The Wilts and Berks Canal Trust

Abingdon Feasibility Study

Final Report

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July 2004

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CONTENTS

APPENDICES

EXECUTIVE SUMMARY

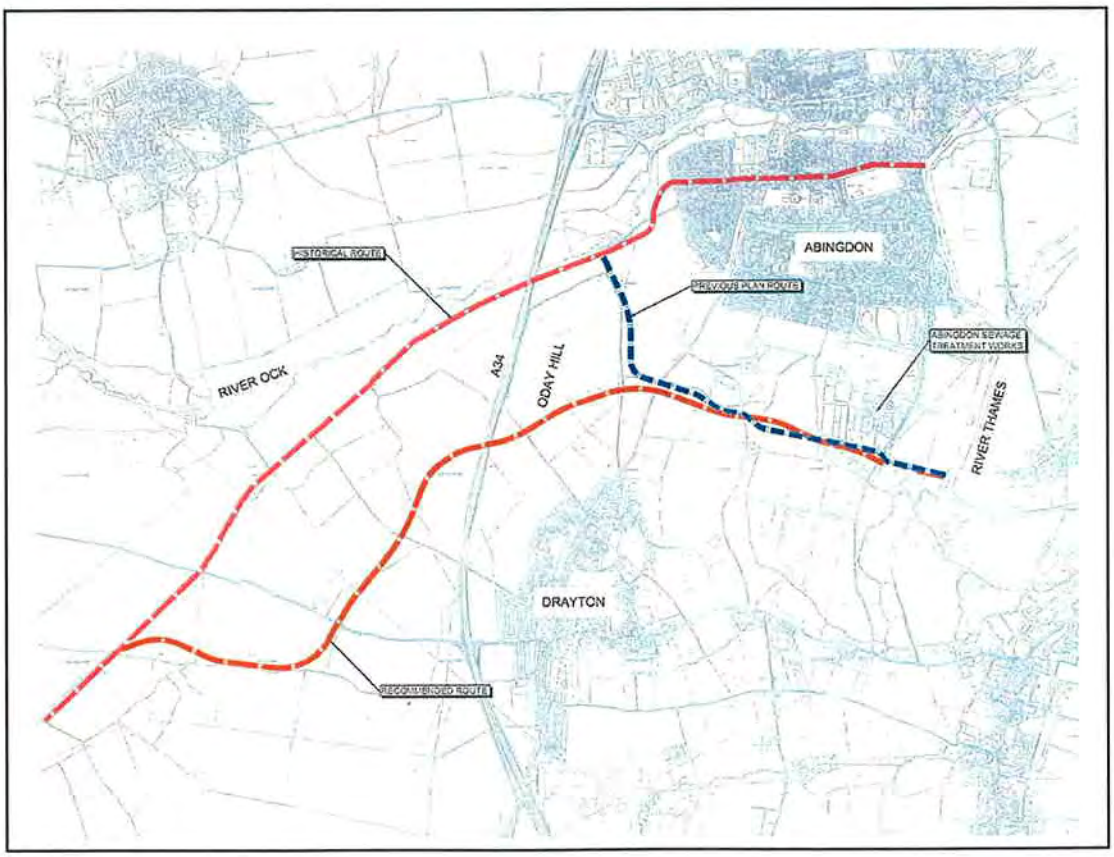
The Wilts and Berks Canal Trust are promoting the reconstruction of the Wilts and Berks Canal between the Kennet and Avon Canal near Melksham and the Thames at Abingdon. The historic route through Abingdon has been extensively built over and the cost and disruption of reinstating this route is not considered to be feasible.

The Vale of White Horse District Council has expressed its support for the principle of the conservation and restoration of the canal: *"The historic line of the Wilts and Berks Canal and the proposed new route to the south of Abingdon should be safeguarded..."* within the Local Plan.

A route skirting immediately south of Abingdon was previously included in the Draft Local Plan (first deposit). This study assesses alternatives to this previous route and proposes a new route.

The advantages of this route are as follows:

- The alignment minimises excavations, visual impact and cost
- Water does not need to be pumped over Oday Hill, and vessels will not need to lock over the hill
- The route is mostly outside the 1:100 year floodplain of the River Ock, and crosses the Thames floodplain at low level, which does not interfere with the river flows during flood events. The proposal is therefore compatible with the principles of PPG25 and flood compensation measures should be relatively small
- The crossing of the A34 is at a location where temporary detours are feasible during construction. This considerably reduces cost and construction risks.



The new selected route diverges from the historical route throughout the study area, which in heritage terms is unfortunate. Conversely, this route avoids destroying the relatively valuable habitat in the ditches that are all that remain of this section of canal.

Other important factors are:

- The route follows close to existing hedgerows where this is practical, to minimise impact on the existing fields and ecology
- The canal will not be operable when the River Thames floods its banks south of Abingdon during extreme flood events
- The canal would to improve public access for pedestrians and cyclists to the study area, especially the crossing under the A34
- The canal offers the potential provide landscape improvements in an area designated as 'Area for Landscape Enhancement'

Through consultation with key stakeholders, no major issues of principle have been uncovered at this stage that are likely to prevent the selected route being safeguarded in the local plan, or constructed. Further consultation will take place as part of the public consultation for the Draft Local Plan (second deposit).

As a result of this assessment, the Trust have proposed that the new selected route be safeguarded in the Local Plan 2011.

1. INTRODUCTION

1.1 Background

The Wilts and Berks Canal was constructed between 1795 and 1810. It linked with the River Thames at Abingdon and with the Kennet and Avon Canal at Semington near Melksham (see Figure 1). The canal was used extensively until the introduction of the railways, during the 1840's, and was abandoned in 1914 by Act of Parliament.

The Wilts & Berks Canal Trust is a registered charity committed to the restoration of the Wilts & Berks Canal. The Trust's aim is:

"To protect, conserve and improve the route of the Wilts & Berks and North Wilts Canals, and branches, for the benefit of the community and environment, with the ultimate goal of restoring a continuous navigable waterway linking the Kennett & Avon at or near Melksham, the River Thames at or near Abingdon, and the Thames and Severn Canal at or near Cricklade."

It is understood that funding for the reinstatement of the Wilts and Berks Canal is dependant upon obtaining a safeguarded route throughout the length of the canal. It is intended to safeguard a selected route near Abingdon in the Vale of White Horse Local Plan 2011.

A route skirting immediately south of Abingdon was previously included in the Draft Local Plan (first deposit). This route used as much of the historical route at possible. However, the Trust subsequently found that there were significant technical and cost risks associated with this option and commissioned an assessment of alternatives by Glanville and then by Arup. This report details Arup's assessment of options for a new route between Drayton Lock and the Thames. It also justifies the technical feasibility of the selected route.

The selected route (as detailed within this report) was submitted to the Vale of White Horse District Council in January 2004 and has been included in the second deposit draft of June 2004.

1.2 Objectives

The main aims of the study:

" 1. To provide sufficient evidence in the form of engineering studies, ecological appraisal and water resources, to satisfy Local Plan requirements.

2. To demonstrate that the Canal restoration is technically and financially feasible within a reasonable period

The study should also play a role in supporting future funding applications."

1.3 Scope

The section of canal under consideration is between Drayton Lock and the proposed new junction with the Thames (see Figure 2).

The study comprises three phases:

- Options appraisal (initially for three routes proposed during previous studies, which was later amended to cover a fourth route)
- Consultation with statutory bodies

- Final report

This final report follows the first phase interim report and subsequent options appraisal for the section of canal in the scope. The objective of this report is to explain the technical decision process and justifications made for the selected route.

1.4 Methodology

The methodology for this feasibility study has been as follows:

- Desktop study of previous reports and literature written about the study area
- Assessment of three route options as devised by previous consultants Glanville and Scott-Wilson Kirkpatrick
- Crossing options study for the A34
- Obtain and assess available geotechnical and borehole information
- A desktop study of water supply issues based on previous issues including estimated demand, supply and losses for the canal based on previous studies
- A desktop study and walk over ecological appraisal of the study area along three route options
- Site inspection of alternative routes and A34 crossing locations
- Initial consultation with selected key consultees
- Interim Report Issue plus revisions made after Steering Group meeting
- Landscape & visual impact assessment
- Alignment revision to selected route in light of consultation findings
- Costing at schemes
- Submission of selected route to be safeguarded within Local Vale Plan
- Utilities check
- Site inspection of selected route and technical feasibility assessment
- Final consultation round on selected route
- Final report

1.5 Limitations

This report takes no account of assessment of comparative costs to mitigate any disruption of landowner property.

The proposals in this report have not been tested against the expectations of landowners or interest groups. It is assumed that the Trust will conduct this exercise at some point in the future.

The site assessments by Arup's ecologists have not included the western part of the selected route between Drayton Lock and the A34 crossing.

1.6 Nomenclature

In chapters of this report where the comparison between routes is being discussed, routes are termed *1, 2, 3 and 4* respectively. In non-comparative (or overview) chapters the preferred route 4 - which was the route submitted to the Vale of White Horse District Council- is termed the *selected route.*

2. PLANNING CONTEXT

2.1 The Local Plan 2011

2.1.1 The Procedures

The Vale of White Horse District Council is responsible for the Local Plan 2011. Together with the Oxfordshire Structure Plan and the Minerals and Waste Local Plan (which are both prepared by the County Council) the local plan forms the development plan for the district. This document is part of the planning system that regulates the development of land in the public interest. It provides the essential framework against which planning applications will be judged.

The Draft First Deposit was open to consultation until 23rd December 2002. On the 24th March 2004 the Council considered the comments made on the Draft Local Plan (first deposit) and agreed a number of changes which were included in the Second Deposit Draft. This was issued on 6th June 2004. People will be able to support or object to the changes made until 15 July 2004.

The Council will then consider the representations and objections to the changes. An independent inspector will consider all objections to the plan at a Public Inquiry, which is likely to start in May 2005.

2.1.2 Relevant Policies

The Second Deposit Draft Local Plan 2011 includes policy L13, which states that developments will not be permitted which:

- Cause demonstrable harm to the essential character of the Wilts and Berks Canal or to its setting
- Would be likely to prevent or impair the restoration of the canal
- Would result in the loss of any buildings, locks or other structures associated with the original waterway function of the canal

Policy L13 states that any development that would prevent the historic alignment of the canal will only be permitted if arrangements for the reinstatement of the canal on a viable alternative route can be secured by the developer.

Policy L14 states that development which would prevent the implementation of the proposed new route for the canal south of Abingdon as shown on the proposals map will be refused.

See Appendix A for the relevant policies L13 and L14 and extracts from the Second Deposit Draft Local Plan 2011.

2.1.3 The Route to be Safeguarded

The route that was previously proposed to be safeguarded in the Draft Local Plan (first deposit) is as shown on Figure 3. This follows the historical route of the canal eastwards as far as the immediate edge of Abingdon, before skirting around the southern edge of the urbanised area.

The selected route to be safeguarded has now been submitted to the Vale of White Horse, which will supersede the previous route shown in Figure 3. The selected route can be seen in Figure 4, and it is assumed that this route will be seen in the Draft Local Plan (second deposit).

2.1.4 Land Use Designations

The Draft Local Plan (first deposit) shows that land has been set aside for informal recreation uses south of the existing marina, which is north of the proposed junction with the Thames. Most of the study area has been marked 'area for landscape enhancement' (see Figure 3).

It is assumed that the land uses in areas near the canal alignment will not change for the Draft Local Plan (second deposit).

2.1.5 Consultation on the Draft Local Plan

Comments on the Draft Local Plan (first deposit), which are relevant to the proposed canal, are included in Appendix B.

A summary of the comments has been that:

- For policy L14 there have been four objections and three letters of support comments, totalling 7
- For policy L13 there have been six objections and six letters of support totalling twelve

Overall, the canal received support from some influential bodies. Objections made to the canal route do not appear to be 'showstopper issues'.

Comments on the Draft Local Plan (second deposit) will not be seen until later on this year.

2.2 DETR Policy

The Department for Environment, Transport and Regions (DETR) issued a document in June 2000 entitled '*Waterways for tomorrow*'. This document was a follow on to the White Paper *A New Deal for Transport: Better for Everyone*, by setting out proposal for the future of English and Welsh Inland Waterways.

A summary of the policy measures relevant to the planning context within this document is as follows:

- The Government wants to encourage people to make use of the inland waterways for leisure and recreation, tourism and sport;
- The Government supports the protection, conservation and enhancement of the waterways heritage and their built and natural environment, and the use of waterways as an educational resource;
- The Government wants to increase the economic and social benefits offered by encouraging their improvement, development and restoration, wherever possible in partnership between the public, private and voluntary sectors;
- The Government supports the provision of passenger boat services on the inland waterways, wherever practicable and economic;
- The Government wishes to encourage the transfer of freight from roads to waterborne transport where this is practical, economic and environmentally desirable;
- The Government will support the development of the inland waterways through the planning system.

3. BASELINE SITUATION

3.1 Topography

The topography of the study area follows the valley of the River Ock, and indeed historically, the original route of the canal followed the River Ock to the confluence with the Thames.

The new canal is forced southwards from the historical route outside Abingdon, to avoid the built up areas, and has to cross a range of low hills (named Oday Hill Ridge) approximately 15m high, running N-S adjacent to the A34 trunk road.

To the east of the hills, the canal crosses the Thames floodplain, which dips gently towards the River. Figure 5 shows highlighted contour levels and topographical restrictions.

Implications for the canal link:

- The historical section is on the topologically optimum route, following the Ock valley to the Thames.
- To cross Oday Hill Ridge will be expensive, and will require a number of locks to cross over or a deep cutting (or a combination of the two)
- The canal must cross the floodplain of the River Ock and River Thames West and East of Oday Hill Ridge
- Ideal canal route therefore will be the lowest and shortest section of hill, combined with as much of the historical route as possible. However this low lying route will need to be optimised with the flooding area

3.2 Land Use

3.2.1 Gravel Pits

There are gravel pits works at the site of the proposed junction with the Thames. These are active, flooded, and dry pits owned by J. Curtis. The site is located in the centre of Sutton Wick mineral working area, south of the sewage works. It is bordered to the east by Peep-o-day Lane and to the south by land which has been restored to agricultural use following infilling. Existing trees and hedges create an effective screen to the north, east and west of the site. See Figure 6 Gravel Pits Plan[1].

There has been an extension to mineral extraction and processing licence by the landowners, which agrees with the Oxfordshire Minerals and Waster Local plan and policy M13 in the Oxfordshire Structure Plan (OSP). The production of material is to be phased as follows:

- Area shown as current area of working to be completed and restored to a lake (duration 3 years)
- 'Camas land' to be worked (duration 4 to 6 years)
- Gravel Works processing plant to be dismantled and area dug out and used to obtain a further three lakes (included in above duration)
- Extraction and restoration to the lakes would take place over a 2 year period

[1] See Planning & Regulation Committee 2nd December 2002 – Extension of time for mineral extraction and processing and the importation of a limited volume of inert material to improve/ reclaim the southern margins of Lake J at Sutton Wick, Abingdon, Oxon (Application No. DRA/SUT/1179/18-CM and P00/Q0012/CMR).

This means that the mineral extraction and processing licence extension would be around 9 to 12 years in all.

Implications for canal:

- Flooded gravel pits are potentially an opportunity or a restriction. This depends on whether it is feasible to integrate the lakes as part of canal system or not

3.2.2 Sewage Works

Thames Water Sewage Works are to the north of the Gravel Pits. There are two outfalls from Abingdon STW, one into the River Thames and one into the Oday Hill Ditch.

There is a stream running west to east, immediately south of the sewage works. The canal will be required to cross this. This stream is the same as the discharge from sewage works

The latter outfall relates to a previous objection made to the Draft Local Plan relating to the Wilts and Berks Canal. The reason for objecting to this policy was:

"*Thames Water has significant reservations regarding the proposed new route for the canal for the following reasons:*

The proposals for reopening the canal around the south of Abingdon could have an impact on our discharge at Abingdon sewage Works. It would appear from the proposals map that the canal would incorporate a large portion of Oday Hill Ditch to which Thames Water currently discharges and this would have implications for the operations of the works.

If the canal were to be routed here, there would be an increased number of people using this stretch of water, which may lead to an increased number of complaints from the public regarding odour, litter etc.

For the above reasons Thames Water would wish to be kept informed if and when any proposals for the new route of the Canal came forward."

Implications for canal:

- Possible smell issues near sewage works, especially in the summer
- Possible problem crossing stream as quality of water from stream is not ideally suitable to link to canal – solution may be to divert stream or siphon under the canal

3.2.3 Residential

There are residential areas close by the study area. This includes Abingdon to the North of the canal route and Drayton to the south.

Implications for canal

- Avoid built up residential areas
- Ideally, canal would be near enough to residential areas so that nearby residents can walk the towpath and access it in a relatively short time.
- Potential to provide an improved 'corridor' with both pedestrian and cycle links under the A34, which currently acts to restrict passage from east to west (or vice-versa)
- Provide attraction for walks and linkages between Abingdon and other towns and areas where the canal will eventually visit, as the canal will be near enough to residential areas, schools and the marina to attract visitors from those areas

3.2.4 Farmland

The majority of land within the study area is used for farmland. The Earl of Plymouth owns much of the west section of the study area and is tenant to the Vale of White Horse immediately to the west and south of Abingdon.

Implications for the canal link:

- Need to minimise disruption to farming e.g. following hedgerows where possible
- Alignments to run alongside field hedge lines as far as possible, but be located away from existing vegetation to ensure minimum disruption from construction works
- If canal route is to run through farmland, provision of means of access to farmers and landowners (and similar for footpaths)
- Compensatory measures will be required by the landowners

3.2.5 Landfill Sites

Landfill sites exist immediately north of the Sewage Works and South of the mineral extraction plant. The north landfill site has been filled over and is owned by the Vale of White Horse District Council and leased by Abingdon Rugby and Football Clubs.

Implications for the canal link:

- The canal should not cross a landfill site if at all possible. Therefore, landfill sites will restrict the route the canal can take at the junction at Abingdon (especially combined with the Sewage Works between the two landfill sites)
- Canal channel close to landfill should have a impervious lining to avoid contamination of the Canal, and also potentially the River Thames from polluted groundwater

3.3 Ecology

The majority of the study area consists of agricultural land, and although such areas of low ecological value, hedgerows surrounding the fields may be ecologically significant (especially where coinciding with the historic canal route). More detailed information on the baseline Ecology is included in Section 9.

Implications for the canal link:

- Minimise severance of and damage to hedgerows
- Work to existing canal sections may require mitigation and compensation measures
- Works to new canal lengths should be aligned to avoid areas of ecological concern

3.4 Archaeology

Abingdon was occupied in prehistoric times by settlers of the Bronze and Iron ages. It was a flourishing town in the Roman period, which in turn gave way to a Saxon settlement. It is known that the flood plains are littered with archaeological sites along the Thames in this

area[2]. Previous examples of burial sites include Drayton, Sutton Court, and Longwittenham Clumps. A summary of archaeological sites of interest can be seen in Figure 7.

Consultations with the Deputy County Archaeological Officer have revealed that the study area contains many archaeological features, especially from the prehistoric and Romano British periods.

3.4.1 Sutton Wick Settlement

The Sutton Wick Settlement is a scheduled monument and is therefore currently protected under the Archaeological Areas Act 1979. This requires that developments may *'neither spoil the actual monument or it's setting'*. Scheduled monuments consent, which is obtained from the Department for Culture, Media and Sport, is required for any works affecting the fabric of a scheduled monument. The Secretary of State consults English Heritage on such applications

3.4.2 Tumulus

There is a site of archaeological importance, a tumulus, just north of Drayton. A tumulus is a mound over ancient grave or more usually tumulose (plural), where many small mounds exist as part of what was ancient burial and ritual grounds.

While tumulose are frequently classified as scheduled ancient monuments, this particular tumulus is not a scheduled ancient monument.

The National Monument Record holds some detail of the tumulus. It is a large, roughly circular ploughed mound near Barrow Road on Sutton Wick Field. Shards of 1st and 2nd century (AD) pottery have been collected by members of Reading Museum from the ploughed surface of the mound, and it is assumed that a Roman settlement site underlies the area. The mound is much spread, with trace of a ditch, and situated in a field that has been extensively ploughed over in recent years, therefore barely discernable during field investigations by the Ordnance Survey reviser.

3.4.3 Archaeological Findings Areas

These two areas are of considerable archaeological potential, as they are believed to be Romano British settlement with activities defined into two phases: the first and second centuries AD and the late third and fourth centuries AD. There has also been some indication of Middle to Late Iron Age settlement.

These areas will require a greater level of archaeological mitigation than for the watching brief agreed for the eastern part of the route[3].

Implications for canal:

- Avoid tumulus and Sutton Wick settlement on canal routes, with an acceptable amount of clearance (it has been advised that the canal route should not come within 100 metres of the tumulus or crop marks)
- Any mitigation required would be the financial responsibility of the developer
- Oxfordshire County Council (subject to investigations at later date) may wish to review the selected route in terms of where significant archaeological features are located, and what type of archaeological assessment and mitigation would be required during detailed design stages

[2] Current Archaeology No. 63 Vol. VI September 1978 and No. 95 Vol. VIII January 1985 which both had articles about similar finds in these areas
[3] See Consultation Chapter 11

- Any investigation and mitigation would be financial responsibility of developer.

3.5 Ground Conditions

The underlying stratum in the study area is Kimmeridge Clay, which was formed during the Jurassic Period, around 195 million years ago, during the Mesozaic Age. The original construction of the canal (during 1795 – 1810) moved from west (at Melksham) to east and ended at Abingdon. Bricks made for the engineering walls (e.g. locks, bridges and culverts) were produced in brickyards along the route and luckily Kimmeridge clay was found in generous amounts along the route. The last bricks built at each yard were used to build the next kilns.

Figure 8 shows the Geological map and soil survey data. The various canal routes may pass over the following soils:

- Rowsham Series – which is a clayey or fine loamy over clayey drift, over the Jurassic or Cretaceous clay, and is part of the soil group of 'surface water gley soils'
- Isle Abbots Series – which is loamy, drift over clay and belongs to the 'gleyed brown earths' soil group
- Sutton Series – which is loamy and over calcareous river terrace gravel and belongs to the 'browns earths' soil group
- Hatford-Kelmscot Complex – which is a complex of Hatford, a silty or loamy soil over peat or alluvium, and Kelmscot, a silty or loamy or a calcareous silty or loamy gravely drift. Hatford is part of the 'calcerous humic gley' soil group and Kelmscott is part of the 'ground water gley' soils group

British Geological surveys information hold borehole data on the site. The location of the boreholes that they hold can be seen in Figure 9. As can be seen from the diagram, some of these boreholes are directly relevant to the study site. This borehole information has been obtained from the British Geological Society.

A section through the study area geology can be seen in Figure 10.

Implications for canal:

- There will be a source of puddling clay for construction (generally not used in layers less than 750 mm thick)
- Leakage should be low where the canal passes through clay.

3.6 Hydrology

3.6.1 Existing Agricultural Drainage

The site study area contains many existing drainage systems, which are mainly used for agricultural drainage (see Figure 11). These drains take excess flows in winter and are the method for distributing water during summer months.

The canal will inevitably have to cross some drainage systems in several places. During canal construction, a siphon or culvert could be built to carry flow under the canal.

Implications for canal:

- Provide siphon, culvert or divert drainage (if feasible) where required
- Groundwater flow obstruction dependant on selected canal route alignment

3.6.2 Flooding Issues

Appendix C shows the 1 in 100 year River Ock and Thames floodplain maps (modelled by Halcrow) from Environment Agency, obtained in January 2004. These show the limit of the 1:100 year[4] floodplain. A floodplain is the natural 'overspill' area when a river rises above its banks. The maps do not show flood defences that offer protection in many areas, and hence the maps do not necessarily indicate the degree of flood risk to land or property. In this area, there are no flood defences and hence this is an active floodplain.

Within the study area, much of the historical canal route is within the floodplain. A substantial section east of Drayton is in the floodplain of the River Thames. In addition, the northern section of the historical canal route including the A34 crossing point is in the floodplain of the River Ock.

Modelled nodal points and selected water level heights can be seen in Figure 12.

Implications for canal:

- Need to consider whether to allow canal to flood or to take special protective measures to isolate canal from flooding where it crosses the floodplain.
- If isolate the canal from flooding (e.g. by use of an embankment to above the 1 in 100 year flood level) the canal could adversely affect river flows during flooding

3.7 Transport

The canal will have to cross the A34 trunk road and busy local road B4017. Figure 13 shows the Transport Constraints.

The A34 runs at capacity during peak hours and maintains heavy flows throughout the day. Accordingly, any infringement into this dual 2-lane trunk road could quickly result in massive congestion. Therefore it is likely that whichever method of construction is chosen for the crossing, it is essential to maintain full A34 carriageway widths throughout construction.

It should be noted that, during the Draft Local Plan (first deposit) public consultation Sustrans supported the policies pertaining to the safeguarding of the canal route on condition that the route of the canal was recognised as a potential walking and cycling route in advance of the canal restoration.

Extraction at the gravel pit operations utilise lorries to transport the mineral to the processing plant via Basset Lane. Processed mineral would be taken out by lorry via Basset Lane and Stonehill Lane to the B4017. As part of the lorry route follows a National Cycleway (Peep-o-day Lane), it will be important to warn vehicle drivers of public access by signing and the surface of the road must be maintained to standards suitable for cycling.

There are also a number of farm access roads across the site that will most probably need to be kept open. However, it may be possible to divert some of these.

Implications for the canal

- The trunk road crossing will be major constraint because of high construction risks and potential impacts to traffic.

[4] A return period is a means of describing the magnitude of a flood. Statistical return periods of floods relate to the long term average time interval between floods of a particular magnitude. For example, a 1 in 100 year return period flood has a 1 per cent chance of occurring in any one year; i.e. the odds of it happening any year are 100:1.

- B4017 also significant crossing- will maybe need to keep open or divert onto A34 during construction
- Cycling network access along canal should tie in with existing Sustrans network

3.8 Utilities

Major utilities companies were contacted to confirm whether major utility lines lay across the site. A summary of the major utilities can be seen in Figure 14. The major obstructions are the high-voltage overhead pylons, and the smaller lower-voltage overhead, and a 12 inch intermediate pressure gas line running to the west of (but mainly parallel to) the A34.

Thames Water advised of the SWARP major engineering proposals to improve long term water supplies in the South East of England, including a reservoir, pump house and intake/outfall. These proposals, if implemented, would substantially affect the feasibility of the canal. However, Thames Water has advised their outline proposals are at an early stage and will not be put forward for consideration in the Local Plan 2011. Consequently, the proposals have not been regarded as constraints to the canal.

Implications for the canal:

- Avoid high voltage pylon positions
- Compensatory cost measures for lower voltage electricity cables and gas pipe if affected by selected canal route
- Ignore potential future Thames Water engineering works

3.9 Landscape

The area south of Abingdon between the A34 and the Thames is classified in the draft Local Plan as an area for landscape enhancement. At present this area is dominated by gravel pits, a gravel processing area and the sewage works. Alongside the Thames some worked out pits are now small lakes with some reeds, shrubs and bird life. Further west, the land is intensively farmed agricultural land with relatively sparse hedgerows and trees. The A34 trunk road dominates this area.

Appendix F provides a photographic record of the existing site.

3.10 Summary

A summary of the physical constraints and opportunities around the study area include many features:

- Oday Hill
- Gravel pits operations and future developments and Abingdon Sewage works
- Residential areas of Abingdon to the north and Drayton to the south
- Farmland field boundaries
- Landfill Sites
- High ecological and heritage value of the historical canal route
- Scheduled Ancient Monument and other known areas of archaeological importance
- Floodplain areas and agricultural drainage

- Road crossings and Sustrans cycle routes
- Utilities
- Landscape

The only way to discern which route to take through this study area is to look in more detail at the longitudinal alignment and detailed crossing parameters. Section 4 looks at such issues below.

4. ASSESSMENT OF ROUTE OPTIONS

4.1 Study Area and Historical Route

The study area is between Drayton Lock and the previously determined new junction with the River Thames (as seen in Figure 2).

The historical route has now been heavily built over in Abingdon town centre and it is no longer considered a viable option for a canal route. This is due to:

- Expense and the disruption it would cause to the town centre
- Serious implication for traffic and transport flows through the town centre
- Need for purchase of properties
- Environment Agency have previously objected to the re-opening of the historic junction with the River Thames

4.2 The Route in the Draft Local Plan 2011 (First Deposit)

This follows the historic route to the outskirts of Abingdon, then swings sharply southeast to avoid the urban area and the Abingdon sewage works. Key problems of this route were:

- The vertical alignment of the canal was poor. It would have to be lowered to cross under the A34, and then rise over a flight of locks to cross the high ground of the Oday Hill (or a cutting up to approximately 11m deep, or a tunnel). This has cost, landscape and operational impacts which the Trust would prefer to avoid
- The A34 crossing point is seen as 'high risk' in engineering and cost terms because it is at a difficult location immediately adjacent to the River Ock bridge

As a result, the Wilts and Berks Canal Trust have resolved to look at alternative route options.

4.3 Previous Study Route Options

Previous studies have been made by Glanville Consultants and Scott Wilson Consultants for alternative canal routes south of Abingdon. Figures 15, 16, and 17 give the plans, sections and details for each. All these routes have common paths between point D and point F, approximately from Stonehill Farm to the junction with the Thames.

4.3.1 Glanville Consultants

The original Glanville proposals can be seen in Appendix D. The three routes studied here were:

- Route 1 see Figure 15 (XABCDEF in Appendix D)
- Route 2 see Figure 16 (XAZDEF in Appendix D)
- Route 3 see Figure 17 (XYDEF in Appendix D)

Route 1 follows the historical route from Drayton Lock until deviating near point C on Figure 15. Route 2 deviates from the historical route at point A on Figure 16. Route 3 deviates from the historical route at point X on Figure 17.

Although the Glanville Study sets the initial bed levels of proposed canals, it does not cover them for the full length of the proposed routes 1, 2 and 3. This is because no level

information is provided between point D on the canal and the River Thames. In addition, the Glanville study does not consider how the vertical alignment would be affected by locks. The Glanville report appears to propose a deep cutting through the hillside without any locks.

The Glanville alignments include some very sharp bends, which would not be navigable for narrow boats. The study includes ground levels along routes 1, 2 and 3 which was later supplemented by ground levels along route 4

4.3.2 Scott-Wilson Kirkpatrick

The Scott Wilson Kirkpatrick Report was entitled 'Restoration of the Wilts and Berks Canal Feasibility Study', and the later study 'Restoration of the Wilts and Berks Canal Strategy Study', which built on the previous feasibility study.

Topics addressed were route selections, planning considerations, leisure and tourism, land ownership, construction strategy and institutional arrangements.

The original Scott Wilson proposals can be seen in Appendix E. Scott Wilson originally considered the historical route along with three other route options. The option that was taken forward was assessed in more detail, as can be seen from the second part of Appendix E.

Scott-Wilson's chosen route and Glanville's Route 'XABCDEF' are very similar and are treated as the same for the purpose of this study. These two options are assessed under the same name of Route 1 (see Figure 15). However, the Scott-Wilson study proposes four locks for Route 1 to lift the canal up and over Oday Hill.

The Scott-Wilson report sets the canal water level at Drayton lock (tail) at 55.2 mOD, which is the historical level. This level can be seen on Figure 15 as a dashed line. This is incompatible with the road level at the A34 crossing , which is at approximately 56.7mOD at this point. The water level would need to be lowered to ensure clearance under the A34.

4.4 Wilts and Berks Trust Route Option

Route 4 (see Figure 18) was proposed by the Wilts and Berks Canal Trust after consultation with the Environment Agency. The main aim of this route was to keep out of the flood plain as much as possible which complies with principles of PPG25. This route option also minimised the number of locks required along the canal stretch. This route is the same as Route 3 in the eastern part of the site, after meeting the A34 trunk road.

4.5 Assessment of Routes

4.5.1 Route 1

Route 1 (see Figure 15) follows the most of the historical canal route compared to the other options. The western part of the route follows the historical alignment horizontally and vertically (water at +55.2mOD).

Section 1 shows the detail of the A34 crossing. The spot height at the A34 road is 56.68m OD, Allowing for 0.7m minimum structural clearance above the soffit of a bridge and 2.3m headroom to water level of the canal, gives a resultant water level at 53.7m OD maximum for the crossing. (If it is required to use a jacked tunnel, the level will be lower- see Section 5). It is not feasible to raise the A34, therefore it is necessary to lock down under the road. This solution is not desirable because of increased operational costs and complexity. The system will we entirely dependent on large capacity pumps unless there is a very deep cutting through Oday Hill. In addition, the deep cutting adjacent to the River Ock will be subject to groundwater infiltration and will be at risk from serious flooding when the River Ock bursts its banks.

After the A34 crossing the historical route turns into a steep hillside between points C and D. Section 2 shows the dimensions of the cutting between C and D in the event of using either no locks, one lock or two locks. The decision regarding the number of the locks will have to be made based on construction and operational costs, operational flexibility and land acquisition.

Because the locks are very close to each other, a number of on- or off- line water storage areas will need to be provided to prevent the water levels dropping substantially every time a lock is used.

The vertical alignment of the canal also has to be lowered to cross under two other roads, the B4017 and Stonehill Lane. It is assumed that the Peep-o-day lane crossing will be a raised pedestrian/ cycleway crossing over the canal. See Figure 15. Agricultural drainage disruption and farm vehicle access will also need to be provided where the canal route crosses such facilities. An outfall stream from the sewage plant near point E also has to be taken into account.

The Glanville version of this route shows an extreme sharp bend at Stonehill Farm, however, as the Scott-Wilson version does not, we have included the most appropriate version e.g. without the severe angle.

The canal level across the Thames floodplain is likely to be dictated by the requirements of the Environment Agency. Ideally for navigation and operation of the canal, the canal water level would be just above the 1:100 year flood level. However, in this case, the canal embankments would substantially affect the river flows during an extreme flood. The canal could not in this case be routed through the existing lakes. Alternatively, the canal level would be close to the existing ground level (at the existing lake level). This would not interfere with flood flows and would allow the canal to be routed through the lake. However, there would be disruption to the canal when the Thames is in flood.

Summary of vertical alignment:

Route 1	**Level (m OD) at tail of lock**	**Rise/ Fall (m)**
Drayton Lock	55.2	-3.02 *
Lock west of A34	53.7	-1.5
New Cut Mill North Lock	56.2	+2.5
Lock (optional)	58.7	+2.5
Lock (optional)	56.2	-2.5
New Cut Mill South Lock	53.7	-2.5
Oday Hill Lock	50.0	-3.7
Regulating Lock	49.5	-0.5

* assuming canal upstream of Drayton Lock is at historical level of 58.2mOD

Base Case:

The base case selected for costing is the option with a summit of +56.2mOD. This avoids the two extra locks and summit pound for the high level alternative or the very deep cutting/tunnel for the low level alternative.

4.5.2 Route 2

Figure 16 shows the shortest route, which passes across the highest section of the land on the A34 route near Abingdon. Compared to route 1, this route makes less use of the historical canal route.

Route 2 runs the from historical alignment west of the A34, turning southeast to pass under the trunk road to the north west of Drayton. The A34 crossing is immediately north of the existing vehicular road bridge. The spot height at the A34 road is 59.65m OD. Allowing for 0.7m minimum structural clearance above the soffit of a bridge and 2.3m headroom to water level of the canal, gives a resultant water level at 56.6m OD maximum for the crossing.. Therefore the historic level of 55.2mOD could continue under the A34 without dropping. (However, if it is required to use a jacked tunnel under the A34, the level will be lower- see Section 5)

The disadvantage with this option is that after turning east from the historic route the canal route faces a large hill between A and D, which means large amounts of cutting. This will have substantial excavation costs and landscape impact. This impact could possibly be reduced by two sets of locks to climb up and down before and after the A34 crossing. These two locks occur over a distance of around 370m, which is a constrained rained system to navigate within. In addition, on- or off- line water storage areas will need to be provided to prevent the water levels dropping substantially every time a lock is used. Route 2 therefore requires 3 locks with very deep cuttings across Oday Hill or seven locks in order to minimize excavation costs.

Agricultural drainage disruption and farm vehicle access will also need to be provided where the canal route crosses such facilities.

The existing farmland contains both pedestrian and bridleway routes. It is understood that the over bridge above the A34 is used as a bridleway and for private vehicular access to reach the farmland to the west of the A34. If, in the open space of the countryside an adjacent cycle track were constructed outside the towpath, this would also allow mechanical maintenance or emergency vehicular access along the canal route (similar for routes 3 and 4)

As with the previous Route 1, there are three road crossings and one footbridge required, as well as the outfall stream by point E to be considered. Summary of vertical alignment:

Route 2	Level (m OD) at tail of lock	Rise/ Fall (m)
Drayton Lock	55.2	3.02*
Lock A (optional)	58.2	+3.0
Lock B (optional)	55.2	-3.0
Lock C (optional)	58.2	+3.0
Lock D (optional)	55.2	-3.0
Lock E	52.8	-2.4
Oday Hill Lock	50.0	-2.8
Regulating Lock	49.5	-0.5

* assuming canal upstream of Drayton Lock is at historical level of 58.2mOD

Base Case

The base case selected for costing is the crossing at +55.2m. This avoids the four extra locks and four extra basins required for the high level alternative.

4.5.3 Route 3

Route 3 (see Figure 17) runs from the historical alignment west of the A34, and turns east to pass under the trunk road between the vehicular bridge crossing and the north west of Drayton. Initial water level from Drayton Lock is set at 55.2m OD.

This route has the advantage of reduced cut and fill work as compared to the previous two route options. This route requires five locks for minimum excavation, or three locks with deep excavation across Oday Hill; three road bridges and one footbridge. Agricultural drainage disruption and farm vehicle access will also need to be provided where the canal route crosses such facilities.

The A34 height at crossing point is 60.4m OD, and as in Routes 1 and 2, allowing for 0.7m structural clearance and 2.3m water level clearance, the resulting maximum water level is +57.4m OD. The canal could cross the A34 at the historical level of +55.2mOD or could even be raised to +57.4m OD. (However, if it is required to use a jacked tunnel under the A34, the level will be lower- see Section 5)

The advantage with this option is that after turning east from the historical route the canal follows a natural valley, which means a reduction in excessive amounts of cutting and excavation costs. This south section of the vehicular bridge requires less cut into the hill due to the existing topography of the area. A similar turning detail to Route 2 is required at the Stonehill Lane.

Route 3	Level (m OD) at tail of lock	Rise/ Fall (m)
Drayton Lock	55.2 (tail)	-3.02*
Lock H (optional)	57.4	+2.2
Lock I	53.7	-3.7
Oday Hill Lock	50.0	-3.7
Regulating Lock	49.5	-0.5

* assuming canal upstream of Drayton Lock is at historical level of 58.2mOD

Base Case

The selected base case for costing is with the summit at +57.4mOD. This substantially reduces the landscape impact and land acquisition requirements of a 1200m long very deep cutting.

4.5.4 Route 4

Route 4 starts at Drayton Lock (see Figure 18), and turns eastwards on an embankment, swinging around to make a turn adjacent to the existing public footpath. The water level is set at 57.0 m OD throughout the western part of the site, running along existing hedgerows and footpaths. In the western part of the site the canal would require three agricultural vehicular

access crossings and six agricultural drainage network crossings. A small length of drainage ditch would have to be diverted.

The canal then swings into Oday Hill, and a cutting is required into the hill to get under the A34. The A34 height at crossing point is 60.37m OD, and allowing for 0.7m structural clearance and 2.3m water level clearance, the resulting maximum water level is 57.4m OD. OD. (However, if it is required to use a jacked tunnel under the A34, the level will be lower- see Section 5)

The canal follows eastwards over Oday Hill in the same cutting, where the water level is still 57.0m OD. Two vehicular access bridges are required in the section of the canal between the A34 and B4017 crossing. A lock down allows a crossing under the B4017. A second lock is required to bring the water level down to 50.0 m OD to get under the Stonehill Lane road. The last bridge on Peep-o day lane is assumed to be raised over he canal, or alternately a lift bridge. In the eastern part of the site from the A34, a total five drainage networks are crossed, along with a section of diverted drainage.

The canal level across the Thames floodplain is likely to be dictated by the requirements of the Environment Agency. The canal level would be close to the existing ground level (at the existing lake level). This would not interfere significantly with flood flows and would allow the canal to be routed through the lake. However, there would be disruption to the canal when the Thames is in flood.

Route 4	Level (m OD)	Rise/ Fall (m)
Drayton Lock	57.0 (tail)	-1.2*
B4017 Lock	53.5	-3.5
Oday Hill Lock	51.0	-3.5
Regulating Lock	49.5	-0.5

* assuming canal upstream of Drayton Lock is at historical level of 58.2mOD

4.6 Summary

Route	1	2	3	4
Length (m)	5900	5250	5250	5400
Number of Locks (including regulating lock at Thames[5])	5	3	4	3
Historical Route length (m) from Drayton Lock	3450	2350	1450	0
Historical Route Percentage (%)	62	43	29	0
Number of Road Crossings (A34, B4017 and Stonehill Lane)	3	3	3	3

[5] Drayton Lock is not included in this figure.

Number of Farm access bridges/ bridleways/ footbridges	3	5	5	5
Number of Agricultural Drainage Crossings	10	5	10	7
Estimated length of Agricultural Drainage Parallel to Route (m)	4995	3960	2285	1000
Maximum depth of cut required through Oday Hill	11.4m	8.2m	4.9m	5.3m

See Figure 19 for the Proposed Junction with River Thames and Figure 20 Qualitative Summary of Route Options for the major positive and negative factors marked out.

Route 4 is the preferred option because:

- The vertical alignment is much improved as the canal follows higher ground west of the A34; follows shallow valleys up either side of Oday Hill; and crosses the A34 at the highest point on this stretch of road - this minimises excavations and hence cost
- Numbers of locks involved is minimal
- Water does not need to be pumped over Oday Hill- a much more cost effective and sustainable solution.
- The depth of cutting to achieve this is the smallest compared to the other options. This reduces cost and landscape impact.
- The route follows higher ground west of the A34 and is mostly outside the 1:100 year floodplain of the River Ock

Other factors that have been taken into account (applicable to all options):

- The crossing of the Thames floodplain will be at low level so that it does not interfere with the river flows during flood events, hence the proposal is compatible with the principles of PPG25
- The route follows close to existing hedgerows where this is practical, to minimise impact on the existing fields and the environment.

5. A34 CROSSING OPTIONS

One of the major constraints on the canal route is the crossing of the A34.

- It is not feasible to change the vertical alignment of this trunk road, therefore the canal vertical alignment must be designed to suit the road.
- The method of construction of the crossing must not disrupt this very busy road.
- The costs and risks for this crossing are very high.

The existing road drainage layout will need to be examined and continuity measures will need to be included as part of the scheme.

There are three options for the construction of the A34 crossing. These are:

- **Option A - Road diversion** over the construction period with structure built using conventional construction techniques
- **Option B - Build bridge adjacent to crossing and slide in** during temporary closure/possession of road.
- **Option C - Jacked structure** where the road is able to be kept 'live' whilst structure is pushed under the motorway

Key issues affecting these choices are

- Cost
- Risk
- Disruption to traffic flows
- Groundwater levels
- Existing road drainage
- Existing utilities in road

Another crucial factor affecting the type of construction will of course be the position of crossing e.g. as Route 1, 2, 3 or 4 (see Figure 21- A34 Crossing Options).

5.1 Option A – Road Diversion

The road would be temporarily diverted around the site of the bridge and the bridge constructed using conventional construction methods. Cover to the top of the structure would be of the order of 200 mm minimum plus a half metre structural depth required to give a total clearance of 0.7 metres between the soffit of the bridge and the road surface.

There would need to be sufficient space on either side of the site for the road to be diverted off line and back onto line. Depending on Highway Agency constraints, it may be possible to first constrain each carriageway to a single lane and then divert the two single lanes at the site.

The location of the A34 under bridge for Routes 1 and 2 is close to an existing bridge – for Route 1 the River Ock Bridge and for Route 2 the Farm Accommodation bridge. The presence of these existing structures would probably make the road diversion option prohibitively costly for temporary diversion structures.

Subject to the agreement of the Highway Agency, diversion of the road may be an option for the Route 3 and Route 4 under bridge.

Total costs for this option would be dependant on the diversion costs. When the scheme near detailed design stage, the Highways Agency would be able to give feedback on the route and construction method and penalty charges if the construction were to run over programme.

5.2 Option B – Build bridge adjacent to A34 Crossing

This option includes constructing the bridge adjacent to the road and sliding the bridge into place whilst in possession of the trunk road. This option has the advantage of limited period of disruption, as the road remains fully usable up to the point where the concrete structure would be moved in under the trunk road.

The bridge would either be constructed as a single element and slid into position, or comprise a series of match-cast pre-cast concrete box elements that could be craned into position and sequentially stressed together. The issues relating to maintaining continuity of the A34 road drainage would need to be managed so as to minimise their impact on the possession related works. Cover to the top of the structure would be of the order of 200 mm minimum.

Insertion of the reinforced concrete structure followed by backfilling and replacement of the highway and finishes would take approximately 3 days.

Total job costs for this option would be dependant on the lane charged for possession of the highway. When the scheme near detailed design stage, the Highways Agency would be able to give feedback on the route and construction methods and lane charges.

5.3 Option C – Jacked Structure

This option has the advantage of allowing the A34 to remain live throughout construction. The reinforced concrete structure would be constructed off line and thrust-bored under the live trunk road with careful monitoring to ensure pre-agreed movements were not exceeded. To facilitate the mining operation, the cover to the top of the structure would need to be approximately 2 metres, plus the additional structural depth required brings us to a total clearance of 2.5 metres.

This is likely to be the most expensive option for construction methodology, despite the fact that lane charges or diversion costs are not applicable. The construction risks of this method of construction are relatively high. In particular, it would need to be very closely monitored throughout the mining operation to ensure that there was no unsafe settlement of the road. There is also an additional cost to other sections of canal because the jacked structure forces the canal to a lower level, increasing the excavation costs and visual impact of the cutting through Oday Hill.

5.4 Qualitative Summary

As a result options A and B are preferable because they involve:

- Low to medium cost
- Low to medium risk
- Low to medium disruption to traffic (which could be decreased by timing of work)

Groundwater level risk will be dependant on the route chosen rather than crossing type at this time and will need to be established for the chosen site.

Crossing	Option A - Diversion	Option B – Adjacent Bridge/road possession	Option C – Jacked Structure
Cost	Least cost	Medium cost	Highest cost
Lane Charges	Yes	Yes	No
Time	Short to medium timescale	Short timescale	Short timescale
Risk	Least	Medium	Maximum
Disruption to Traffic	Medium – depending upon work timing	High for short period	Low
Sensitivity to groundwater Levels & obstructions	Least	Medium	Maximum

5.5 A34 crossing & route selection

Route 1:

- A34 crossing is in the floodplain of the river Ock with serious implications for construction problems given the groundwater levels and the proximity of the River Ock to what will be a deep excavation
- No space for road diversion during construction of A34 crossing; Option A not feasible at this location
- Large petrol interceptors will need to be relocated in order to construct crossing

Route 2:

- Inadequate space for road diversion during construction of A34 crossing; Option A not feasible at this location

Routes 3 and 4:

- Space is available for road diversions; Option A is feasible at this location
- No known obstructions to a crossing at this point.

5.6 Conclusion

Option A appears to be the least risk solution and this is feasible for the preferred route (Route 4). However, the construction methodology will be very sensitive to the conditions imposed by the Highways Agency at the time that the works progress. Therefore the two alternative methods of crossing the A34 should not be altogether discounted as alternatives.

6. COST AND PROGRAMME

6.1 Assumptions

Exclusions from pricing (the costs below represent comparative rather than absolute costs):

- A34 crossing (and HA charges or penalties)
- Utility diversions (overhead power lines and intermediate pressure gas main)
- Land purchase and compensation costs
- Archaeological excavations and mitigation/compensation
- Compensation for floodplain encroachment
- Professional fees
- VAT, financing costs, inflation and contingencies

6.2 Route 1

See Section 4.5.1 and Figure 15

Change/Description	Distance (m)	Rate (£/m)	Amount (£000)
Chainage –1,450 to 0.00	1,450	2,500	3,625
Ch. 0.00 to 700.00	700	2,750	1,925
Ch. 700.00 to 1,500.00	800	2,500	2,000
A34 crossing			*(tbc)*
Locks adjacent to crossing 2 no @ 0.75m			1,500
Basin and moorings			250
Ch.1,500.00 to 1,900.00	400	2,750	1,100
1,900.00 to 2,600.00	700	8,000	5,600
Locks – 2no @ £0.75m			1,500
Ch. 2,600.00 to 3,100.00	500	4,000	2,000
Basin and moorings			250
Ch. 3,100.00 to 3,500.00	400	3,000	1,200
Road Bridge B4017			650
Road Bridge Stonehill Lane			400
Ch. 3,500.00 to 4,450.00	950	3,500	3,325
Stream Crossings			500
Junction with Thames (inc. lock)			750
Basins and moorings - 2no			500
Lift bridges and footbridges			200
Permanent Bridge (vehicle access)			200
TOTAL	**5,900 metres**		**£ 27,480**

6.3 Route 2

See Section 4.5.2 and Figure 16

Chainage/Description	Distance (m)	Rate (£/m)	Amount (£000)
Chainage –2,150 to 0.00	2,150	2,500	5,375
Ch. 0.00 to 1,350.00	1,350	6,000	8,100
A34 crossing			*(tbc)*
Ch. 1,350 Lock			750
Road Bridge B4017			650
Ch. 1350.00 to 2150.00	800	4,000	3,200
Ch. 1,850 Lock			750
Road Bridge Stonehill Lane			400
Ch. 2,150.00 to 3,100.00	950	3,500	3,325
Stream Crossings			500
Junction with Thames (inc lock)			750
Basins and moorings - 2no			500
Lift bridges and footbridges			400
Permanent Bridge (vehicle access)			200
TOTAL	**5250 metres**		**£ 24,900**

6.4 Route 3

See Section 4.5.3 and Figure 17

Chainage/Description	Distance (m)	Rate (£/m)	Amount (£000)
Chainage –1,450 to 0.00	1,450	2,500	3,630
Ch. 0.00 to 700.00	700	2,500	1,750
Ch. 700.00 to 1,500.00	800	6,000	4,800
Ch. 1,500.00 to 2,850.00	1,350	4,000	5,400
A34 crossing			*(tbc)*
Ch. 2,850.00 to 3,800.00	950	3,500	3,325
Locks 3 no			3,000
Road Bridge B4017			650
Road Bridge Stonehill Lane			400
Junction with Thames (incl. lock)			750
Basins and moorings - 2no			500
Lift bridges and footbridges			400
Permanent Bridge (vehicle access)			200
Stream Crossings			500
TOTAL	**5,250 metres**		**£25,300**

6.5 Route 4

See Section 4.5.4 and Figure 18

Chainage/Description	Distance (m)	Rate (£/m)	Amount (£000)
Ch. 0.00 to 600.00	600	2,500	1,500
Ch. 600.00 to 1000.00	400	2,750	1,100
Ch. 1,000.00 to 2,400.00	1,400	2,500	3,500
Ch. 2400.00 to 2,650.00	250	5,000	1,250
A34 crossing			*(tbc)*
Ch. 2,650.00 to 3,550.00	900	6,000	5,400
Lock			750
Road Bridge B4017			650
Ch. 3,500.00 to 4,450.00	950	5,000	4,750
Lock			750
Road Bridge Stonehill Lane			400
Ch. 4,450.00 to 5,400.00	950	3,500	3,325
Junction with Thames (incl. lock)			750
Basins and moorings - 2no			500
Lift bridges and footbridges			400
Permanent Bridge (vehicle access)			200
Stream Crossings			500
TOTAL	**5,400 metres**		**£ 25,780**

See Figure 18

6.6 Summary

Canal Route	Total Price*	Average price per metre length*
Route 1	£27.5m	£4,660
Route 2	£25.3m	£4,820
Route 3	£24.5m	£4,665
Route 4	£25,8m	£4,750

* these do not take account of the exclusions highlighted in Section 6.1

As a benchmark, a comparison has been made with the Huddersfield Narrow canal through Stalybridge. According to British Waterways, an 800m length of canal including four locks and four bridges cost approximately £8m, of which 'nearly half' was attributable to land and compensation costs. These costs can also be compared the benchmark figure of the basic rate for a canal in urban areas £8,000/m, the above rates are clearly reduced because of the open countryside environment.

Cost estimates are clearly indicative budget figures with relatively high uncertainty, which is appropriate for this feasibility stage assessment. This uncertainty is because of unknown factors such as the compensation measures, water supply and quality issues, and other factors not included (see section 6.1 Assumptions). However, conversely, the budget should not be regarded as an 'upper bound' estimate.

Conclusion:

Route 1 is clearly more expensive than other Routes. The A34 crossing would be most expensive on Route 1, further widening the cost gap.

The assessed cost differences for the other routes are relatively very small compared to the overall cost and level of uncertainty at this stage of the design development. Land acquisition costs may dominate. The cost of flood compensation works will be less for Route 4 than other routes, but it is not clear what compensation might be required and therefore what the cost saving would be.

However, the operational cost of Routes 2 and 4 will be significantly less than the others, because these do not have the requirement to pump water up and over Oday Hill and the number of locks are less.

Therefore, on purely cost grounds, Routes 2 or 4 would be preferred.

6.7 Implementation Programme

The Draft Local Plan is expected to go to Public Inquiry commencing May 2005. Therefore the proposed route is not likely to be safeguarded before early 2006.

The key driver affecting the implementation programme is obtaining funding for construction. Assuming this could be assured by the end of 2006, a year should be allowed for landowner agreements, design and obtaining the relevant consents and licences. This may include an order under the Transport and Works Act. This period would be longer if plans for the canal were to go to Public Inquiry.

Construction of this section of canal could be completed in two years from commencement. Critical factors affecting construction programme are likely to be:

- The A34 crossing, which would be subject to a detailed programme agreed with the Highways agency.
- Earthworks, particularly excavation through Oday Hill. In the clay soils, earthworks may not be practical in wet weather or in winter.
- Enabling works, particularly service diversions, which will be to a programme partially dictated by the relevant authorities.

It is assumed that the sand/gravel processing plant will be relocated from the area south of the Abingdon sewage works before construction commences.

In summary, a most optimistic scenario for the implementation of this section of canal is the end of 2008.

It may be possible to construct a very short section of canal to link the Thames to the existing small lake to the southeast of the sewage works (i.e. an initial 300m length). This would establish the starting point of the canal, would generate some income from moorings in the lake. However, there would be no benefit from constructing the remainder of the canal within the study area until a link is secured to a significant destination point, possibly near Wantage

7. LANDSCAPE AND VISUAL IMPACT ASSESSMENT

7.1 Impact of Vertical Alignment

The options for the vertical alignment are:

- 'Up and Over' option, which is the highest option, including the most number of locks, with the aim to skim the land surface and provide minimum but significant excavation into the hillside. This option would require the least land take. However, this option would entail additional land take for the summit pound. The pound would need to be in a shallow excavation with water level 2-3 m lower than the ground levels in order to be level with the canal. The locks and lock building will be noticeable structures
- 'Straight Through' option, which would be the lowest vertically of all options. Although this option would require no locks whatsoever. Navigational users would have to navigate through large cuttings. This option requires the largest land take of all.The side slopes of the cutting could be softened by extensive planting with shrubs and possibly trees
- The 'Middle' option has a single lock up and a lock down and an intermediate depth of cutting. However, this option also requires a summit pound which will be in a substantial excavation compared to the 'up and over' option Land take areas would be somewhere between the two previous options.

7.2 Opportunities for the Canal

Although the canal will of course have both positive and negative visual impact on the surrounding landscape, it should not be forgotten that the canal would also be providing a variety of opportunities:

- Improved corridor with both pedestrian and cycle links under the A34, which currently acts to restrict passage from east to west (or vice-versa) The pedestrian, cycle and boat activities along the canal will add to the variety in the landscape.
- Large opportunities for landscape enhancement in a largely 'industrial' area where the Sewage works and gravel pits exist
- The canal will provide a landscape link between the different landscape environments through the 'industrial' area and out to the countryside to the south and south- west of Abingdon. At the moment, fences and the A34 isolate the different landscapes.
- Conversely, the canal will tend to break up the landscape continuity; such as it is, in a north-south direction.
- It is proposed to moor barges in one of the small lakes adjacent to the Thames. The moored barges will add some colour and variety to this area but conversely this could be seen as reducing the wilderness interest of the area.
- The canal route generally follows hedgerows but there are a number of corners that inevitably will be cut off. Where these are too small to be viable for farming use, the intention is to plant these with indigenous trees and shrubs.
- The quality of the landscape along the canal will be dependent on good maintenance of the canal side areas; such as removing litter and graffiti.

7.3 Route 1

The visual impact of the canal can be split into three distinct sections:

- Historical route alignment from the tail of Drayton Lock following the natural shape and contour of the surrounding land until the A34 crossing, the canal would involve a small shallow excavation very close to the existing ground levels. However, it would require the removal of much of the tree and shrub vegetation that has grown in and alongside the existing ditch. The canal locks down below ground levels at the A34 crossing, and will require embankments to avoid flooding from the River Ock. This will give an appearance of a deep cutting in this section
- Crossing the Oday Hill Ridge, would require either a deep cutting of some/ several locks in a short length of canal alignment to pass through (or over) Oday Hill Ridge – this phase would have a substantial visual impact onto the existing landscape depending on the number of lock used.
- After B4017 road bridge we turn into lower land, passing the 1 in 100 year flood level and returning to a less visually impacting route until we reach the Thames – this again returns to a lesser visual impact on the landscape by keeping close to the existing levels and tying in the topography. There is great scope to improve existing landscape in this industrial and generally working area, which would also be able to link to the Sustrans networks near the Peep-o-Day lane

7.4 Route 2

The impact of Route 2 visually can be split into three distinct phases:

- Historical route alignment from the tail of Drayton Lock following the natural shape and contour of the surrounding land until turning east into Oday Hill Ridge - as in route 1 the main visual impact on the landscape will be the loss of tree and shrub vegetation along the existing ditch, the length following the historic alignment is less in Route 2
- Crossing the Oday Hill Ridge will require either a very deep cutting or some/ several locks in a longer length of canal alignment to pass through (or over) Oday Hill Ridge. The cutting through the ridge will be very evident to passing traffic on the A34 or from
- After crossing under the B4017 road bridge we turn into lower land, passing the 1 in 100 year flood level and returning to a less visually impacting route until we reach the Thames, again with the opportunities for landscape enhancement

7.5 Route 3

- Historical route alignment from the tail of Drayton Lock following the natural shape and contour of the surrounding land until reaching the west side of the highest point of Oday Hill Ridge - as in option 1 this length would have minimal visual impact on the landscape, however the length following the historic alignment is less than Route 1 and the same as Route 2
- Crossing the Oday Hill Ridge will require either a deep cutting or some/ several locks in a longer length of canal alignment to pass through (or over) Oday Hill Ridge. This route requires less excavation west of the A34 than Route 2 as it follows more of the natural contours of existing landscape, and it requires similar amounts of excavation to Route 2 east of the A34.

- After passing under the B4017 road bridge we turn into lower land, passing the 1 in 100 year flood level and returning to a less visually impacting route until we reach the Thames, again with the opportunities for landscape enhancement

7.6 Route 4

- The western part of the canal is not visually intrusive, as the canal follows higher ground west of the A34; follows shallow valleys up either side of Oday Hill; and crosses the A34 at the highest point on this stretch of road. The most significant visual impact is likely to be from the embankment that is 1.5 to 2m above ground level for significant sections. The visual impact of this embankment can be minimised through a gentle side slope and the planting of trees and shrubs.
- The route follows close to existing drains and hedgerows where this is practical, to minimise impact on the existing fields
- Crossing the Oday Hill Ridge will require a deep cutting and a lock prior to the A34 road crossing, and it requires similar amounts of excavation to Route 2 east of the A34.
- After passing under the B4017 road bridge the canal returns to relatively flat ground and will be close to ground level. The visually impact will be small until we reach the Thames. Again there are substantial opportunities for landscape enhancement along this rather degraded area.

7.7 Summary

The whole area is to be designated in the Local Plan 2011 as an area for Landscape Enhancement. It is understood that there are very similar landscape opportunities and constraints for the four routes 1,2, 3 and 4.

The major landscape impacts come with the vertical alignment (e.g. 'up-and-over' being of minimal landscape disruption and the 'straight through' option being the most severe visual interruption to the landscape).

It is understood that there are many varied opportunities for landscape enhancement for development of the canal and its surrounding land in the future, especially in the area of the gravel pits.

With the possible exception of the deep canal cutting through the Oday Hill ridge, the canal can be seen as part of the landscape enhancement of the area south of Abingdon that is envisaged in the draft Local Plan.

8. WATER SUPPLY

8.1 Introduction

This section of the report considers the water requirements of the restored Wilts and Berks Canal, and draws conclusions for the options considered for the Abingdon section of the canal.

8.2 Water Losses

Water losses from the canal result from the following:

- Seepage and leakage from the base and sides of the canal. Seepage is the flow of water through the canal lining, whereas leakage occurs where the lining is breached. These losses are the most significant, and their rate depends on the permeability of the ground;
- Evaporation
- Lockage losses due to normal operation of the locks, transferring water from higher to lower pounds and lock leakage.

As the only direct recharge is from rainfall into the canal, the shortfall needs to be provided by establishing a supply of water especially in the summer. This reportedly was a constraint on the operation of the original Wilts and Berks canal.

8.3 Water supply to the Original Canal

The measures used by the Wilts and Berks Canal Co. to minimise water losses and recharge the canal are described by Dalby (1986). The canal was routed across clay areas, and the base and sides of the canal were sealed with puddled clay. It is also reported that the summit section near Swindon was deeper and wider than elsewhere to increase its storage capacity, but restoration work has shown that this may only have been a proposal that was never carried out.

Surface water from watercourses and possibly land drainage was the primary source for recharging the canal, and the historic canal companies were empowered to take water from most watercourses within 2,000 yards of the canal. The Wanborough feeder supplied most of the required water.

In addition, off-line storage reservoirs were constructed at Coate in 1822 and at Tockenham in 1840. There are reports that water was pumped from the lower pounds of the canal to the summit, and that an attempt was made to also use a well to obtain additional water.

8.4 Water Requirements of the Restored Canal

See Figure 22 Potential Local Water Supply Sources for potential sources within the study area.

Scott Wilson (1998) used a water balance model of the entire canal to establish the water supply requirements during original operation, the water needs of a new canal and possible water sources. They conclude that the regenerated canal would have a water requirement of 4,200Ml/year, which could be met from abstracting surface and ground water. Reservoirs would be required to store water during wet months and ensure a constant supply.

The study concluded that the seepage/leakage rate of the original canal was less than 20mm/day, and probably nearer 10mm/day, which they suggest should be the target rate for the redeveloped canal. Other reports estimate seepage/leakage losses to be 4.7mm/day (Griffiths, 1996), 20mm/day for the western section of the mainline and the North Wilts Canal (Allen & Harris/Royal Insurance, 1994) and 25mm/day for the section at Melksham where the canal crosses the more permeable River Sands and Gravels (Halcrow, 2002). By comparison, the target rate set by British Waterways is 25mm/day. These figures indicate the variability of seepage predictions. It should be noted that much the Abingdon Canal would be built over more favourable geology that would reduce seepage and that a supply of puddling clay would be available over this area. However the section crossing the Thames floodplain is on relatively permeable sands and gravels.

Lockage losses occur during normal operation of the locks, and can be reduced or even eliminated by the use of back pumping. This should be considered for the new canal. The Scott Wilson report concluded that back pumping would be required throughout the Canal.

The water used to supply the canal should be of suitable quality, which may be an issue depending on the groundwater and whether treated sewage effluent is used as a water source. Water quality will be affected by the amount of circulation within the canal.

8.5 Solutions for the Regenerated Canal

Much depends on whether the canal is only operated once the full length has been completed or whether sections such as the canal south of Abingdon considered here will be operated as an isolated section. In principle, it will be most efficient to supply water to the summit section (outside the study area) and rely on gravity to supply lower sections. However, it is assumed that the Abingdon section may not be immediately linked to the summit section and therefore may need to be self sufficient in terms water resources.

8.5.1 Reduce seepage/leakage by lining canal

Lining systems which are available are discussed in the Scott Wilson Report (1998). The most likely options are using puddled clay as in the original construction of the canal, concrete incorporating an impermeable PVC liner or bentonite matting.

The section of canal crossing the sands and gravels of the Thames floodplain will need to be lined to reduce leakage or possible infiltration of contaminated groundwater. Scott Wilson (1998) suggests that there may be inflows through the permeable strata along the River Ock. Water levels and fluctuations will need to be investigated further to confirm this.

The four route options considered have similar geology, and therefore route selection was dependent on other factors as described in section 4.

8.5.2 Reduce lockage losses by back-pumping

It is anticipated that the new canal will be fitted with back-pumping facilities at each lock, which pump water from the lower to the higher pound after a lock has been operated. In this way, lockage losses are reversed.

Back pumping would make it possible to recharge the canal at the summit section and then transferring to the lower pounds.

8.5.3 Increase in-line storage capacity

The original summit section of the canal was reportedly approximately 0.5m deeper than the rest of the canal. Even though widening the restored canal might not be an option due to increased land take, deepening should be considered to increase the storage capacity.

One disadvantage of using in-line storage is that it needs to be ensured that the fluctuation of the water levels does not result in increased leakage. Cracks in the lining may result from drying out of the bank during periods of low water levels. This will need to be taken into account in the detailed design of the canal walls by possibly incorporating full PVC lining along sections used for in-line storage.

8.5.4 Establish off-line storage capacity

Off-line storage in reservoirs would be used to store water during the winter, for use in the summer. Such reservoirs would probably have a small catchment area of their own, but principally be used to store water abstracted from surface water, ground water or rainfall.

One option may be to reuse the historic reservoirs. However, for example, both Coate reservoir, which is situated in Swindon south of the town centre, and Tockenham reservoir which is located south-west of Swindon are now used for recreational purposes, including fishing. It is therefore likely that they are subject to environmental restrictions and obtaining abstraction licences for either reservoir would almost certainly prove to be very difficult.

Water would need to be transferred to the canal via pipes or channels, and most likely with the method of transporting water up the canal by back-pumping. The gravel pits and reservoirs the Thames to the east of the canal section considered here may be able to be used for the canal.

If it were decided to lock up and over Oday Hill, then a brick reservoir would be required at the top of the hill to limit fluctuations.

8.5.5 Abstract surface water

The abstraction of any surface water is regulated by the Environment Agency. The entire area is currently managed such that minimum flows are maintained at all times in all watercourses, and it is therefore possible that the EA could resist any proposals that would reduce flows, especially in the dry summer months.

The Abingdon section of the canal and runs alongside the River Ock and joins the Thames/Isis. This provides several options for surface water abstraction, and will probably be the most suitable water supply option. The canal options all lie above the water level, therefore water would have to be pumped into the canal.

Thames Water has raised concerns about a section of canal near their Abingdon sewage work. They are currently discharging effluent into Oday Hill Ditch and are concerned about losing this discharge.

8.5.6 Abstract ground water

Groundwater abstraction is subject to the same regulations as that of surface water, and the same considerations apply. Scott Wilson (1998) carried out a detailed study of the possibilities of groundwater abstraction, and approached the EA to obtain their view on the feasibility of using groundwater.

Water quality was identified as a possible problem in the feasibility study. The presence of iron, dissolved solids and salinity may mean that not all water could be used.

8.5.7 Re-use urban run-off

The issues connected to using urban run-off is similar to surface water, with the added complication that water would need to be treated to reduce solids and avoid contamination. A scheme would therefore probably need to include silt traps and oil separators. Currently, urban runoff is managed by Thames Water and contributes to maintaining river flows in the summer (Scott Wilson, 1998).

8.5.8 Drainage of Agricultural Land

Land drainage was considered a useful option by Scott Wilson (1998) as it does not need consent from the EA and may need to be included in the scheme to reduce the effects of the canal on the surrounding land.

The canal is higher than the agricultural drains; therefore lower than surrounding land for gravity drainage; pumping would have to be used. The agricultural drains along the route of the canal were all too small and unreliable to provide a useful source of water over the summer months. The only possible benefit of utilising these is to reduce back pumping costs in the winter.

8.5.9 Use sewage effluent

There is the Thames Water Sewage plant located along the route of the canal adjacent to the River Thames. At present, discharge is from two outfalls, one directly into the River Thames and one into the Oday Hill Ditch.

It is likely that effluent would have to be treated further than it is at present, by treatment with UV light or similar, which could prove very expensive both to establish and maintain. Even after such treatment it is likely that the effluent will be very rich in nutrients, leading to increased growth of algae, which would cause problems for the canal where circulation is negligible.

In summary, this option is likely to be more expensive than others, but this can only be evaluated fully at the detailed design stage.

8.6 Conclusion

The most efficient supply of water for this section of canal is from sources near the summit of the canal system in the area around Swindon. This would minimise the need for back pumping upstream towards the summit. Assessment of these remote sources is outside the scope of this study. If these remote sources do not materialise, or if the Abingdon section of canal is constructed initially in isolation, then it would be possible to operate the Abingdon section using (in order of preference);

- Surface water from the River Thames and/or Ock
- Groundwater
- Treated sewage effluent from the Abingdon Sewage Treatment Works

We consider that water resources do not pose a significant constraint for the canal in the Abingdon area.

9. ECOLOGY DESK STUDY

9.1 Introduction

This section of the report represents a preliminary assessment of the potential ecological constraints and opportunities of likely significance to the proposed canal restoration.

Further ecological studies will be required in order to fully assess the ecological resources present along the proposed route, and to assist in the detailed design of mitigation measures that may be required and opportunities for environmental enhancements that can be incorporated within the proposals. This study outlines the likely ecological issues that will need to be assessed, indicates those that may pose particular constraints to the proposals, and identified the scope for further studies that are recommended such that the completed scheme would be sufficiently robust to stand up to Public Inquiry.

9.2 Data Collection

A preliminary evaluation of designated sites in the vicinity of the proposed route has been carried out. As far as can be determined without the findings of full consultations, the proposed route does not pass through any statutorily designated areas of ecological value rated at a national or international level of importance. Consultations have been initiated with BBOWT (Bucks, Berks and Oxfordshire Wildlife Trust) who keep up to date records of the locations and ecological interest of sites of lesser importance for nature conservation, such as County Wildlife Sites.

For the major part of its length, the proposed routes pass through agricultural land. Such areas are in themselves likely to be of relatively low ecological value although where fields are bounded by hedgerows sections of these may be of importance, particularly in relation to the Hedgerow Regulations 1997. An objective of scheme design is to minimise severance of and damage to hedgerows where practicable. If this approach is combined with a policy of enhancement such that severed hedgerows are re-connected by new planting of appropriate hedgerow species, overall benefits may be achieved.

9.3 Specific Issues

Specific issues of potential ecological importance relate to two types of operation that will take place:

- works to existing sections of degraded canal; and
- new cuts of canal.

9.3.1 Renovation of Existing Canal Sections

These areas are likely to be of more ecological significance than those areas of new canal given that specific ecological resources may have become established in the remaining sections and former canal structures where works may be required. Briefly, these are likely to include:

- **Bats** in broken or damaged sections of wall, bridges and former bridge piers, and former canalside buildings and structures. Bat roosts may also be present in established trees along the line of the canal. All species of bat and their roosts are strictly protected in the UK under the Wildlife & Countryside Act 1981 and its amendments. Any construction activities that are likely to disturb roosting bats are therefore subject to strict controls and if bats are present, are generally only

permissible under licence from DEFRA, and only then subject to the approval of English Nature. All measures must therefore be taken by the developer to ensure that bats would not be adversely affected by the proposals, and this typically means that surveys of potential bat roosts along the length of the route would need to be undertaken such that their presence/absence can be determined and, if required, an appropriate mitigation plan can be initiated with English Nature. Such a bat survey would need to be carried out prior to obtaining planning permission for any proposed works and would normally form a component of an Environmental Statement for the proposals. Surveys for bats are seasonally dependent and can generally only be undertaken during the period April-August inclusive.

- **Great crested newts** are also strictly protected under the Wildlife & Countryside Act 1981 and amendments, as well as the EU Habitats Directive, implemented in the UK under the Habitats Regulations 1998. Impounded sections of canal, and in particular, sections that may periodically dry out, and which are fringed by other habitat types such as grassland, wetland, woodland and scrub, form potential habitats usable by this species. Surveys of such water bodies would normally be required to determine the presence of this species, and if present, determine an appropriate mitigation plan. Works carried out in relation to great crested newts would normally also be undertaken under licence from DEFRA. Such works are highly sensitive to seasonality (even more so than bats – surveys should be carried out from spring to summer; translocation, should this be necessary, would normally be carried out throughout this entire period). For this reason surveys should be carried out at least a year in advance of any proposed works to ensure that an appropriate window of opportunity for implementing any mitigation programme is available.

- **Other protected species** include water voles, badgers, otters, reptiles and birds such as kingfisher that may be present in or near to sections of remaining canal. Surveys to establish the presence/absence of these species would be required prior to the approval of any works that might have adverse effects. Again, if present, an appropriate ecological strategy would need to be developed with English Nature, and works are likely to need to be undertaken under licence from DEFRA.

- **All bird species** in the UK and their nests are fully protected when breeding and therefore clearance of vegetation or demolishing of buildings, canal walls, etc, where birds may be nesting, is subject to strict control during the period March to July inclusive.

9.3.2 New Canal Sections

The above concerns apply to areas where new canals are proposed, although some degree of flexibility in the precise canal alignment may be possible to avoid such concerns that may arise if they might otherwise pose insurmountable constraints. Of the above considerations the most significant is likely to be the protection of birds during the breeding season if extensive clearance of vegetation is required.

Other than the above, severance of hedgerows is likely to be a key issue and assessments would therefore normally be made during surveys of the route of the condition and quality of hedgerows, referring to the guidance given within the Hedgerow Regulations 1997 concerning what constitutes an Important Hedgerow. It would be an objective of the scheme design to minimise any removal of lengths of Important Hedgerow, and to replace severed hedgerow links and removed hedgerow lengths with hedgerows of an appropriate native species mix, designed to promote ecological resources.

9.4 Invasive Plant Species

Japanese knotweed, giant hogweed and Himalayan balsam are three species of invasive weed that are currently strictly controlled by law. Undertaking activities that cause the spread of these species is strictly prohibited. Japanese knotweed is arguably the most serious to concern of the above species as it typically spreads along the line of disturbed ground such as that associated with watercourses, and is likely to be a localised issue in areas of former canal and other areas of disturbed ground. The locations of any stands of Japanese knotweed (and other invasive weeds) will need to be identified and indicated on a plan so that appropriate measures can be taken to prevent its spread in advance of the proposed works. In general, the most practical way to achieve this is through the wholesale removal of the plant, for subsequent deep burial or disposal to a site approved for Special Waste. Typically, because of the invasive nature of the plant, this requires disposal of all soils for a distance of up to 7m laterally around plants and to 2m depth, but the local Environment Agency will specify precise details.

9.5 Opportunities

Introduction of new canal and renovation of existing degraded canal represents a major opportunity for the enhancement of ecological resources in an area that is generally an open agricultural landscape. The project has significant potential for the overall enhancement of ecological resources and notwithstanding any local adverse impacts, it is expected that with the implementation for an appropriate ecological management plan, overall ecological benefits will result.

9.6 Further Work

A full survey of the length of the proposed route is required before the detail of any proposed measures or enhancements in relation to ecological resources can be fully undertaken. This should initially comprise a habitat survey, but should identify the potential for occurrence of significant protected species or other species or features of ecological merit that may pose a constraint or opportunity with relation to the proposals. The survey should also determine the extent of, and map the locations of, any stands of invasive species present.

Further specialist surveys, subject to the findings of the above habitat survey, should then be implemented as necessary to gain the necessary understanding of relevant species-specific issues so that appropriate mitigation plans can be developed, and such that the overall scheme will be sufficiently robust to stand up to scrutiny at Public Inquiry.

It is strongly recommended that following the interpretation of the information obtained from the above studies, an ecological management plan is drawn up for the proposals, to enable all issues to be addressed and to maximise the potential ecological benefits that can be implemented alongside the proposed restoration works. Such a plan should guide the future ongoing maintenance and management of the completed project.

10. ECOLOGICAL SITE VISIT

10.1 Introduction

This site visit was undertaken to assess the possible effects on ecological resources, of the reinstatement of the Abingdon Canal between Drayton Lock and the River Thames.

Route options were broadly identified for this section of canal (see Figure 23):

- **Route 1** - this route follows the former course of the canal from Drayton Lock and beneath the A34, running north-south to the west of Abingdon before turning east to the south of Abingdon before joining the Thames;
- **Route 2** - this alternative diverts south of the historic route of the canal to the west of the A34, travelling west-east to join the alignment of Route 1 above north of Drayton;
- **Routes 3** - this route option diverges from the historic canal route further west than Routes 1 and 2, again joining the same alignment north of Drayton.
- **Route 4** – the western part of Route 4 was not surveyed, but follows much of the Route 3 line, after the A34 towards the eastern part of the site.

This section of the report presents an assessment of existing ecological resources within the vicinity of all of the proposed routes. Potential ecological constraints have been identified from consultations with statutory and non-statutory bodies, and original survey of the area through which the proposed route alignments pass.

An appraisal of the different routes is presented with specific consideration of their potential implications for ecological resources.

A series of recommendations have been made addressing further studies that should be undertaken, measures that are desirable as mitigation in respect of potential adverse effects on ecological resources, and measures that could be beneficially included as part of the completed proposals for the benefit of ecological resources.

10.2 Objectives

The ecological study addressed the following objectives:

- to identify and describe sites that have been designated in respect of their ecological value within the vicinity of the proposed routes;
- to undertake a walkover survey of the route alignments, to identify and map habitat types present, and note any features of potential ecological importance;
- to note any indications of the presence of, or potential activity of species that are protected by law or otherwise of particular conservation concern, within the vicinity of the proposed route options;
- to carry out an appraisal of the three route options, highlighting ecological issues of relevance to each option, and indicating any preference for options on the basis of ecological issues;
- to identify any likely adverse effects on ecological resources of works that may be required as part of the reinstatement of this section of the canal;
- to make recommendations for mitigation measures that might be implemented to alleviate adverse effects on ecological resources where these may be likely to occur;

- to make recommendations for further studies or surveys of ecological resources that may be required within the future programme of reinstatement of this section of canal;
- to make recommendations for ecological enhancement measures that could be beneficially included within the completed works.

10.3 Methodology

10.3.1 Consultations

Consultations have been undertaken with statutory bodies with responsibilities for nature conservation issues during the course of this assessment. The following organisations have been consulted:

- English Nature;
- Environment Agency;
- Berks, Bucks and Oxfordshire Wildlife Trust (BBOWT).

10.3.2 Original Survey

A walkover survey of the area through which the canal routes pass, which involved walking the route of each of the proposed route options, was carried out on 27th and 28th November 2003. The walkover survey was undertaken from west to east during bright, clear weather.

The survey was broadly undertaken to English Nature's Phase 1 Habitat Survey method. Habitat types along and adjacent to the line of each route option were identified and have been mapped (see Figure 23). Where key observations were made of relevance to the ecological assessment, these are described as target notes in Section 10.4.4 below. The location of each target note is indicated on Figure 23.

During the survey, any indications of signs of the presence of, or indications of the potential presence of, species that are rare or protected by law were noted. Particular attention was given to the potential presence of habitats and features suitable for use by badgers, bats, breeding birds, water voles, and reptiles and amphibians.

10.3.3 Limitations

All parts of the canal route were walked where access was possible (apart from the western part of Route 4). The final section of the canal, for a distance of approximately 0.7km, cannot be accessed safely because it lies within operational gravel pits. However, access to the central point of the line of this route could be obtained from a public footpath, enabling views of each of the inaccessible sections and permitting their assessment.

Undertaking this survey during November means that some ecological resources may be missed by the survey due to seasonal factors. Spring woodland ground flora, for example, cannot be assessed at this time. However, surveys in winter when less dense leaf growth is present on vegetation makes observations of the presence of other features, for example, badger setts, to be made more easily. For the purpose of the comparative assessment of each of the three route options, this is not considered to be a major deficiency at this stage. Should an Environmental Statement be later prepared for one of the route options, it is recommended that confirmatory ecological surveys be undertaken during the spring/summer period to address this issue.

10.4 Existing Conditions

10.4.1 Designated Sites

None of the proposed route options pass through any sites that have been designated on the basis of their ecological value. The closest site of nature conservation importance to the canal route is Marcham Salt Spring County Wildlife Site (CWS), which is approximately 1.1km to the north-east of the route at its closest point. This site is separated from the canal route by the River Ock and its tributary drains and would not be affected by the proposed canal restoration works.

No other designated areas of ecological value lie within the immediate vicinity of the route. No designated sites would be affected by the proposals.

10.4.2 Species Records

Consultations with BBOWT concerning protected species records in the vicinity of the proposed route options have indicated numerous sightings of water voles along the tributaries of the River Ock on both sides of the historic canal route alignment, Mill Brook, and the Thames. This species is highly likely to be present and active in the vicinity of water bodies along the length of the canal routes.

It is anticipated that following its construction, the new canal cut would have the potential to contribute to local Biodiversity Action Plan (BAP) objectives for water voles, and that a range of suitable ecological enhancement measures for this species could be installed in association with the canal on any of the possible route alignments.

Data identifying the locations of records of water voles in this area do not indicate any difference in potential impact on this species as a result of selection of any route option over the others.

10.4.3 Effects on Biodiversity

English Nature have indicated that while new canals can confer benefits for biodiversity, achievement of these benefits is influenced by factors such as numbers of boat movements and effects on water quality. In order to enable the potential benefits to ecological resources to be realised, it is therefore recommended that an Ecological Management Strategy for the proposed canal restoration is designed and implemented. Statutory and non-statutory bodies responsible for ecological issues should play a significant role in the guidance of those implementing the strategy.

10.4.4 The Canal Routes

For the major part of its length, the selected route passes through agricultural (arable) land. These areas are of relatively low ecological value, although hedges and watercourses bounding them, and small areas of scrub and woodland also present, provide a network of habitats of local value for a wide range of wildlife species.

Habitats present along the length of the possible canal routes are shown in Figure 23. The photos relevant to the following section are seen in Appendix G.

Target notes (TN1-TN15 - see Figure 23), describing specific features of note, are presented in the following section of this report.

- **TN 1** - Drayton Lock represents the westernmost point of the section of canal considered in this study. Remains of the lock itself are present at this point, partially fenced for safety purposes. The lock itself is a dilapidated brickwork structure within which some open water still exists. To the south-west of the lock the former canal

alignment has been infilled, and forms a linear ditch and double-bank structure along its length (Photo 1). Mature trees, dominated by oaks, stand on each of the banks forming a linear woodland feature likely to be of local ecological importance. Enhancement measures for the benefit of wildlife have been applied to this area Principally these take the form of dead tree trunks and woodpiles wired in place along the central ditch of the feature. These will provide habitats for invertebrates on which birds and other wildlife feed. They may thus also provide a resource for bats that forage along the linear habitat (and which may roost in some of the trees present) and foraging grounds and overwintering hibernaculae for reptiles and amphibians that may be present.

Although this area lies outside the route alignments considered in this appraisal, it is anticipated that a range of further ecological studies would be required at this location in the event of canal restoration, though it is likely that most of the mature trees present would be able to be retained. The lock itself may provide bat roosting sites and its integral water body has potential to be used by amphibians including great crested newts. Further surveys addressing both of these issues are recommended to be undertaken in due course. A fox earth exists at the eastern side of the lock. This is within a hole probably formerly part of the rabbit warren (see below). A hedgerow adjoins the line of the canal route from the east at the lock. In the north-eastern corner of this hedge and the line of the route a small area of woodland dominated by ash trees is present. An extensive rabbit warren is also present at this location.

- **TN2** - Extending to the north-east from Drayton Lock, between open, arable fields, the line of the canal runs to the east of an old hedgerow composed of crack willow, hawthorn, ash and sloe. Several of the willows, particularly those towards the Drayton Lock end of this section, are very old trees that have been regularly coppiced. Their trunks are multiply-fissured and many of them provide potential bat roosting and bird nesting sites as well as being of ecological value in their own right. Immediately adjacent to this hedge, the line of the canal forms an open agricultural drainage ditch for the field, now only around 2m in width. To the west of this open ditch, there is a line of telegraph poles (Photo 2).

  The telegraph poles form a significant potential constraint to the reinstatement of the canal along this route. Removal of the hedgerow would be highly undesirable in ecological terms, owing to the age of the crack willows present. If the canal is to be reinstated here, it would be preferable to remove and/or realign the telegraph poles rather than this hedgerow.

- **TN3** - To the north-east of the crossing of the route line by a paved farm track, a stream (identified as a field drain) runs along a meandering course to the south-east, separated from the route line by an area of scrub and ruderal vegetation that provides a refuge for wildlife and a habitat used by birds and local wildlife. This field drain is one along which records of water vole have been recorded and habitat along its length appeared ideally suitable for use by this species. At the immediate point of the crossing of the farm track, there is a single large mature ash. The route line is similar in this section to that described at TN2, although the hedgerow to the east of the field drain is composed largely of hawthorn and ash and does not contain crack willows of the same value as those previously noted. The line of telegraph poles is no longer on the opposite side of the canal line to the hedge. Again, the route passes through arable fields in this section (Photo 3).

- **TN4** - An area of grassland, dense scrub and crack willow exists in the northern corner of the field to the south-east of the line of the route, between the hedge adjacent to the canal route line and the meandering field drain described in TN3.The

field drain at this point turns north-west, deviating from the alignment of the canal route, and can be crossed at a footbridge at this point. Beyond, to the north-east, a hedge continues along the line of the route but progressively thins, finally following a post-and-rail fence with patchy hawthorn bushes (Photo 4). No open water exists along the line of the route immediately north of this point.

The dense scrub at this point provides a habitat of value for birds and local wildlife and several of the older crack willows present may be potential bat roosting sites. In addition, this area is a potentially suitable habitat for reptiles.

- **TN5** - This is the point where the route adjoins a second paved farm track, and where Route Options 3 and 4 diverge from the line of the historic canal alignment (Photo 5).

  North from this point the route runs parallel with a dense band of scrub and trees to the south-east while passing through arable fields. The concrete track of the farm access road extends along the line of the route from this pint to TN6. A green woodpecker was observed in the field to the north-west at this point.

- **TN6** - At this point the farm track diverges from the historic canal alignment, turning south-east and then immediately east. A hedge composed predominantly of hawthorn and patchy willow runs along the north side of this track enclosing arable fields. An open, water-filled ditch runs along the canal route to the north-east, bounded by a dense band of scrub dominated by willows, hawthorn and sloe (Photo 6). This band of vegetation is isolated from adjacent fields by the open ditch and a second ditch on its south-east side, and the entire area is used as a feeding area for pheasant reared for a local shoot. Feeders have been regularly placed within this zone. Ground vegetation in this area is relatively sparse, likely to be a result of rabbit grazing. An extensive rabbit warren is present along much of the length between here and TN7. The field to the north-west of the canal route is arable and extends to the River Ock, which runs along a meandering course throughout this section. The banks of the River Ock are lined with crack willow and other scrub vegetation, and provide excellent potential habitat for birds and wildlife including water voles.

- **TN7** - A band of dense scrub surrounds the north-east end of the field where the canal route alignment is severed by the A34. Immediately north, the River Ock passes beneath the A34 under a bridge beneath which access is possible (Photo 7).

- **TN8** - On the eastern side of the A34 there is a small field of semi-improved grassland between the River Ock and the line of the canal. The field ditch with open water running along the historic canal alignment continues beyond the A34 as does the band of scrub and willow vegetation to its immediate south.

- **TN9** - Roughly at the point where the River Ock splits to pass around an island on which a residential property is located, and beyond which the historic canal route continues, the proposed route (Route Option 1) turns south roughly along the line of a farm track. Fields around this area are arable. The hedges adjacent to the farm track are relatively sparse from this point to TN10. After a short length of reedbed against the western side of the track, the path rises, adjacent hedges typically composed of patchy hawthorn, sloe and bramble amongst long grass and formative scrub, running along the line of post-and-rail fences. Route Option 1 passes over a low ridge line to descend towards TN10 along the line of a more well-established double-hedge, again formed on the line of post-and-rail fences, dominated by hawthorn, bramble, dog rose and occasional willow. No mature trees are present along this hedge.

- **TN10** - This is a low point in the topography where all route options recombine for the distance along a common route from this point east to the proposed confluence with the Thames. All fields surrounding this location are of arable land of little

ecological value. Hedges bounding these fields are of patchy or closely-cut hawthorn without mature trees that typically follow the lines of post-and-rail fences. These habitats are of low value for ecological resources (Photo 8).

Target Notes TN11-TN13 consider Route Options 2 and 3 where their proposed alignments differ from that of Route Option 1.

- **TN11** - Route Option 2 diverges from the historic canal alignment at a point between TN6 and TN7, passing through arable land and across a single patchy hawthorn hedge to the A34. Construction of a new canal cut southeast from the historic route would give rise to the loss of scrub and willow vegetation at the point of the turn, but this would not be expected to cause significant adverse effects on ecological resources.
- **TN12** - Route Option 3 follows the same alignment to the west of the A34, diverging from the historic route at TN5 and passing through arable fields to a new proposed crossing beneath the A34. This proposed route would be likely to cause the loss of some sections of patchy and closely-cut hawthorn hedge separating arable fields but this could be minimised by detailed design of the precise new canal alignment. There would be significant opportunities to reinstate new hedges in association with any new canal along this section. New hedgerows should be established according to sensitive ecological design principles and, if so, could be expected to rapidly become of greater ecological value than those currently present.
- **TN13** - This target note considers Route Options 2 and 3 between their new crossing-points of the A34 and their conjunction at TN10. All route options in this section pass through arable land of low ecological value. All routes have the potential to cause loss of sections of, and/or severance to, patchy and closely-managed hawthorn hedges between arable fields. Again, construction of new canal cuts on any of these alignments provides potential to reinstate hedgerows along ecological design principles and achieve overall benefits for wildlife over those currently present in these areas.
- **TN14** - After passing eastwards through arable fields, the proposed canal route passes through improved grassland to the south of Stonehill Farm close to the course of an existing drain. If the canal route is constructed so as to retain existing fringing vegetation along the drain and its associated hedges, ecological benefits could be achieved in these otherwise relatively denuded areas. After crossing a road serving the operational gravel pit south of a sewage treatment works, the route skirts south of an area of large, mature oak trees that are potential bat roosting sites. Other isolated trees in these fields and adjacent to the road, in particular a single very old crack willow, provide further potential bat roosts in the wider landscape.
- **TN15** - The route passes through land currently used for gravel extraction to the south of the sewage treatment works, finally continuing through the site of a disused gravel pit to its proposed confluence with the Thames. The operational gravel pit comprises bare ground of negligible ecological value, while the disused pit is an area of open water surrounded by disturbed ground dominated by naturally-colonised scrub and ruderal communities. These habitats have some local value for wildlife but can be readily reinstated following disturbance such as that which would be likely to be caused by construction of the new canal cut.

10.5 Fauna

Potential exists for the following significant issues at locations along the proposed canal routes:

10.5.1 Bats

All species of bat and their roosts are strictly protected in the UK under the Wildlife & Countryside Act 1981 and its amendments. Any construction activities that are likely to disturb roosting bats are therefore subject to strict controls and if bats are present, are generally only permissible under licence from DEFRA, and only then subject to the approval of English Nature. All measures must therefore be taken by the developer to ensure that bats would not be adversely affected by the proposals, and this typically means that surveys of potential bat roosts along the length of the route would need to be undertaken such that their presence/absence can be determined and, if required, an appropriate mitigation plan can be initiated with English Nature. Such a bat survey would need to be carried out prior to obtaining planning permission for any proposed works and would normally form a component of an Environmental Statement for the proposals. Surveys for bats are seasonally dependent and can generally only be undertaken during the period April-August inclusive.

Potential bat roosting sites exist in mature trees along the line of the route and structures. These are most likely to occur at:

- the damaged brick structure of Drayton Lock;
- old crack willow trees within the hedgerow adjacent to the line of the historic canal route north-east of Drayton Lock (TN2);
- occasional other old crack willow trees in hedgerows adjacent to the historic canal route;
- mature trees adjacent to the proposed canal route south of Abingdon (TN14).

It is recommended that further surveys assessing the possible occurrence of bats at these locations are undertaken to inform the detailed design of the proposals and any ecological measures that are included.

10.5.2 Breeding Birds

All bird species in the UK and their nests are fully protected when breeding and therefore clearance of vegetation or demolishing of buildings, canal walls, etc, where birds may be nesting, is subject to strict control during the period March to July inclusive.

Birds will potentially breed in any stands of mature and semi-mature vegetation, including trees, hedgerows, scrub and long grassland along the route.

Potential exists for the occurrence of birds of special conservation interest in the wider area of the proposals. Kingfishers, for example, are likely to occur along the corridor of the River Ock. Measures for the enhancement and promotion of this and other species can be readily incorporated in the detailed design of a new canal and should be included within the design of the completed proposals.

10.5.3 Amphibians

Great crested newts are strictly protected under the Wildlife & Countryside Act 1981 and amendments, as well as the EU Habitats Directive, implemented in the UK under the Habitats Regulations 1998. Impounded sections of canal, and in particular, sections that may periodically dry out, and which are fringed by other habitat types such as grassland, wetland, woodland and scrub, form potential habitats usable by this species. Surveys of such water bodies would normally be required to determine the presence of this species, and if present, determine an appropriate mitigation plan. Works carried out in relation to great crested newts would normally also be undertaken under licence from DEFRA. Such works are highly sensitive to seasonality (even more so than bats – surveys should be carried out from spring to

summer; translocation, should this be necessary, would normally be carried out throughout this entire period). For this reason surveys should be carried out at least a year in advance of any proposed works to ensure that an appropriate window of opportunity for implementing any mitigation programme is available.

It is possible that great crested newts may occur along the length of the route alignments, in particular where appropriate terrestrial habitats exist within close proximity to areas of temporary inundation or non-flowing water, though potential for the occurrence of great crested newts reduces dramatically where fish are also present in such water bodies. Significant areas where it is recommended that further, detailed surveys for this species are undertaken, exist at:

- Drayton Lock;
- Water bodies associated with the historic canal alignment (e.g. at TN2, TN3, TN5).

10.5.4 Reptiles

Some patches of habitat suitable for reptiles are present along the length of the route although these are largely isolated from each other by agricultural land. The most significant area suitable for reptiles are:

- the alignment of the canal to the south-west of Drayton Lock, outside the study area;
- the zone of grassland isolated between the historic canal route and the relatively natural, meandering course of the field drain (TN4).

Surveys are only considered necessary at these locations where proposed works might encroach into these habitats.

10.5.5 Water Voles

Records of the occurrence of water voles in this area indicate that populations are likely to be present over the wider area of the River Ock catchment. Suitable habitats for water voles exist in association with the River Ock and field drains throughout the area through which all canal route options pass.

While construction of the new cut has some potential to cause temporary disturbance of water voles, this is considered unlikely to cause significant effects as the watercourses with which they are most associated would not be directly affected. Potential does exist, however, for the inclusion of significant new measures for the promotion of water voles in connection with the proposals, and given the propensity for occurrence of this species in this area, such enhancement is considered an essential inclusion in the detailed design of the completed scheme.

Once the final route design is known, further surveys of watercourses and their adjacent habitat potentially affected by the works may be necessary to ensure that potential disturbance effects on water voles are minimised.

10.5.6 Otters

Although no historic records of otters in this area were found, and no signs of the occurrence of this species were noted at the time of the survey, this species is known to be expanding its range throughout mainland Britain. Measures to facilitate the natural spread of otters should therefore be included within the completed proposals.

10.5.7 Badgers

No evidence of the occurrence of badgers in the area surveyed, nor signs of their setts, were found. It is therefore concluded that badgers are not a significant ecological issue in the context of this proposal.

10.6 Invasive Plant Species

No evidence of the presence of stands of invasive plants, most particularly, Japanese knotweed, was found in the survey area. The risk of spreading any such species already present in the study area is therefore considered minimal.

10.7 Appraisal of Route Options

All of the possible canal routes pass through areas of agricultural land of low inherent ecological value for most of their lengths, varying principally in their relative points of departure from the historic canal alignment.

With regard to ecological issues, none of the proposed route options differs significantly enough from any other to warrant its being selected as a preferred option.

All of the routes have the potential to sever hedgerows separating agricultural fields, though none of the hedgerows in the area are of high ecological value. The ecological value of those hedgerows removed and/or severed by any of the route options could be fully replaced, and enhanced, by appropriate ecological design measures included as a component of the selected option.

Overall, given appropriate design and management, reinstatement of this section of the canal is an opportunity to improve the ecological resources within this area, and should be seen as an overall potential ecological benefit.

10.8 Recommendations

Consideration should be given to the following specific ecological issues in the further design process for the reinstated canal.

10.8.1 Severance

Although none of the hedgerows within the agricultural landscape away from the historic canal alignment are of more than low ecological value, a new canal would sever these features. Even hedgerows of low value can serve as routes for the movement of wildlife in an otherwise barren environment. Measures should therefore be taken to minimise the degree of severance that takes place and to replace sections of hedgerows that are removed as a result of construction of the proposals.

If this approach is combined with a policy of enhancement such that severed hedgerows are re-connected by new planting of appropriate hedgerow species, overall benefits can be expected to be achieved.

10.8.2 Enhancement of Rare and Protected Species

Reinstatement of the canal affords a wide range of opportunities to promote and enhance ecological resources such as rare and protected species within the area concerned. Specific measures should therefore be introduced to promote the following issues:

- Bats;
- Birds;

- Water voles;
- Otters;
- Amphibians, including great crested newts;
- Reptiles.

A wide range of enhancement measures exist for all of the above groups, which could be included within the detailed design of the selected canal route during the further design of the proposals, and implemented in accordance with an ecological strategy for the completed scheme.

10.8.3 Further Surveys

Several key issues have already been identified as warranting further survey to confirm whether or not they are a significant issue, inform the detailed design of the proposals, and assess any need to obtain licences in relation to proposed activities in due course.

Specific issues where further surveys are recommended are provided in 10.4.4 above.

11. CONSULTATION

The second phase of the feasibility study was to consult with the key Statutory and non-statutory bodies relevant to the canal study.

The objective of the consultation was to understand the constraints and opportunities affecting each route, in order that an informed selection could be made of the preferred route, before going to public consultation.

The Wilts & Berks Canal Trust has consulted with landowners along the alternative routes, but these consultations are not included in this report. In addition, consultation provided an opportunity to engage with future key stakeholders in the project.

11.1 Vale of White Horse Council

Comments from the Vale of White Horse Principal Engineer (see Appendix I1) :

1. *The route cuts through a considerable number of small watercourses that are vital for the land drainage of a flat area like the one in question. Plainly these watercourses will need to be able to 'continue' after the canal is in place*
2. *In crossing the watercourses and ditches, the canal should only be allowed to capture excess water from ditches and watercourses. It should not generally re-route water from watercourses into the canal. This is particularly relevant near the Sewage treatment Works.*
3. *The canal should not be allowed to have a dam-like effect on the natural flow of the groundwater through topsoil and sub-soil in the area. Again, in such a flat area as the vale this could have a disastrous effect on flooding and the quality of the surrounding fields.*
4. *I have assumed that all of these concerns will be addressed at detailed designed stage and that they need only be mentioned here as potential Conditions to any consent given.*

Item one and two have been dealt with in section 3.2.2 and 3.7.1. Item 3 has been considered in terms of groundwater flow and the topography of the area, to the selected canal alignment.

11.2 Environment Agency

Consultation with the Environment Agency concentrated on floodplain development issues and ecological issues (see Appendix I2). It is intended that the Environment Agency will provide further detailed comment as the canal development progresses through the detailed design and planning application stages. The Environment Agency has recently undertaken hydrological modelling of the relevant watercourses, and this was available 1 in 100, 1 in 50 and 1in 20 year flood levels, modelled at suitable node points. (see Figure 12).

Environment Agency consultation has also shown preference for route options that minimise impact on the River Ock and Thames floodplain. During initial consultation on Routes 1, 2 and 3 little preference was seen between the routes, although it was noted that Route 1 lay immediately adjacent to the floodplain in the western section of site. All routes are in a similar location in the eastern site of the River Thames floodplain.

It was noted that the proposed lines of canal restoration did not appear to have any 'showstopper' issues associated with them, although it did follow the line of a watercourse for a proportion of route. This is something the Environment Agency will discourage, and it was suggested that this be avoided wherever possible.

Route 4 was optimised to stay out of the 1 in 100 year floodplain of the River Ock, and the 1 in 5 year floodplain on the River Thames, although it still passes through small sections of these floodplains.

The Environment Agency accepted the current feasibility scope of study, including assessment of existing ecology and possible ecological impacts of restoration, along with identification of suitable mitigation measures.

It was accepted that the canal could potentially provide positive enhancement of local ecology, providing that the advantages available were weighed up and balanced against wider concerns regarding catchment-wide ecological effects. Key examples of these concerns were the source of water for the canal, and its impact on the hydrology of existing watercourses and wetlands resources, and also on the water quality of the River Thames at the point of discharge.

Of particular concern was the impact of Route 1 on the possible impact of the canal on the ecology of the River Ock, both directly and indirectly by local changes in the hydrology of the river. It was anticipated that planning or detailed design stages should address both these concerns in terms of ecology. It was stated that in the event of water transfer from another catchment (or from temporary storage in a reservoir facility) should be considered to disallow transfer of non-indigenous species to the River Ock. This would also be of similar concern at the junction with the River Thames.

It has been advised that a Flood Risk Assessment (FRA) must be provided with planning application to demonstrate that the proposed canal reinstatement does not increase flood risk to people or property on the site and adjoining areas. PPG25 "Development and Flood Risk" paragraph 30 states that no inappropriate development should take place within the floodplain and that an applicant for planning permission should first submit a FRA.

The Agency has stated that it will resist all development or works within the floodplain that result in a loss of flood storage capacity, or works that impede flood flow routes. It was also advised that any losses identified as part of the intended works be fully compensated for on a level for level, volume for volume basis (generally in 100mm increments). It was also advised that under the terms of the Water Resources Act 1991 and the Land Drainage Byelaws 1981, prior written consent from the Agency was required for any proposed works or structures in, under, over or within 8 metres of the brink of the River Ock, Sandford brook or River Thames.

It was agreed that the option for allowing the canal to flood during flood events was preferable to using an embankment to above the 1 in 100 year flood level.

It is of importance that none of the proposals for the canal result in adverse change of flows or levels in any rivers, streams, ditches, springs, lakes or ponds in the vicinity. It was noted that culverting, diverting or any other works effecting the flow of a watercourse requires prior written approval of the Local Authority under the terms of the Public Health Act 1936, and also prior written consent of the Agency under the terms of the Land Drainage Act 1991/ Water Resources Act 1991.

The Environment Agency were concerned that there is potential for the canal route to cut through contaminated land areas, which becomes especially important around the vicinity of the landfill site south of the gravel pit works, and also north of the Thames Water Sewage Treatment Plant. This would affect water quality at the junction with the River Thames. It should be addressed during further studies that the canal does not act as a pathway for the movement of contaminated groundwater. Implications for the canal during detailed design or planning stages would be to carry out desk studies and site investigations to ascertain areas of contaminated fill to avoid running the canal through contaminated sites, alternatively, if this was to be the case, to then mitigate pollution of ground and surface waters. Of particular

interest were potential impacts of both the general quality of the water used to supply the canal and the increase of boat movements on suspended solids levels.

11.3 Highways Agency

Highways Agency consultation has shown a preference for Route 3, because this is the only route that enables the diversion method to be used as a means to construction. It has also been stated that diversion is preferable to closure, and that there are no lane rental charges at present. The Agency will own the structure beneath the trunk road, and will require a commuted sum paid to the Agency for maintenance over a 120-year structural life period.

Consultation with the Highways Agency did not include Route 4. However, it is assumed that comments pertaining to Route 3 are the same as for Route 4 because the A34 road crossing location is identical (see Appendix I3).

11.4 County Archaeologist

Oxfordshire County Archaeological Service maintains a register of all known archaeological sites in the county, known as the Sites and Monuments Record (SMR). It is also responsible for comprehensive development control and strategic planning advice on archaeology and the historic environment within the planning process.

Consultations with the Deputy County Archaeological Officer have revealed that the study area contains many archaeological features, especially from the prehistoric and Romano British periods (see Appendix I4). Oxfordshire County Council have reviewed the four possible canal routes. The only areas of archaeological potential that might be directly affected by construction works of the canal are comprised of areas where flint implements have been found. This is surprising given the number of known archaeological features in the area through which the routes pass.

Route 1 passes through an area where flint implements have been found, which were dated to Neolithic and Bronze Age periods (NGR centred SU 481955). Route 2 passes through an area where flint implements have been found, which were dated to Neolithic and Bronze Age periods (NGR centred SU 47039547). Routes 2 and 3 pass either side of an area where flint implements have been found, which were dated to Neolithic and Bronze Age periods. Route 4 (NGR centred SU 464942) passes directly over this area of considerable archaeological potential.

However, the artefact flint scatters through which the routes pass are of limited potential so as to preclude the principle of canal reinstatement. Also, as it is also not a commercial development or non-profit project - and a Local Plan issue - Oxfordshire County Council were willing to forego the requirement for predevelopment archaeological investigation for Routes 1, 2 and 3. This is not the case for Route 4. However, they have specified that for all Routes archaeological monitoring is present during construction works to ensure revealed features are recorded.

For the selected Route 4, it is understood that as there are reasonable grounds for believing that important archaeological remains may be disturbed or otherwise affected by the canal development proposals, the Council - before determining the planning application - will require the Wilts and Berks Canal Trust to carry out archaeological field evaluation of the site and its setting to enable the Council to make an informed decision. This evaluation would be expected to indicate the nature, importance and condition of any archaeological monuments or remains, the likely impact of the proposed development on the remains and the mitigation methods for effects of the development on the archaeological remains. This is likely to be a high cost exercise to fully cover the scope that the County Archaeologist may require.

11.5 Thames Water

Thames Water own and operate a Sewage Treatment Plant works immediately south of Abingdon, and west of the River Thames. Any canal restoration near or adjacent to the plant would be required to implement mitigation measures on behalf of Thames Water, because the existing site would take precedence over new development in terms of planning requirements.

Thames Water have stated that because all canal routes lay on the same plan location immediately around and south of the Sewage Treatment Plant, there is no preference for a particular canal route (see Appendix I5).

Thames Water have stated that they would object to the canal in its proposed position (as detailed in the Draft Vale of White Horse Local Plan first deposit) because it lies on the boundary of their site, and that the objections will be as previously made during consultation for the draft Vale of White Horse Local Plan. It is understood that the legal land boundary owned by Thames Water runs beyond existing security fences, but does not extend further than north bank of Oday Hill Ditch.

There are two outfalls from the Sewage Treatment Plant, one into the River Thames and one into the Oday Hill Ditch. The outfall south of the Plant is required for operational reasons.

Thames Water are worried that rubbish, odour and other issues in the vicinity of the proposed canal route may be of concern to the public, which may encourage complaints. Thames Water can to be penalised for rubbish around their sewage works, hence their concern about more canal users in the area.

Thames Water have stated that although there is no preference for a particular canal option, mitigation measures should be taken during the detailed design and construction stage of the canal, they intend to retain their holding objection regarding proximity to the Sewage Plant site boundary

Mitigation measures for the outfall include:

- Piping the outfall flow to an existing agricultural drainage network outfall with River Thames (although the Environment Agency would require flow monitoring under the Water Bill, and also new consent for moving the discharge point) or,
- Constructing an invert siphon system to be used under canal route.

The following mitigation measures have been suggested during detailed design stages to minimise rubbish and odour problems for Thames Water:

- Planting and screening to the hide the security fencing and Oday Hill Ditch from the canal which is preferable because of the 'non-glare' impact, but would be ineffective if odour problems were to occur (Thames Water to confirm if this is the case at Abingdon). It has been assumed that British Waterways would be responsible for maintenance of the planting and screening.
- The above measure would also mean that increased rubbish and litter would not congregate in the ditch

Mitigation measures as discussed above should be taken during the detailed design and construction stage of the canal, to a sufficient level to compensate for the objections held by Thames Water.

Thames Water indicated that their holding objection to the outfall should be relatively easy to overcome following consultation on the developed proposals for the canal.

11.6 Utilities Companies

Information about utilities in the area has obtained from:

- Thames Water
- Transco
- Oxfordshire County Council
- British Pipeline Agency
- Linesearch (incorporating Esso Petroleum, Government Pipelines, Manchester Jetline and Mainline Pipeline)

See Appendix I6.

11.7 Sustrans

Initial consultation with Sustrans has provided us with vertical clearances required above the towpath level for cyclists. Sustrans advise that an ideal vertical clearance for cyclists would be 2.3 metres for new structures[6]. However there do exist bridge structures that only provide 2.0 metres or less vertical clearance. This nominal 2.0 metres clearance is what the canal sections have used in section 4 below to dictate vertical alignments of the route options.

The existing towpath width (set at 2.0 metres) would be suitable for the canal users and cyclists to use under the A34 crossing. It should be noted that the crossing structure would be more cost sensitive to vertical alignment (e.g. the depth to which it reaches), whereas the width of the crossing is less of a cost restriction. There would therefore be little advantage in reducing the width of any underpass. There would, however, be a significant disadvantage of increasing the vertical clearance to allow for a modern maintenance dredger boat. It should also be considered that this is not standard practice throughout the Wilts and Berks Canal, and therefore would have little advantage to the whole canal route[7].

[6] Source: Sustrans Guide

[7] If the regulating lock to the Thames is to be set above the 1 in 100 year flood level e.g. far back from the River Thames, there will be large amount of silt building up until the first regulating lock (and indeed maybe inside the lock), therefore an increased draught requirement for dredging and maintenance vessels up to this lock may be a good solution to the silting problem.

12. CONCLUSIONS

12.1 Preferred Route

Route 4 is the preferred route to take forward for further scheme and later detailed design stages. The primary reasons for this are that the vertical alignment is better than for Routes 1 and 2, and 3. The number of locks is minimised and it is feasible to gravitate water from Drayton Lock to the Thames and the A34 crossing is the least constrained. This option also avoids the floodplain more than other options and therefore there is less risk of objection from the Environment Agency or extensive floodplain compensation measures being required..

12.2 A34 Crossing Method

The A34 crossing location has been selected to be near the high point in this section of the A34. There are three feasible options for crossing under the A34 trunk road at this point;

- road diversion over the construction period with structure built using conventional construction techniques,
- build bridge adjacent to crossing and slide in during temporary closure/possession of road and
- jacked structure where the road is able to be kept 'live' whilst structure is pushed under the motorway.

All three methods for crossing the A34 should be taken forward at this stage for further consultation with the Highways Agency and local and county transport planners. However, the diversion method is feasible with the crossing location and holds considerably less risk than other options. The Highways Agency has also stated a preference for this method.

12.3 Landscape Issues

There are very similar landscape opportunities and constraints for the four Routes 1, 2, 3 and 4. There appears to be opportunities for minimal visual impact differences in the horizontal routes, whereas the major landscape impacts come with the methodology for vertical alignment (e.g. 'up-and-over' being of minimal landscape disruption and the 'straight through' option being the most severe visual interruption to the landscape).

It is understood that there are varied opportunities for landscape enhancement for development of the canal and its surrounding land in the future.

12.4 Water Supply

It is understood that water resources for the canal do not pose a significant constraint on route selection for the canal in the Abingdon area.

12.5 Ecological Issues

Introduction of new canal and renovation of existing degraded canal represents a major opportunity for the enhancement of ecological resources in the Abingdon area and it is anticipated that with implementation of an appropriate ecological management plan, overall ecological benefits will result.

12.6 Geotechnical Issues

It is understood that ground conditions around Abingdon are generally favourable for canal construction and that the geology at all proposed A34 crossing locations are suitable for all methods of A34 crossing. However, the variable groundwater levels and possible groundwater contamination in the Thames floodplain will need to be addressed in the design of the canal.