 m³/s) the nearest river for which information was available at the time of the assessment. The river width and depth were then estimated by the tool given in the table are for the 30 year low annual flow

Table 3: Results of the freshwater ecosystem assessment

| Organism | Total Dose Rate per organism, µGy h ⁻¹ |
|-----------------|---|
| Amphibian | 0.1 |
| Benthic fish | 1.1 |
| Bird | 0.08 |
| Bivalve mollusc | 1.2 |
| Crustacean | 1.4 |
| Gastropod | 1.2 |
| Insect larvae | 2.8 |
| Mammal | 0.2 |
| Pelagic fish | 0.2 |
| Phytoplankton | 0.00003 |
| Vascular plant | 1.4 |
| Zooplankton | 0.01 |

b) Assessment to groundwater biota

Species of bacteria, nematodes (a type of worm), amphipods (shrimp like species), spiders, insects (adults and larvae), isopoda and copepods have been reported in groundwater samples in the literature. Generally speaking these are very small sized organisms (up to a few mm). Within the ERICA Tool there is no category for bacteria so for this part of the assessment the R&D128 Freshwater Assessment Spreadsheet (v1.15) was used.

The water activity concentrations input into the R&D 128 tool were taken from some monitoring data for H-3 and C-14 taken from boreholes drilled at various points around the Dstl Porton Down site in March 2006 (Table 4). All the boreholes were within 150m of the discharge point. The R&D128 spreadsheet tool was used to assess the dose to the biota by putting the reported activity concentration into the spreadsheet tool as C-14, as this is the most radiologically significant.

Table 4: Groundwater monitoring data (C-14 and H-3) for 5 boreholes on the Dstl Porton Down site

| Sample location | Bq l ⁻¹ |
|--|--------------------|
| Groundwater upstream of Sewage treatment works | <0.0002 |
| Sewage works – inflow | <0.0002 |
| Sewage works – outflow | <0.0002 |
| Groundwater 20m downstream of sewage works | <0.0002 |
| Groundwater at bottom of field | <0.0002 |

The occupancy factors for these reference organisms were modified to place the organisms in the sediment i.e. in close proximity to the soil within a groundwater system this will maximise the external dose rate. The same radiation weighting factors (high energy beta/gamma = 1, low energy beta = 3 and alpha = 10) were applied as in the ERICA Assessment Tool.

The calculated dose rates to the R&D128 freshwater reference organisms of bacteria, zooplankton, phytoplankton and small benthic crustacean (which are representative geometries for small organisms) modified to be in contact with the freshwater/sediment interface as might be expected in groundwater are given in Table 5. These are below the 40 $\mu\text{Gy h}^{-1}$ value that has been agreed as a threshold for the Stage 4 assessments and as such it is possible to conclude, using this monitoring data, that there will be no adverse effect on the biota.

Table 5: Results of the assessment for biota living in groundwater

| Organism | Total Dose Rate per organism, $\mu\text{Gy h}^{-1}$ |
|--------------------------|---|
| Bacteria | 4.6E-06 |
| Small benthic crustacean | 4.0E-05 |
| Phytoplankton | 4.6E-06 |
| Zooplankton | 2.2E-05 |

Completed by David Copplestone

24-12-2009

Appendix 1 for above report: ERICA Tool

The ERICA Integrated Approach is based on generalised ecosystem representations, termed reference organisms. Reference organisms are defined as: 'a series of entities that provide a basis for the estimation of radiation dose rate to a range of organisms which are typical, or representative, of a contaminated environment. These estimates, in turn, would provide a basis for assessing the likelihood and degree of radiation effects'. They have been defined and used for the derivation of geometric relationships between radiation sources and organisms, as well as for

considerations of the dosimetry of both external and internal exposure. The reference organisms can be grouped into three general ecosystem categories, namely terrestrial, freshwater and marine ecosystems. Furthermore, they can be used for pooling some of the effects data generated for a range of species. The selection of reference organisms makes it possible to address all protected species within Europe.

The ERICA Integrated Approach is supported by the ERICA tool, which is a software programme that guides the user through the assessment process, keeps records and performs the necessary calculations to estimate dose rates to selected biota. The inputs required include details of the reference organisms (and any user-specific organism geometry that can be used to define feature species of interest in a particular assessment), the radionuclides of interest, media or biota activity concentration values, concentration ratios for radionuclide transfer between the media and the biota of interest, and dose rate conversion coefficients (which convert the radionuclide concentrations to dose rates).

The ERICA assessment tool has been compared positively through the International Atomic Energy Agency's Environmental Modelling for Radiation Safety Programme to other models (including our habitats assessment tool used for Stage 3 assessments) for predicting dose rates to biota.

Appendix 2: R&D128

The R&D Publication 128 has been used widely by the Environment Agency as its methodology has been incorporated into the Environment Agency's functional guidance on applying the Habitats Regulations to Radioactive Substances Authorisations.

As part of the R&D Publication 128, the three spreadsheet programmes provided dosimetric and concentration ratios for nine radionuclides:

- Coastal and freshwater ecosystems: ^3H , ^{14}C , ^{99}Tc , ^{90}Sr , ^{137}Cs , $^{239+240}\text{Pu}$, ^{238}U , ^{129}I , ^{60}Co , ^{106}Ru , ^{131}I , ^{234}Th , $^{234\text{m}}\text{Pa}$, ^{241}Am , ^{32}P and ^{210}Po , using Coastal aquatic ecosystem release version 1.15 (final).xls and Freshwater ecosystem release version 1.15 (final).xls.

- Terrestrial ecosystem: ^3H , ^{14}C , ^{35}S , ^{90}Sr , ^{137}Cs , $^{239+240}\text{Pu}$, ^{238}U , ^{129}I , ^{210}Po , ^{41}Ar , ^{60}Co , ^{106}Ru , ^{131}I , ^{234}Th , $^{234\text{m}}\text{Pa}$, ^{241}Am , ^{32}P and ^{85}Kr , using Terrestrial ecosystem release version 1.20 (final).xls.

Appendix B - Bickton and Barford fish farm further information

Map B1 – Parr habitat and redd data around Bickton

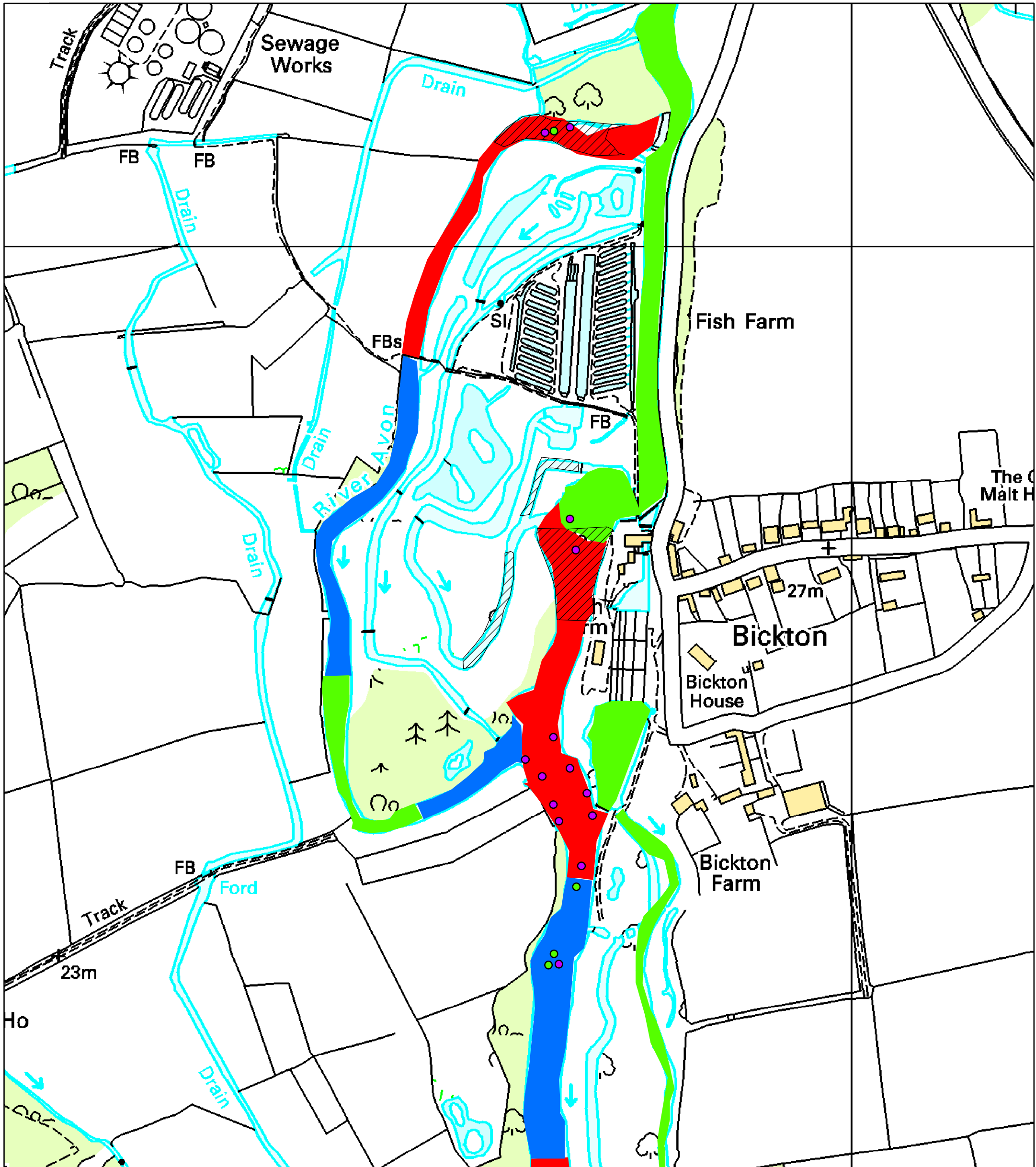
Map B2 – Parr habitat and redd data around Barford

Report B1 - Impounding structure on New Court Carrier, David Solomon, V. 1.1 November 17 2009

Report B2 – 2009 parr habitat and macrophyte walkover survey

Figure B1 – New Court Carrier logger data


Parr habitat and redd data around Bickton



1997 parr habitat survey

 not suitable as parr habitat


 moderate parr habitat


 good parr habitat


channels with no colour - no data available



Bickton good parr habitat Sept 09

 salmon redds 05/06

 salmon redds 04/05

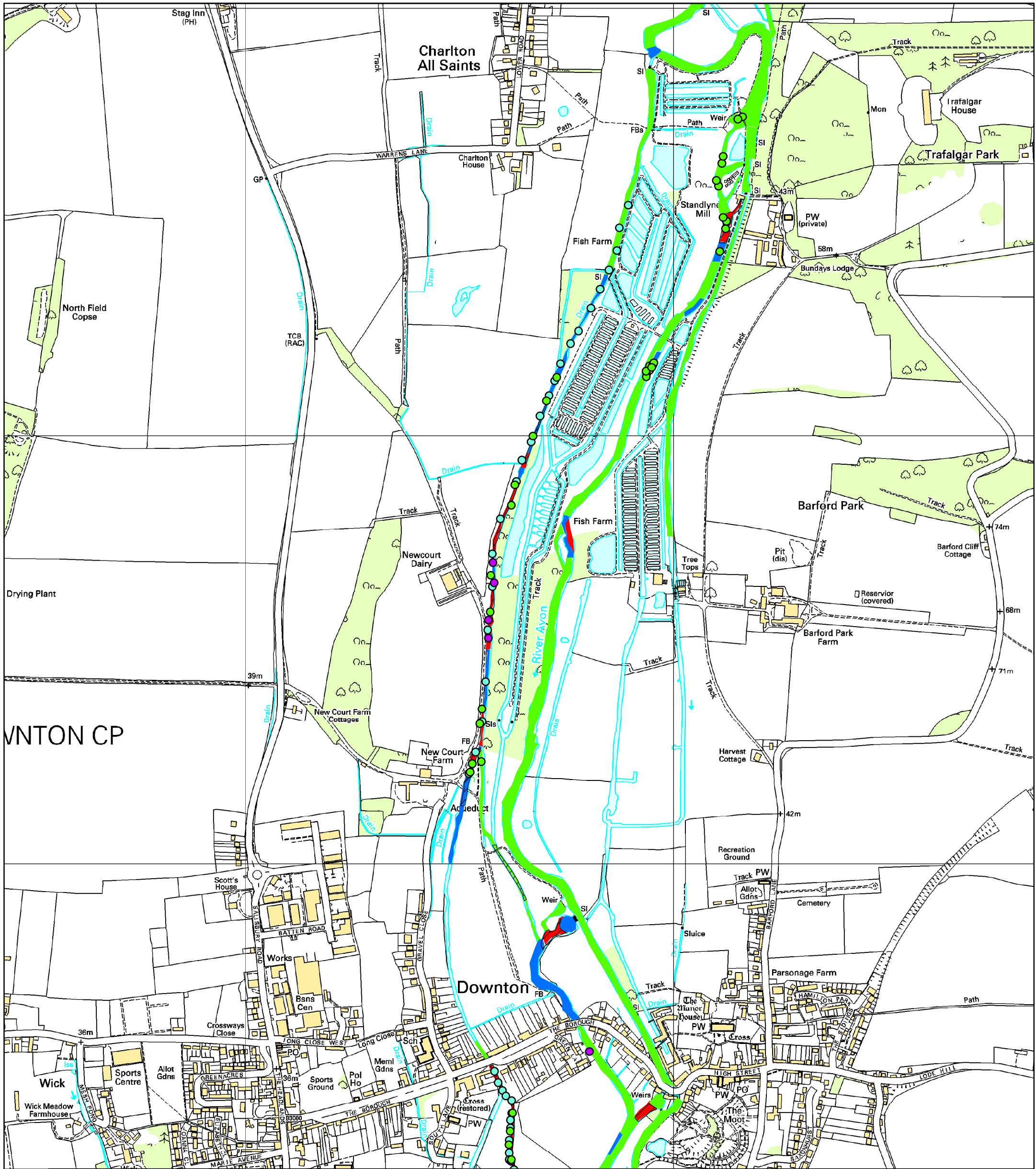
 salmon redds 03/04

0 25 50 100 150 200
Meters

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Parr habitat and redd data around Barford



1997 parr habitat survey

not suitable as parr habitat

moderate parr habitat

good parr habitat

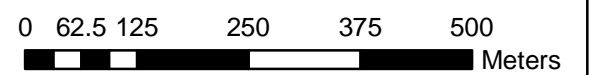
channels with no colour - no data available

Barford good parr habitat Aug 09

● salmon redds 05/06

● salmon redds 04/05

● salmon redds 03/04



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Appendix B Report B1

Environment Agency – South West Region

Impounding structure on New Court Carrier

There is a head-retaining structure on the Newcourt Carrier at the intake for the Newcourt fish farm unit. On October 27 2009 I was asked by Nicole Caetano to look at this structure as a matter of urgency, from the viewpoint of upstream passage of adult salmon. I undertook a site visit on November 3, in the company of the manager of the fish farm, Darren Butterworth.

The structure is located at SU 17913 23622 and is old, presumably originally constructed for water-meadow flooding (Figure 1). It incorporates an eel trap. The head-drop at the time of the visit was almost exactly 1 m.



Figure 1. The structure, looking upstream. The fish farm intake is visible above the structure, with a walkway and handrail running over it. The residual flow passes mainly through a notch against the far bank, with some passing over a level board across a wide crest (centre-right of picture). The other hatches, including the eel trap (centre of picture) are closed.

Although there was enough water passing over the structure for passage of salmon, ascent would be problematic under these conditions. The head-drop is considerable (a metre), the water is shallow at the foot of the fall (there is a concrete cill), and the level-board maintaining the upstream head passes over the top of the notch carrying most of the flow, creating a collision hazard for leaping fish.

At first sight the carrier would not appear to be particularly attractive to migrating salmon, as the residual flow within it, downstream of the fish farm intake and this structure, is limited and unlikely to represent a significant attraction to upstream. Although there is a small linking channel connecting the carrier with one of the fish-farm outfall channels (which migrants are known to enter) the flow within it is very

small. Most of the flow continues down the carrier until it rejoins the river well downstream of Downton, where it would represent a much lower volume of flow than the main river. However, significant numbers of salmon redds have been observed within the Newcourt Carrier, downstream of the structure, in recent years. The number of redds was particularly high (42) in 2003-04, which experienced a fairly low-flow autumn, suggesting that problems with passage towards the top end of the carrier may have contributed to restriction of spawning distribution.

The simplest way to improve passage for salmon at this site may be to shut-off the hatch where most of the flow currently passes (there are slots for stop-boards), and open one of the other hatches on the left of the picture. It would then be necessary to raise the tail-water level by constructing a wall across the apron of the structure – the concrete apron continues for at least 10 m downstream. This would split the head-drop between two sub-structures, and provide a good depth for the fish below the hatch itself. This structure could be a series of piers (blockwork or steel) with the head being retained by stop-boards.

I do not think that this assessment would change with different flows. At lower flows less water would pass on down the carrier, making salmon migration at this point less likely. At high river discharge the flow down the carrier would increase, but not to the same extent as down the river as there is a flow-control structure at the upstream end of the carrier. This would make the main river increasingly attractive to migrating salmon at the point where the carrier rejoins the river. The head-drop is likely to remain similar over a range of flows.

The following observations may be relevant:-

1. The structure is old and any barrier to migration it represents is not due to its use as a head-retaining structure for the fish farm.
2. The habitat within the carrier downstream of the structure is good potential salmon spawning and nursery habitat, and some spawning throughout the channel is desirable. Therefore an alternative approach to the potential passage problem, through attempting to prevent fish from entering the downstream end of the carrier, would be inappropriate.
3. The structure represents no impediment to the downstream migration of smolts and kelts.

David Solomon.

V. 1.1 November 17 2009.

Appendix B Report B2

Bickton & Barford site surveys 2009

Bickton Fish Farm 07/9/09

- A. This section of main river has good parr habitat from the tail of the weir pool to the STW discharge on the right bank, historically the good parr habitat extended further downstream to the foot bridge. The habitat in the channel appeared to be impacted by low flow conditions with emergent macrophytes such as sparganium emersum present in mid channel and the presence of azola (photo P9070008). Exposed tree roots were also recorded. This is an important spawning area for migratory salmonids.

Recommendation

Increase flow in the Ley stream throughout year.



P9070008

- B. This area is heavily encroached with emergent macrophytes, *Phragmites australis* being dominant. Little or no flow present with some clear areas of standing water. High conservation value.
- C. Small high level channel with good flow at abstraction point (4 million gallons/day – Darren Butterworth *pers comm*).

Flows through old earth stew ponds then into wetland area with 90% emergent macrophytes, *Phragmites australis* dominant. Joins z-channel (i.e. channel with abstraction 13/43/028/S/132-Y at top) although it provides no additional flow at this point. Below this point the z-channel is over wide and heavily encroached but juvenile coarse fish (Roach & Dace) were present and the clearer areas of channel with concentrated flows are good 0+ brown trout habitat (photo P9070013).

Check screened at downstream end to prevent entrapment of migratory salmonids.



P9070013

- D. This channel has a good gradient with diverse macrophyte community, in stream cover up to 85% dominated by *Ranunculus*. Good parr habitat on the bottom 2/3rd of channel (photo P9070006) and screened at downstream end to prevent entrapment of migratory salmonids (P9070005), deep glide with smooth flow dominant in top 3rd of channel (P9070007).



P9070006



P9070005



P9070007

- E. The mill stream forms a deep wide impounded section with diverse macrophyte community creating good coarse fish habitat (photo P9070018).



P9070018

- F. The main river from the tail of the mill pool to just below the mill stream confluence remains good parr habitat as recorded in the 1997 survey. This is also an important spawning area for migratory salmonids.
- G. The channel is dominated by deep glides with extensive sand and silt deposits (40%) and a diverse macrophyte and macro algae community indicative of enrichment. Some clear gravel areas were present (20-30%) but overall parr habitat is poor. Chub, dace, pike and roach were recorded.

Barford Fish Farm 26/8/09

A. New Court Carrier

The top of the carrier is impounded downstream to the abstraction point for the western unit of the farm. The channel has been resectioned but shows signs of natural recovery.

Habitat is predominately deep glides with diverse in stream macrophyte cover between 70-80% with stands of emergent vegetation present (photo P8260009). Substrate includes clear gravel areas with localised sand and silt deposits. Parr habitat is moderate and limited spawning of migratory salmonids occurs in this area during high flow winters.

Downstream of the abstraction point the habitat is predominately shallow glide with localised riffles present (P8260032). Parr habitat is moderate too good and similar in extent to that recorded in the 1997 survey. Redd counts indicate a high level of migratory salmonid spawning, this type of clustered spawning is often associated with fish being held up in a given area. There was evidence of low flow conditions with exposed gravel and tree roots present (P8260030 & P8260031).

Adjacent to New Court Farm there is a structure feeding a channel that connects to the discharge channel from the western farm (P8260021 & P8260027). Flows in this channel were low with marginal encroachment. Downstream of the confluence and the outfall screen the parr habitat is good with extensive in stream macrophyte growth (70-90%) dominated by Ranunculus (P8260022 & P8260024).

Recommendations

- Move abstraction licence point downstream to fish farm intake (paper exercise).
- Increase flow in the New Court Carrier throughout year.
- Modify structure to improve fish passage.



P826009



P8260032



P8260030



P8260031



P8260021



P8260027



P8260022



P8260024

B. Main River

The main river is typical of this section of the Hampshire Avon with long sections of deep glide and localised parr habitat associated with the tails of the weir pools and gravel deposition (photos P8260015 & P8260019). In stream macrophyte cover ranged from 40-80% at the time of survey.

Good parr habitat present as indicated by red hatched area although flows appeared to be low, a similar situation was noted in the 1997 survey. Redd counts indicate that migratory salmonids regularly spawn in this area.

Recommendations

Additional flow would benefit this section of good parr habitat (shown on map). Historically there were channels returning flow to the main river.



P8260015



P8260019

C. Discharge channels Eastern Unit

The left and right hand channels downstream of the eastern unit of the farm are deep straight sections. A balancing channel flows from the right to left. The right hand channel is heavily silted with extensive in stream macrophyte cover (80-90%) including filamentous algae (photo P8260037).

The left channel has less macrophyte cover (40-60%) but a more diverse range of species (P8260035).

Both channels are screened to prevent migratory salmonids entering.

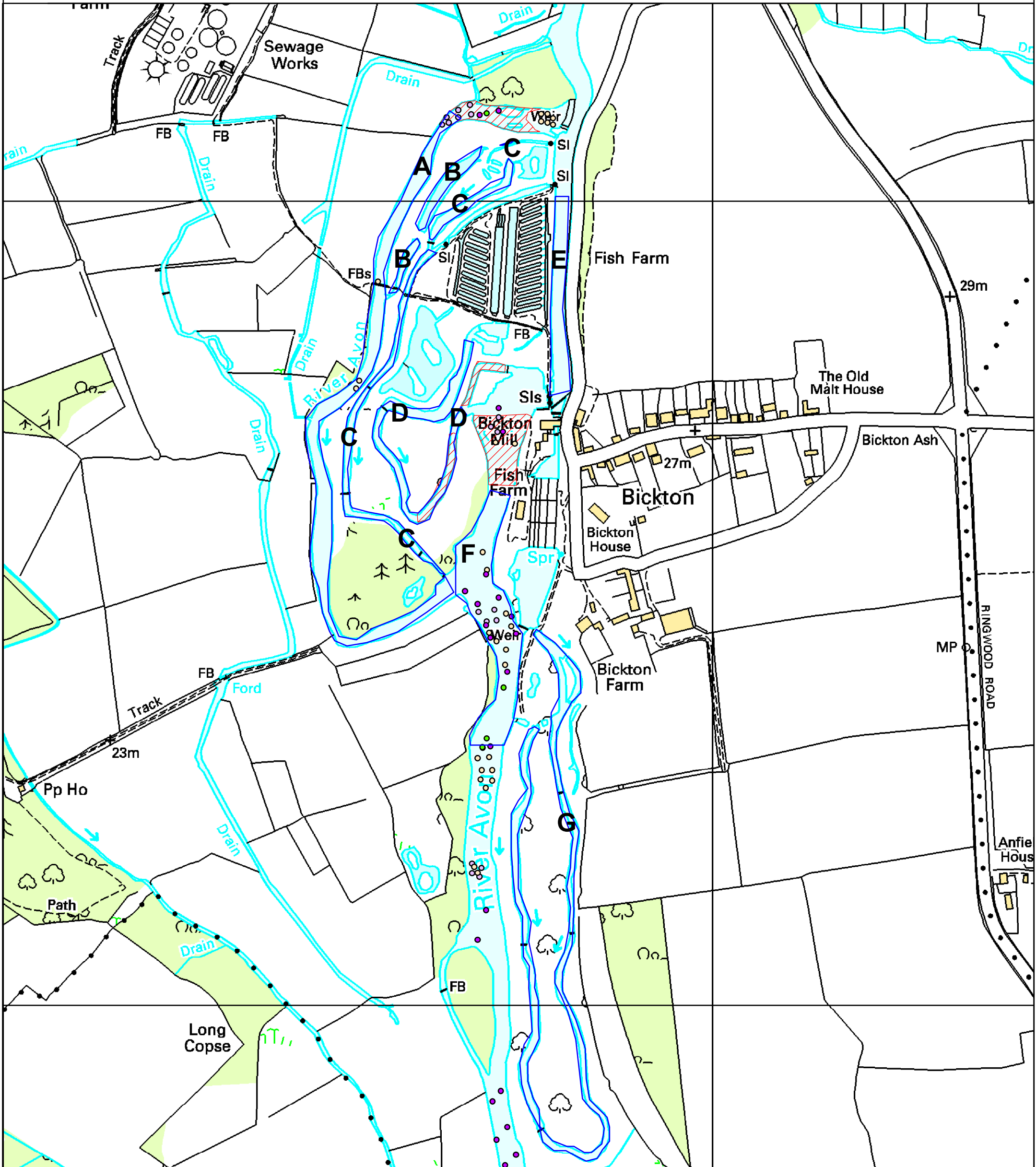


P8260035




P8260037

Bickton fish farm salmon spawning and parr habitat



Avon redd count

- | | |
|---------------|---------------|
| ● winter 0809 | ○ winter 0102 |
| ● winter 0708 | ○ winter 9900 |
| ● winter 0506 | ○ winter 9697 |
| ● winter 0405 | ● winter 9596 |
| ○ winter 0304 | |

 Bickton good parr habitat 7Sept 09

Click on letters to link to annotations and photographs

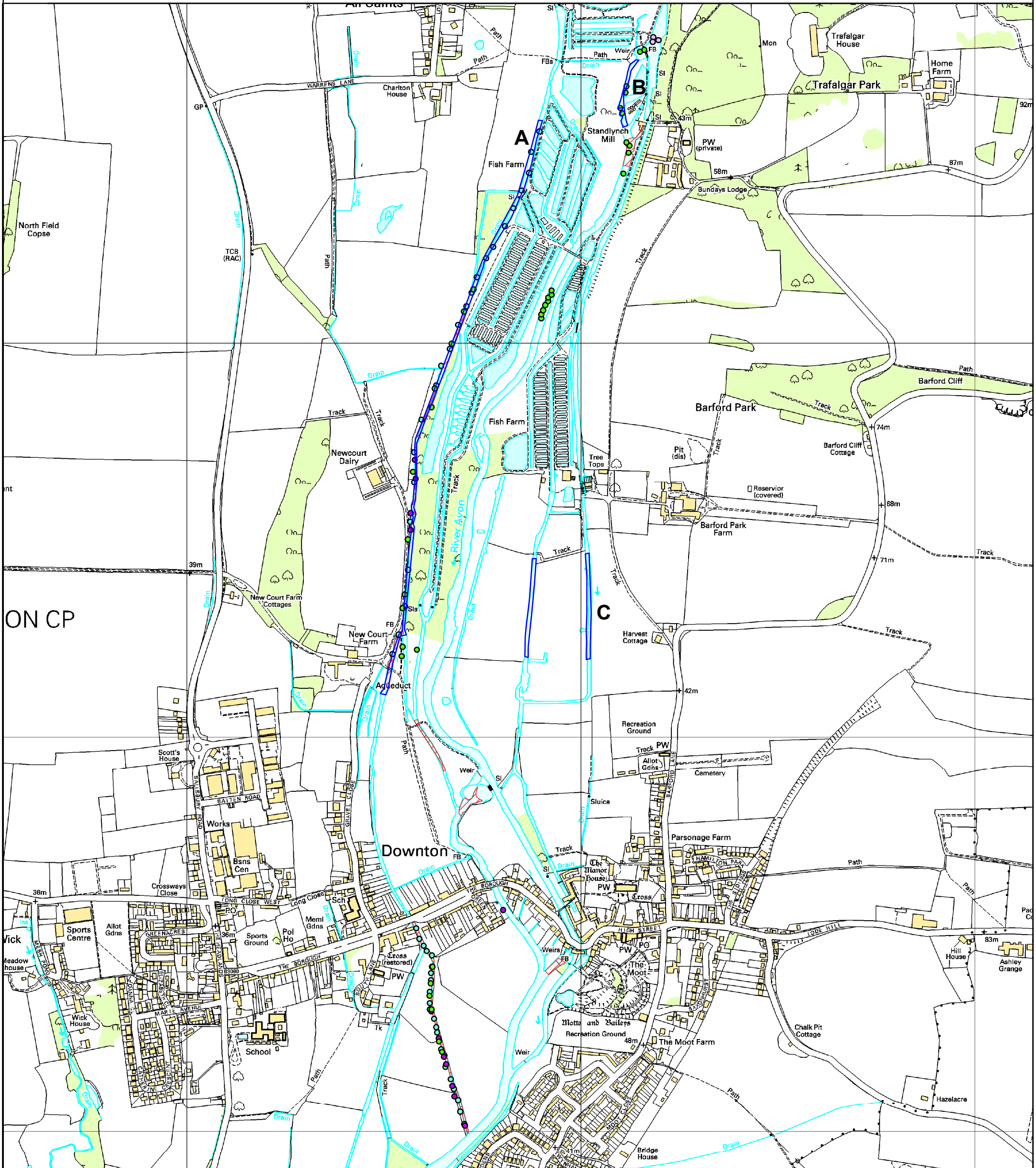
140 70 0 140 Meters



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Barford fish farm salmon spawning and parr habitat



Avon redd count

- winter 0809
- winter 0708
- winter 0506
- winter 0405
- winter 0304
- winter 0102
- winter 9900
- winter 9697
- winter 9596



Barford good parr habitat 26 Aug 09

Click on letters to link to annotations and photographs

290 145 0 290 Meters

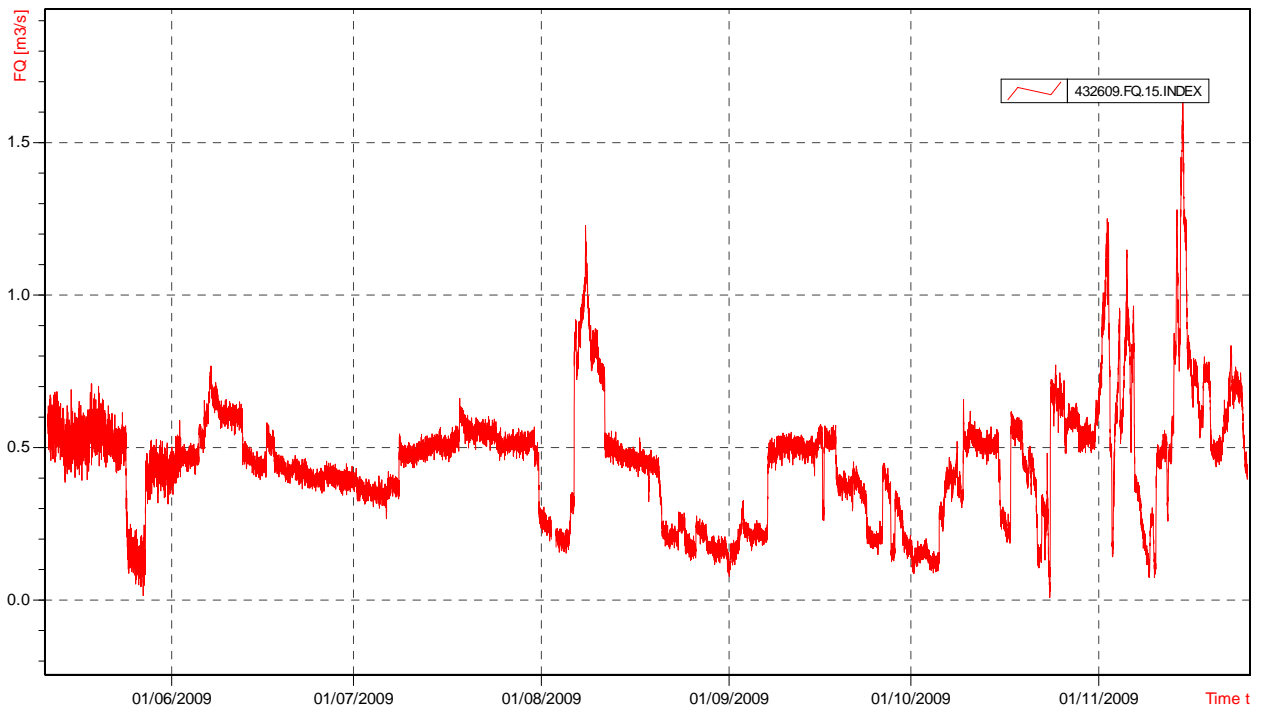


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Appendix B Figure B1

New Court Farm – Data to 25/11/09



New Court Farm with East Mills

