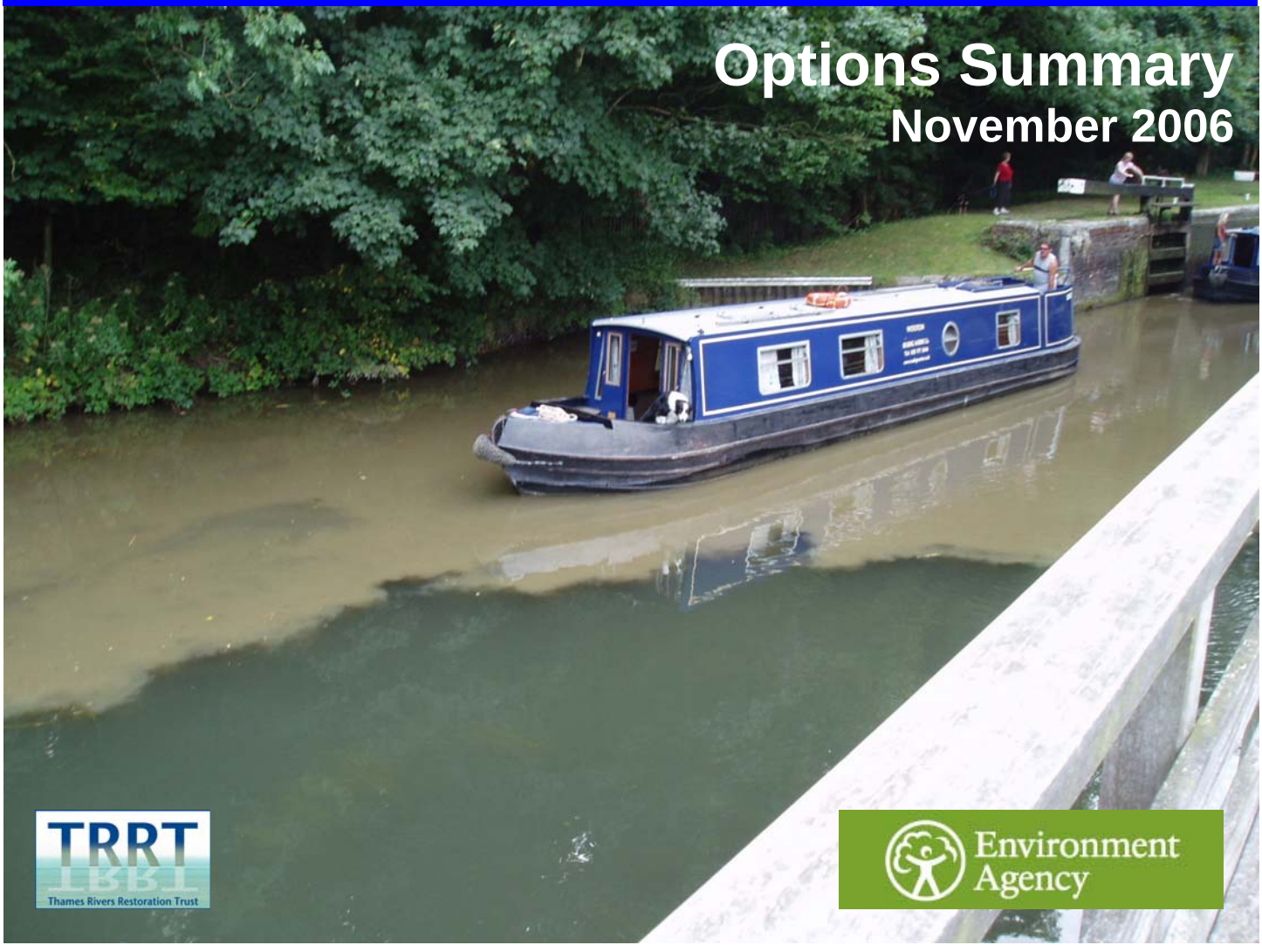
Kennet Chalkstream Restoration Project

Kennet Canal/River Interaction Study



Options Summary
November 2006

TRRT
Thames Rivers Restoration Trust

Environment Agency

Kennet Chalkstream Restoration Project

Kennet Canal/River Interaction Project

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Kennet Chalkstream Restoration Project

This scoping project, funded by the Thames Rivers Restoration Trust, is a part of the Kennet Chalkstream Restoration Project (KCRP) that aims to restore the clarity of the River Kennet and to enhance its value to wildlife and as a recreational fishery.

The KCRP, led by the Environment Agency, is working alongside external bodies:

- British Waterways
- Thames Water
- West Berkshire Council
- Kennet & Avon Canal Trust
- Natural England (English Nature)
- Kennet District Council
- Fisheries Action Plan Stakeholder Group
- Kennet Valley Fisheries Association
- Action for the River Kennet Group (ARK)
- England Catchment Sensitive Farming Delivery Initiative

This Option Summary Document, issued to interested parties for review, contains details of the water quality issues affecting the condition of the River Kennet, Site of Special Scientific Interest (SSSI), and proposed short listed options and recommendations.

We would like to hear from you. Any feedback received will be considered within the final phase of the project. Contact details are given on the back page of this document.

PROJECT DESCRIPTON

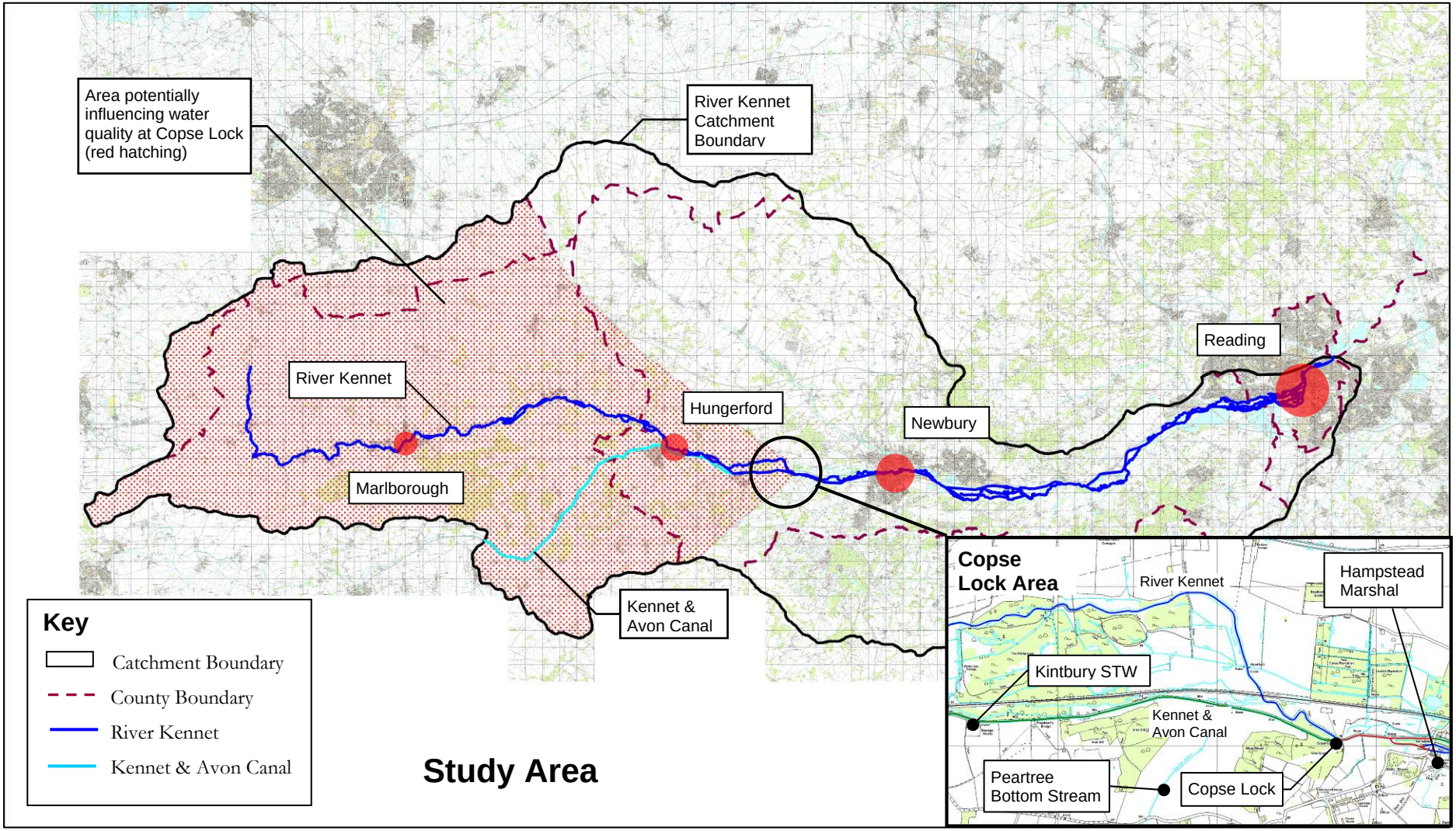
The project investigates the river quality issues of the River Kennet where it interacts with the Kennet & Avon Canal, and considers potential solutions to turbidity problems. (for Study Area see the following page).

At this stage of the project the particular focus is on the problems in the River Kennet as a result of material entering the river from the canal via Copse Lock, where, during the summer months, a plume of turbid water can be seen flowing from Copse Lock into the combined section of channel (see photo on front page) . Copse Lock (NGR SU 416 670) is situated between Kintbury and Marsh Benham, south of the A4.

The River Kennet SSSI is designated for the nationally important chalk stream river habitat (also a UK Biodiversity Action Plan (BAP) priority habitat) and associated species. This is a habitat consisting of gravel bedded watercourses with shallow, fast flows, and characteristic species including brown trout (*Salmo trutta*) (a UK BAP species) and water crowfoot (*Ranunculus*).

The overall aim of the project is to identify potential solutions to the water quality problems at Copse Lock. The problems seen at Copse Lock are believed to be the result of cumulative water quality degradation along the canal. In the long term, the aim is to address this issue along the whole canal using Copse Lock as a pilot study for transferable options. The aim is being achieved by first defining the nature/sources of the problem and targets for improvement, and then investigating generic engineering and maintenance/management interventions.

The approach to the options appraisal has been to carry out a preliminary assessment of generic options and then to develop what are considered the most appropriate options for the Copse Lock area.


Area potentially influencing water quality at Copse Lock (red hatching)
River Kennet Catchment Boundary
River Kennet
Hungerford
Marlborough
Newbury
Reading
Kennet & Avon Canal
Key
Catchment Boundary
County Boundary
River Kennet
Kennet & Avon Canal
Study Area
Copse Lock Area
River Kennet
Hampstead Marshal
Kintbury STW
Kennet & Avon Canal
Peartree Bottom Stream
Copse Lock

THE PROBLEM

Causes

The turbid water is principally caused by algal growth in the canal with the high volumes of sediment within the canal adding to the problem through suspension and nutrient release. High algal growth is due to the presence of ideal growing conditions including:

- Eutrophication due to high nutrient loads
- Slow flowing water
- Increased water temperatures exacerbated by the shallow canal conditions due to high volumes of sediment deposition
- Navigation traffic continues to disturb sediment, releasing nutrients into the water column.

Sources of nutrients

The Kennet & Avon canal has been characterised as having 'fair' water quality[1] with elevated levels of phosphate and nitrate. These levels of nutrients have both diffuse and point sources including:

- Agricultural runoff – common agricultural practices often involve high inputs of nitrates and phosphates on to land to sustain production. During rainfall events excess inputs may be washed directly into the canal through overland runoff and /or groundwater flow. Runoff can also reach water channels/drains which eventually flow into the canal.
- Sewage Treatment Works (STW's) – STW discharges are likely to play a significant role in causing elevated nutrient levels within the canal. The flow conditions of the canal results in a lack of nutrient dilution and hence an accumulation of nutrients as the water moves down the canal. There are a number of STW's which discharge into the canal upstream of Copse Lock, the nearest being Kintbury STW.

Sources of sediment

The accumulation of sediment arises from a number of sources along the entire stretch of the canal as well as the immediate area upstream of Copse Lock. Sources include:

- Feeder streams – streams may have a comparatively large catchment, bringing in sediment from the surrounding land and depositing it within the canal. There are several feeder channels along the section of the canal upstream of Copse Lock.

[1] The Environment Agency categorise stretches with 'fair' water quality as having likely uses and characteristics which include a potable supply of water after advanced treatment, with other abstractions, fair coarse fisheries and impacted ecosystems.

- Agricultural runoff – land use of the Kennet catchment is predominantly agricultural (a mixture of grassland and arable) with some woodland. During severe rainfall events large amounts of sediment could be washed directly into the canal and/or into feeder streams amplifying the problem.
- Winter interaction points – during winter flows river water will have a high sediment load. Water diverted away from the main river channel into the canal will deposit its sediment when joining the slower flows of the canal. (Note: The current arrangement for winter flows controlled by Sherman's hatches is not clearly understood and need further investigation).
- Organic material – within and falling into the canal contributes to the overall sediment load.
- Canal bank erosion, including erosion due to crayfish burrowing – based on studies to date this is not considered to be a significant input into the overall sediment load.

Impacts

Ecological

Conditions within the Kennet & Avon canal are seen as being favourable for algal growth due to nutrient levels, temperature and residence time. Such conditions can lead to high densities of algae within the canal. These high concentrations of algae can strip the water of oxygen, and obstruct sunlight resulting in fatalities of plants, fish and other aquatic fauna.

Siltation of the riverbed as a result of material transferred from the canal can smother and infill coarse gravels. This can affect fish spawning success. It may also impact on the establishment of submerged plants such as water crowfoot and other chalk stream plants on which species such as wild brown trout (*Salmo trutta*), grayling (*Thymallus thymallus*) and barbel (*Barubus barbus*) depend. Invertebrates living in and on the riverbed are also impacted. These are a key food source at the base of the food chain, a loss of which could have the potential to impact a large number of species.

Social

Poor river and canal water quality can affect the visual and recreational quality of the watercourse. On the Kennet this includes degradation in the quality of fisheries. High algal levels can also affect the taste and smell of drinking water as there are abstraction points further downstream.

High levels of sediment can affect navigation, with a canal eventually becoming impassable for boats if not dredged sufficiently regularly to prevent a hazard to boaters. Compared with other canals, high sedimentation rates are evident for the Kennet and Avon Canal, especially between Kintbury and Copse Lock, with dredging necessary once every ten years to maintain navigable levels. The latest dredging survey carried out by British Waterways in 2005 estimated that there is approximately 15,000m^3 of sediment stored in the canal between Kintbury and Copse Lock. This has accumulated since 1997.

THE OPTIONS

Long list of options

Initially, we drew-up a long-list of options for possible interventions that were categorised under the following headings:

- Walk-away – ceasing all operation and maintenance, resulting in eventual abandonment of the canal. This option will result in British Waterways not fulfilling their statutory obligation to ensure navigation routes are kept open, and is therefore not considered further.
- Do minimum – continuation of current operation and maintenance activities on the canal system sufficient to ensure navigation, including asset renewal and dredging programme.
- Options to reduce suspended sediment in canal water
- Options to reduce algae growth in canal water
- Options to reduce algae content in canal water
- Options to reduce mixing of canal and river water
- Options to reduce degradation of river water quality at Copse Lock

Short list of options

Options were then short-listed following a review of the long-list of options. This stage in our options appraisal involved screening out those considered technically and environmentally unacceptable and/or unaffordable. The resulting short-listed options, as listed below, have been evaluated in more detail as discussed on the following pages.

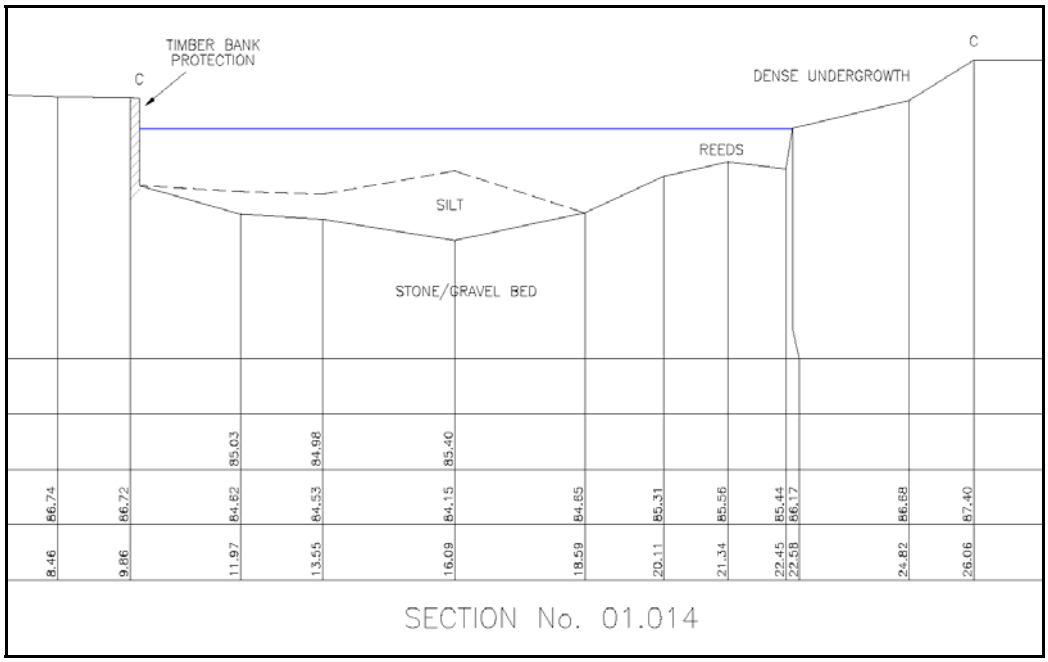
- Option one – Do minimum
- Option two – Kintbury feeder
- Option three – Construct a culvert at Peartree Bottom
- Option four – Filtration of canal flow
- Option five – Reduce storm runoff entering the canal
- Option six – Reduce the volume of poor quality water passing Copse Lock
- Option seven – Control of effluent discharge
- Option eight – Treatment of canal water
- Option nine – Separation of canal and river

Land Use Management

Changes in land use management are key to any holistic solution to the water quality problems. Diffuse pollution from agriculture is known to contribute to the turbidity of the river and canal. Ongoing initiatives include the England Catchment Sensitive Farming Delivery Initiative and a range of agri-environment schemes that are encouraging environmentally sensitive farming methods. It is important that these initiatives are considered in parallel with the options discussed in this document.

Option One – Do minimum

The do minimum option entails dredging of sediment which has been deposited in the canal upstream of Copse Lock in order to restore the original depth of water. While it is understood that the Copse Lock pound is most seriously affected by sediment deposition, other pounds further upstream are also affected. A cross section surveyed in 2003 downstream of Dreweat's Lock is shown below as illustration. Other maintenance measures include, where necessary, erosion protection for canal banks using environmentally sensitive measures.



Opportunities and Constraints

- Dredging the canal will result in deeper water, having several benefits including:
  - (a) Reducing the amount of sediment stirred up by boat movement and reducing the turbidity of water passing downstream
  - (b) Reducing the potential for disturbance of sediments to release nutrients into the water
  - (c) Deeper water will be potentially less affected by solar warming and light penetration, both of which promote photosynthesis and algae growth.
  - (d) Improved navigation
- Canal would require further maintenance due to continued influx of sediment.
- This option is dependent upon sufficient funds and land area for the safe disposal of dredged material.
- This option is treating the symptoms rather than the source

Option Two – Kintbury Feeder

A substantial amount of sediment laden water enters the Kennet & Avon Canal through the Kintbury feeder channel during high winter flows in the River Kennet. Flow velocities in the canal will be lower than in the river and deposition of sediment will occur. The flow into the feeder channel is controlled by a structure known as Sherman's Hatches, supplemented by overbank flows during high flood conditions.

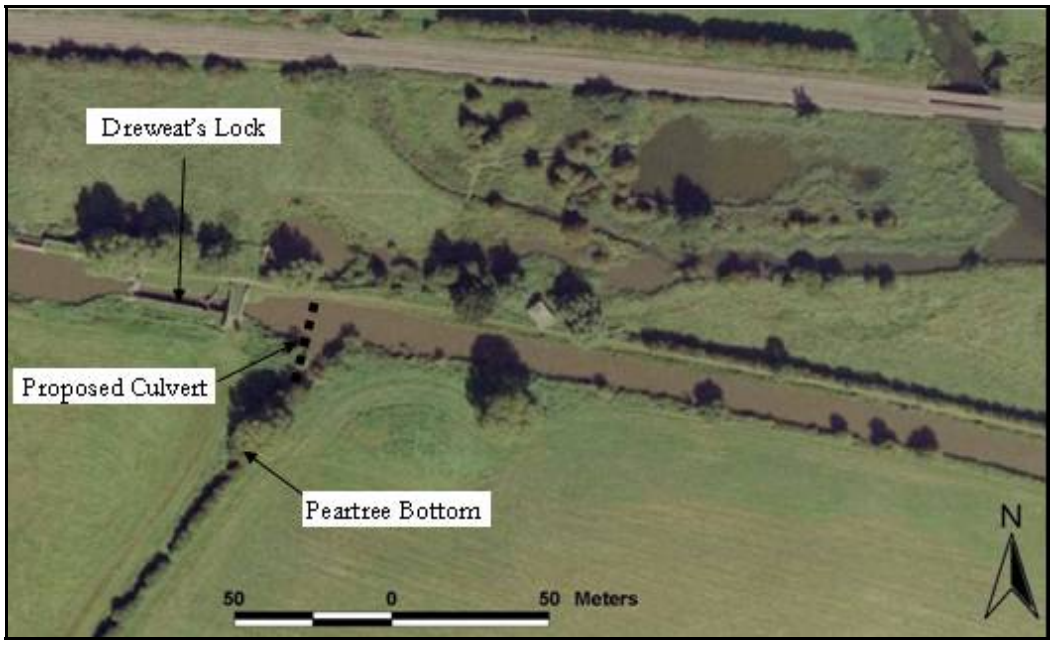
This option would involve modifying the operation of Kintbury feeder. Reduction in the flood flows entering the canal through the Kintbury Feeder channel will reduce the volume of sediment transported into the canal. Other, similar connections would need to be investigated.

Opportunities and Constraints

- The option could decrease the amount of sediment and nutrients entering the canal.
- Flood flows in the river system could have an effect upon fisheries downstream of Sherman's Hatches.
- Loss of flow within the Kintbury feeder channel could impact channel habitats.
- GS The canal may play an important function in the discharge of flood flows (this needs to be investigated further)

Option Three – Construct Culvert at Peartree Bottom

This option proposes the construction of a culvert to convey flow from Peartree Bottom under the Kennet & Avon Canal into a neighbouring back channel flowing into the River Kennet. Peartree Bottom is a feeder channel which flows directly into the Copse Pound immediately downstream of Dreweat's Lock. A settling area and reed bed could be put in place to filter water before entering the main river channel. The culvert will divert sediment which could potentially be one of the main causes of sediment ingress into the canal.

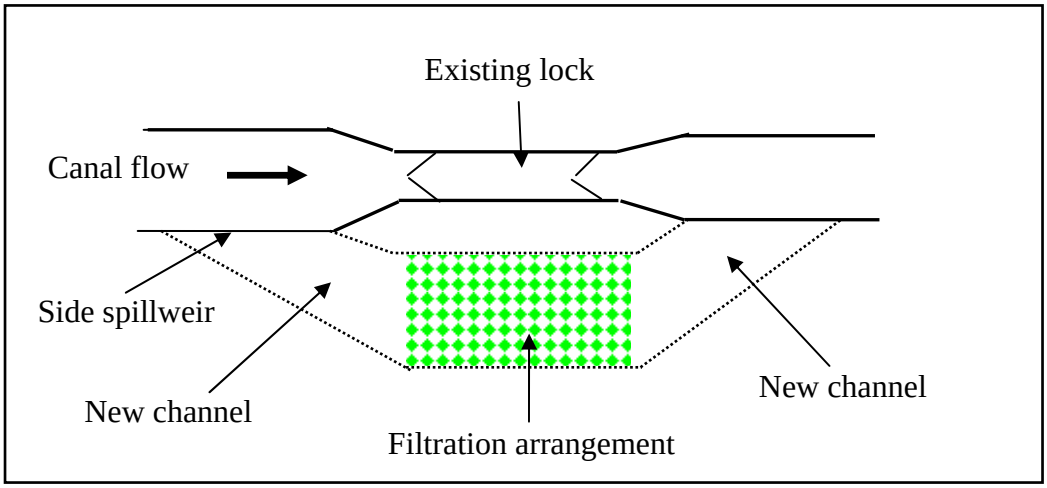


Opportunities and Constraints

- The proposed option can be transferable to other feeder streams along the canal if seen to achieve its aims.
- This option is dependent upon the flows in Peartree Bottom and the neighbouring backchannel which currently carries flows from the sluices upstream of Dreweat's Lock.
- Potential short term harmful effect on the water quality of the River Kennet SSSI during storms but unlikely to result in excess sediment storage
- There will be a maintenance requirement if settling area and reed bed are constructed

Option Four – Filtration of canal flow

The visible quality of water progressively deteriorates along the canal. This problem could be reduced by constructing a by-pass at lock systems upstream e.g. Dreweat's Lock, at which a proportion of the water (derived from more efficient use of current canal water) flowing down the canal is filtered. Filtration would preferably be achieved using natural methods, such as a reed beds. This option would reduce the amount of sediment and algal content flowing along the canal and ultimately into the River Kennet.

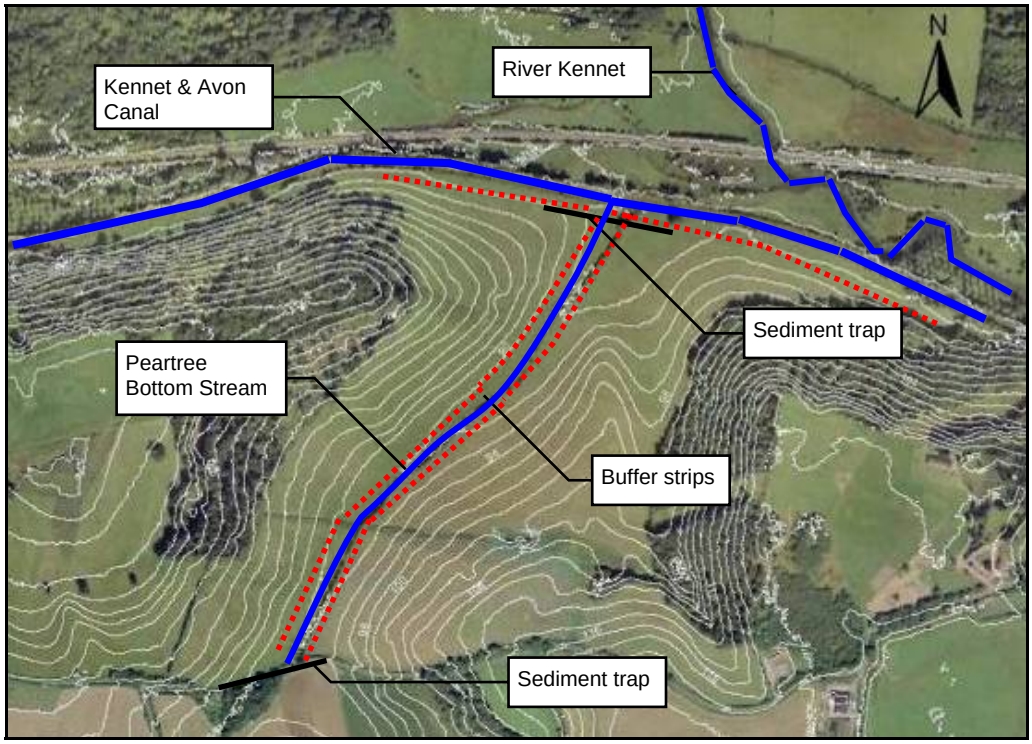


Opportunities and Constraints

- Water passing along the canal will be of an improved quality
- Option could be transferable to other lock systems along the canal if it is seen to be achieving its aims.
- Reed beds will require some form of long-term maintenance.
- Option relies on there being enough space alongside a lock system for the channel and filtration system to be constructed.
- Option requires sufficient flow to enable increased flow down the canal and may reduce flows in the river itself.
- Uncertain what proportion of the water could be treated and the required retention period for an effective filtration system.
- Canal flows will bypass the filter system during the passage of boats and remain untreated.
- Other constraints include the need to reduce leakage through the lock and potential losses from the filter system.

Option Five – Reduce storm runoff entering canal

During high rainfall events high sediment loads are carried into the canal and/or river by storm runoff into small watercourses. This option proposes to reduce the velocity of the runoff so that its sediment is deposited within sediment basins and/or areas of vegetation such as reed beds, and as a result would not be deposited into the canal or river.

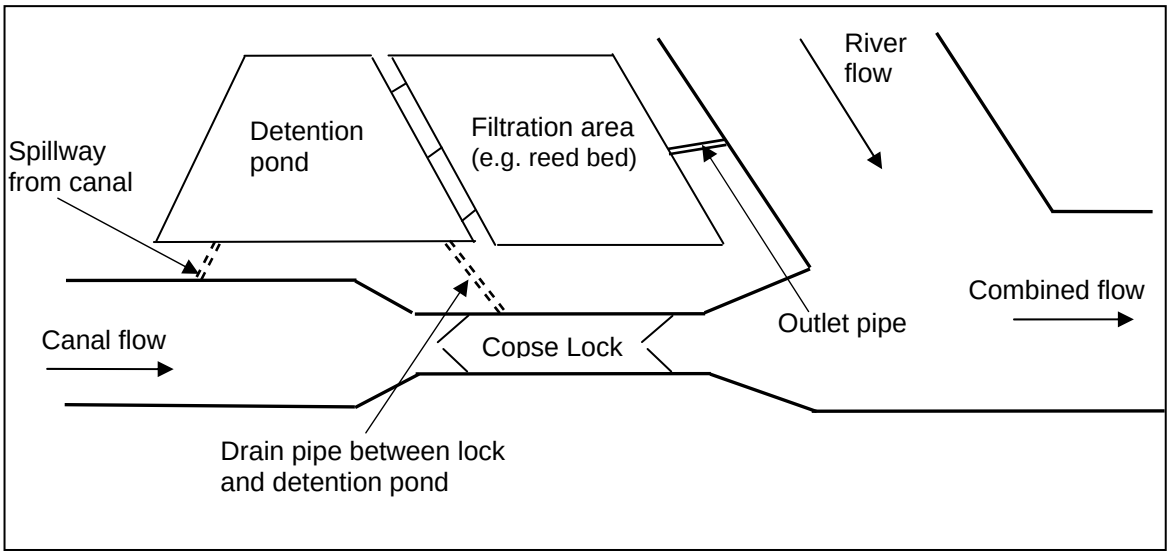


Opportunities and Constraints

- Option aims to reduce the sediment load reaching the canal and/or river.
- Silt traps will require some form of maintenance and may be dependent on regular long term maintenance to function properly.
- Volumes of sediment may be difficult to manage unless land management issues are addressed.
- Sediment traps could damage existing stream habitats, but also could provide new habitats.

Option Six – Reduce volume of poor quality water passing Copse Lock

This option proposes to filter water passing through Copse Lock. Water would be fed into a detention pond from the lock and canal, to ensure the filtration area is not flooded, and then into a reed bed where sediment, nutrients and algal content can be removed. A possible arrangement of this option is shown below.



Opportunities and Constraints

- The majority of the water entering the river from the canal will be of an improved quality.
- Option is potentially transferable to other interaction points along canal system.
- Option relies on sufficient land being available.
- Option relies on canal users tolerating any inconvenience arising due to structure.
- Will require long-term maintenance.
- Some water will still pass directly from the canal into the river.
- Canal flows will bypass the filter system during the passage of boats and remain untreated.
- Other constraints include the need to reduce leakage through the lock and potential losses from the filter system

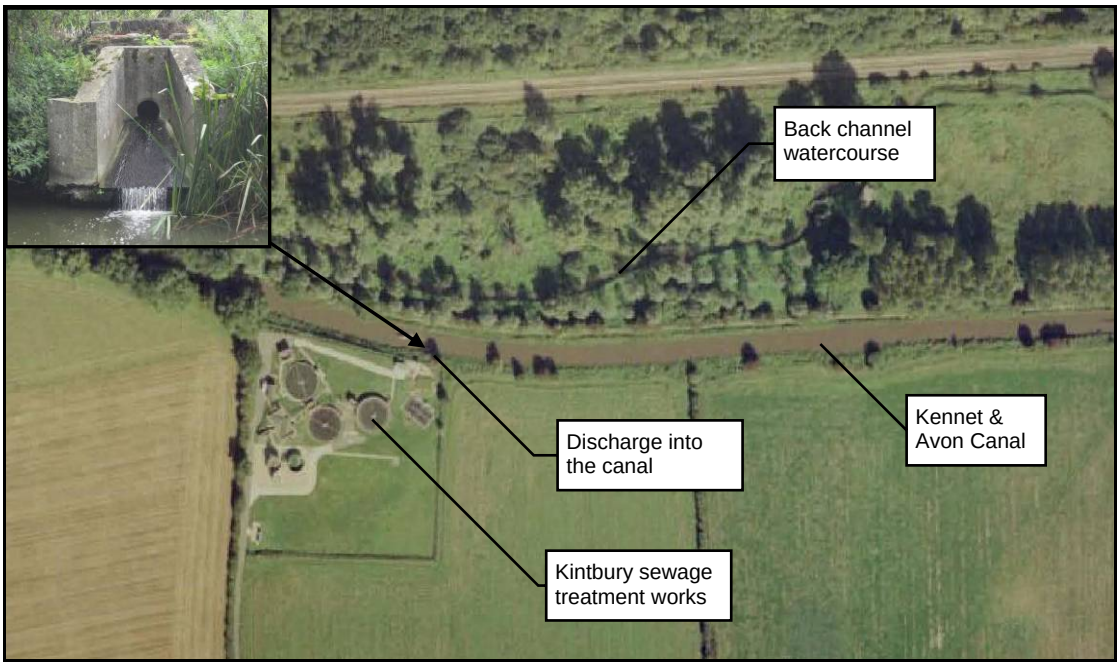
Option Seven – Control of effluent discharge

This option comprises controlling effluent discharges from Kintbury Sewage Treatment Works (STW) into the canal. It is believed that nutrients in the effluent discharges currently tend to be absorbed by the canal sediment or directly support algae growth.

There are two stages for improving the situation:

(i) Raising the quality of effluent above the current discharge standards such that it does not contain any significant amounts of nutrients which facilitate algae growth.

(ii) Diverting effluent to drain into the river system, via back channels, if necessary where the dilution of the discharge will be greater due to the higher flows and where retention periods are minimal.



Opportunities and Constraints

- Option would reduce favourable conditions for algal growth within the canal.
- Option would require sufficient flow in the back channel watercourse and the main river to ensure adequate dilution, noting the concerns over low flow. This option requires further investigation into dilution rates, flow rates, etc.
- Option can be transferred to other STW's which discharge into the canal, including:
  - East Grafton
  - Great Bedwyn
  - Wilton

Option Eight – Treatment of canal water

This option proposes treating the canal water along lengths of the canal upstream of Copse Lock. Treatments could include:

(i) Using flocculants to encourage the settlement of suspended sediment

(ii) Introduction of organisms (e.g. zoo plankton) which will consume the algae

(iii) Introduction of organisms to consume nutrient content on which the algae live

(iv) Use of options to create unsuitable conditions for algae including natural options such as barley straw bales.

It should be noted that the options discussed above require further research.

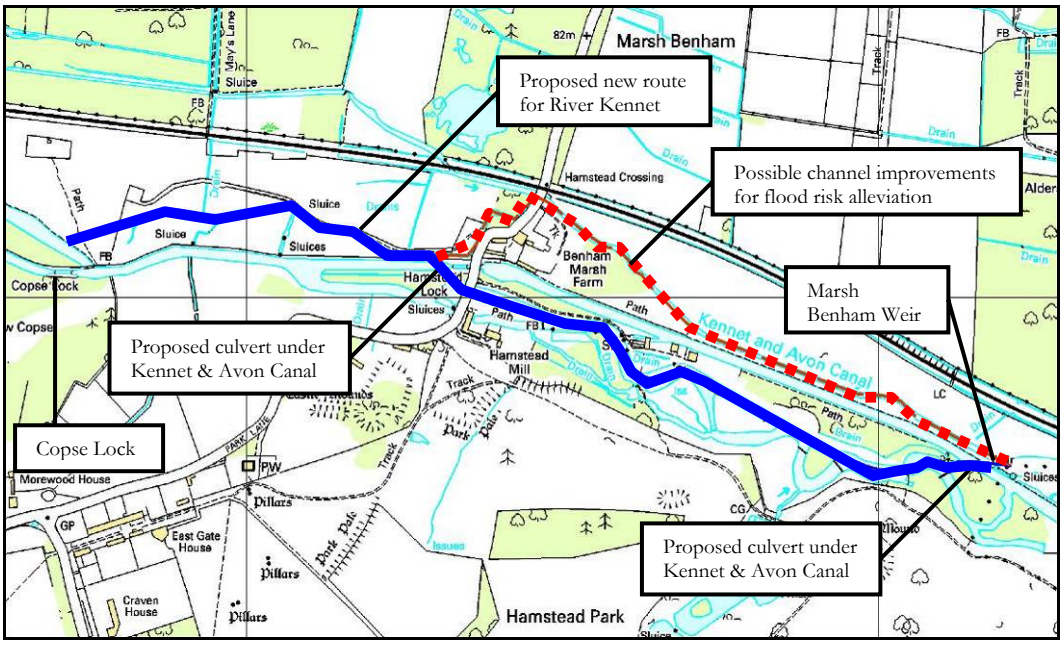
Aerial photo: Kennet & Avon Canal with sediment plume stirred up by boat movement near Hungerford

Opportunities and Constraints

- Option will have an impact on algal blooms within the canal which are affecting the river downstream.
- Ecological benefits from habitat restoration works, especially benefiting fish species.
- Options could be transferable to alternative reaches of the canal.
- Uncertainty in potential results and impacts of certain procedures.
- Potential impact on River Kennet SSSI.
- Potential to affect navigation (straw bales).

Option Nine – Separation of canal and river

This option would provide physical and hydraulic separation between the canal and the river upstream of the confluence at Copse Lock and reconnecting downstream of Marsh Benham weir. The initial review of options has indicated that realigning the river north of the canal (existing back channels could provide the basis for a route) and then directing back under the canal to join the existing river channel upstream of Craven Fishery is seen as the most feasible option to achieve separation.



Opportunities and Constraints

- Option will mean that poor quality canal water will not be affecting the river system immediately downstream of Copse Lock.
- Option has the potential to enhance fish movement within the river.
- High cost option relies on the ability to gain sufficient funding.
- Option also relies on being able to acquire sufficient land and landowner agreement.
- This option only addresses water quality issues at the Copse Lock interaction point and must work in parallel with the other interventions discussed to ensure water quality problem is not passed downstream to the next interaction point.
- Option must ensure sufficient flow is maintained in the canal for navigation.
- This option has a wide range of social and environmental constraints that need to be investigated further.

OUR RECOMMENDATIONS

There are currently nine sections of the River Kennet where it shares the same channel as the Kennet & Avon Canal, with associated water quality problems. It is proposed to undertake a phased approach to combating this overall issue of turbid water entering the River Kennet at these interaction points. The Copse Lock interaction point would be used as the pilot study, for two main reasons:

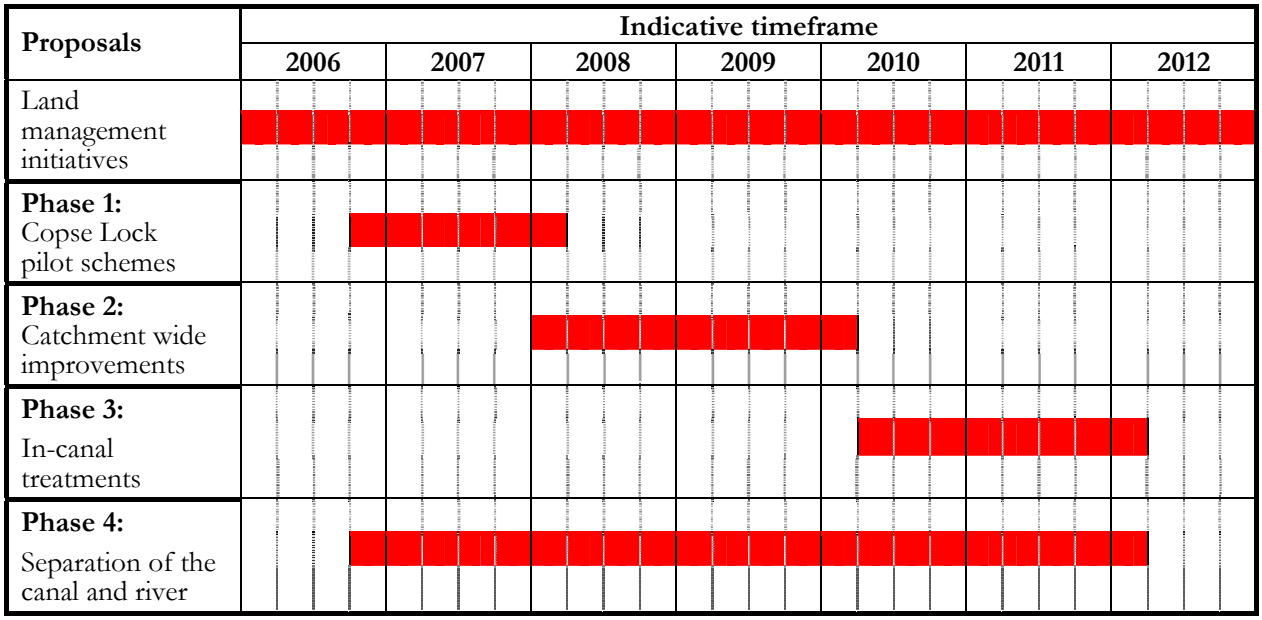
(1) There is a high visual impact at Copse Lock, with the turbid water leaving the lock seen as a plume of cloudy water. (see front cover).

(2) Copse Lock is the most upstream major interaction point, therefore any improvements made here will have a knock-on effect further downstream.

The following 'phasing' is proposed:

- Phase 1: Copse Lock Pilot Schemes
- Phase 2: Catchment Wide Improvements
- Phase 3: In- Canal Treatment
- Phase 4: Separation of canal and river

An indicative timeframe for this phasing is illustrated below, which relies upon the ability to gain funding for more detailed study, including further consultation, and implementation. Although land use initiatives are not covered by the scope of this project they are seen as vital to the sustainability of the phasing of the options recommended, as described below.



Water quality monitoring equipment is currently in place around Copse Lock. Information from the monitors would be used in conjunction with permanent monitor points along the River Kennet, to assess the effectiveness of the proposed improvements.

Phase 1: Copse Lock Pilot Schemes

A number of options would be trialled at Copse Lock to assess each option's impact on turbidity and suitability for catchment-wide application (Phase 2). The Phase 1 works would be in three parts:

- Dredging the canal (Option 1)
- Address point sources of sediment and nutrients into the canal from identified inflows:
  - Kintbury feeder channel (Option 2)
  - Peartree Bottom stream (Option 3)
  - Kintbury sewage treatment works (Option 7)
- Filter the water entering the river from Copse Lock (Option 6)

Dredging the canal (Option 1) is seen as key to improving the existing conditions. There is currently a large amount of sediment stored in the canal which is being stirred up by boats releasing nutrients into the water and increasing suspended sediment. The increase in water depth will reduce the potential for algal growth. British Waterways are planning to dredge the canal between Copse Lock and Kintbury during the winter 06/07 as part of a programme of dredging. This work will then continue upstream as funding permits.

The first inflows identified for improvement are Peartree Bottom Stream, Kintbury sewage treatment works and the Kintbury feeder channel. Tackling these three sources will reduce the inflows of sediment and nutrients and thereby improve the water quality in the vicinity of Copse Lock. This approach also provides scope to test the viability of three improvement options.

There may also be an opportunity to trial biological measures for reducing algae in the canal (Option 8). However, due to concerns with navigation its scope may be limited to Wilton Water, avoiding direct application within the canal.

The final part of the pilot study would be to filter the canal water entering the river (Option 6). However, due to the estimated cost of this option it would only be implemented if monitoring shows that a further improvement in water quality is required before the canal water passes into the river and would only be progressed after the other improvements listed above have been completed.

Phase 2: Catchment Wide Improvement

Once the effectiveness of the Phase 1 measures has been assessed, the lessons learnt from the Copse Lock pilot study could be extended across the river/canal system. The aim would be to work initially upstream from Copse Lock, carrying out a rolling programme to implement the viable options, including dredging and improvement works to drains, ditches and sewage treatment outfalls flowing into the canal.

Each inflow point would be assessed on a case by case basis, looking at the potential impact on flood risk, environmental constraints, water quality, water supply and stakeholder requirements. There are a number of operational issues associated with a reduction of direct river inflows to the canal (Option 2). There is potential to increase flood risk and/or water management concerns, which mean that a large number of inflows can-not just be closed off.

Where feasible, other inflows from drains, ditches and sewage treatment works will be passed under the canal through culverts (Options 3 and 7). Where possible, diversions will be into back channels of the River Kennet that are not part of the SSSI to allow for some filtration before flowing into the main river. A benefit of linking these inflows to the river is that during high flows the river has more capacity to cope with increased nutrient and sediment loading. Works to divert outflows from sewage treatment works would be done in conjunction with improving the quality of the discharge, where necessary.

Phase 3: In-Canal Treatment

Diffuse sources of nutrients and sediment such as direct run off from fields are also a problem. These are currently being addressed using land use improvement schemes such as the Catchment Sensitive Farming Initiative. Schemes such as this encourage farmers to adopt practices that will reduce the run off from their fields, minimising soil erosion. This will reduce the nutrient and sediment run off into both the Kennet & Avon Canal and the River Kennet SSSI.

However, schemes like these are currently only voluntary and significant quantities of nutrient and sediment may still enter the canal. If this is the case then further options could be used to improve the quality of the canal water such as on-line filtration (Option 4). Options such as these will require significant capital investment and maintenance costs. It is anticipated that these options will be implemented only if needed to achieve a higher water quality appropriate for the River Kennet SSSI.

Phase 4: Separation of the River and Canal

There is an opportunity to remove the interaction point completely and realign the river so that it does not combine with the canal at Copse Lock (Option 9). This option could be progressed in conjunction with Phase 1, owing to the significant time period required to organise the necessary funding, agreements and permissions for a scheme of this scale.

Separation of the river and canal at this point would dramatically improve water quality directly downstream of the current interaction point. However, it is essential to still carry out the improvements outlined in Phase 1, otherwise the problem experienced at Copse Lock will just be conveyed further downstream to the next interaction point in Newbury.

WHAT IS NEXT?

We would like to hear from you. This Option Summary Document, issued to interested parties for review, contains details of the water quality issues affecting the condition of the River Kennet Site of Special Scientific Interest and proposed short listed options and recommendations. Any feedback received will be considered within the final phase of the project. Our contact details are noted on the final page of this document.

The next phase of the project will rely upon the ability to gain funding for option implementation, in the order as discussed in 'Our Recommendations'. More detailed study of the preferred options and further consultation will then take place when our options appraisal moves into the planning stage.

CONTACTS

If you have any comments to make on this study, please contact John Hallett (EA Project Manager) by **Monday 27th November 2006.**

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