ANNEX A1.2

Transfer Route Selection

This document has been written in line with the requirements of the RAPID gate two guidance and to comply with the regulatory process pursuant to Severn Trent Water's and Affinity Water's statutory duties. The information presented relates to material or data which is still in the course of completion. Should the solution presented in this document be taken forward, Severn Trent Water and Affinity Water will be subject to the statutory duties pursuant to the necessary consenting process, including environmental assessment and consultation as required. This document should be read with those duties in mind.

Grand Union Canal Transfer SRO

Affinity Water, Severn Trent Water, Canal & River Trust

Affinity Water Limited

GRAND UNION CANAL

Annex A1.2 Gate 2 Position Paper - Route Selection

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Annex A1.2 Gate 2 Position Paper - Route Selection

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CONTENTS

TABLES

FIGURES

APPENDICES

COST

APPENDIX E

PROGRAMME

APPENDIX F

DETAILED ROUTE DESCRIPTIONS

APPENDIX F.1

ROUTE 1

APPENDIX F.2

ROUTE 3

APPENDIX F.3

ROUTE 6

APPENDIX G

POTENTIAL ADDITIONAL BENEFITS

EXECUTIVE SUMMARY

The supply deficit in Affinity Water Limited (AWL) Central Region will arise from a combination of abstraction licence reductions agreed to help preserve the regional water environment and additional demand from forecast increased population. The deficits are forecast to be most significant in the northern part of the Central Region, to the north and northwest of London.

The Grand Union Canal (GUC) Strategic Resource Option (SRO) is proposed to take benefit from a potential discharge of treated effluent from Severn Trent Water's (STWL) Minworth Wastewater Treatment Works (WwTW) into the GUC, and to transfer the additional resource using Canal & River Trust (The Trust) assets.

Three sub-routes were taken forward at Gate 1 for further consideration at Gate 2:

- Route 1: Birmingham-Fazeley Canal to Coventry Canal,
- Route 3: Pipeline route to Atherstone and then Coventry Canal, and
- Route 6: Pipeline route to Leamington Spa Trough on the GUC

This position paper summarises the process of further investigation of the three candidate routes (Routes 1, 3 and 6) to determine the preferred option for detailed assessment.

Based on the assessment undertaken at Gate 2, the preferred SRO sub-route is Route 3.

This incorporates a pumping station and pipeline from Minworth to the GUC near Atherstone, where the canal continues southwards to the abstraction point outside of London. This route provides the advantages that the required pumping stations are located at points of existing development with relatively simple access, existing local power supplies and utilities. They have sufficient space, without significant risk of development blight, and have relatively easy bypass pipeline routes. There also appear to be good opportunities to improve environmental and biodiversity status local to the pumping stations. The treated Minworth wastewater would discharge into the Coventry Canal near Atherstone, which links to the GUC via the Oxford Canal.

1 INTRODUCTION

1.1 BACKGROUND

This position paper relates to the Grand Union Canal (GUC) Strategic Resource Option (SRO) which is one of the potential options that may be used alone, or in combination with other SROs, to resolve the forecast supply deficit facing Affinity Water (AWL) over the medium to long term. The SRO involves conveying water from Minworth Wastewater Treatment Works (WwTW) at Birmingham to the AWL supply area, utilising the GUC.

An initial study by others ("Grand Union Canal strategic transfer - Initial assessment of alternative scheme concepts report, March 2020, Ref 1") proposed a series of sub-route options for such transfer using canal only routes, a combination of pipeline and canal routes and a combination of river and canal routes. During Gate 1, six options were considered between Birmingham to the GUC and shortlisted to three candidate routes. All routes are identical south of Braunston Junction.

Figure 1-1 shows the outcome of the Gate 1 assessment that identified three candidate options for further assessment during the Gate 2.

- Route 1 (Birmingham-Fazeley Canal to Coventry Canal);
- Route 3 (Pipeline route to Atherstone and then Coventry Canal); and
- Route 6 (Pipeline route to Leamington Spa Trough on the GUC).

These routes are described in further detail in Sections 1.2.1.1 to 1.2.1.3 below.

The purpose of this position paper is to summarise the route selection process undertaken during Gate 2. The selection process undertaken to assess the abstraction and potable water transfer options is considered in a separate document (Annex A1.1 G2 Abstraction Site Selection Paper).

The position paper has the following structure:

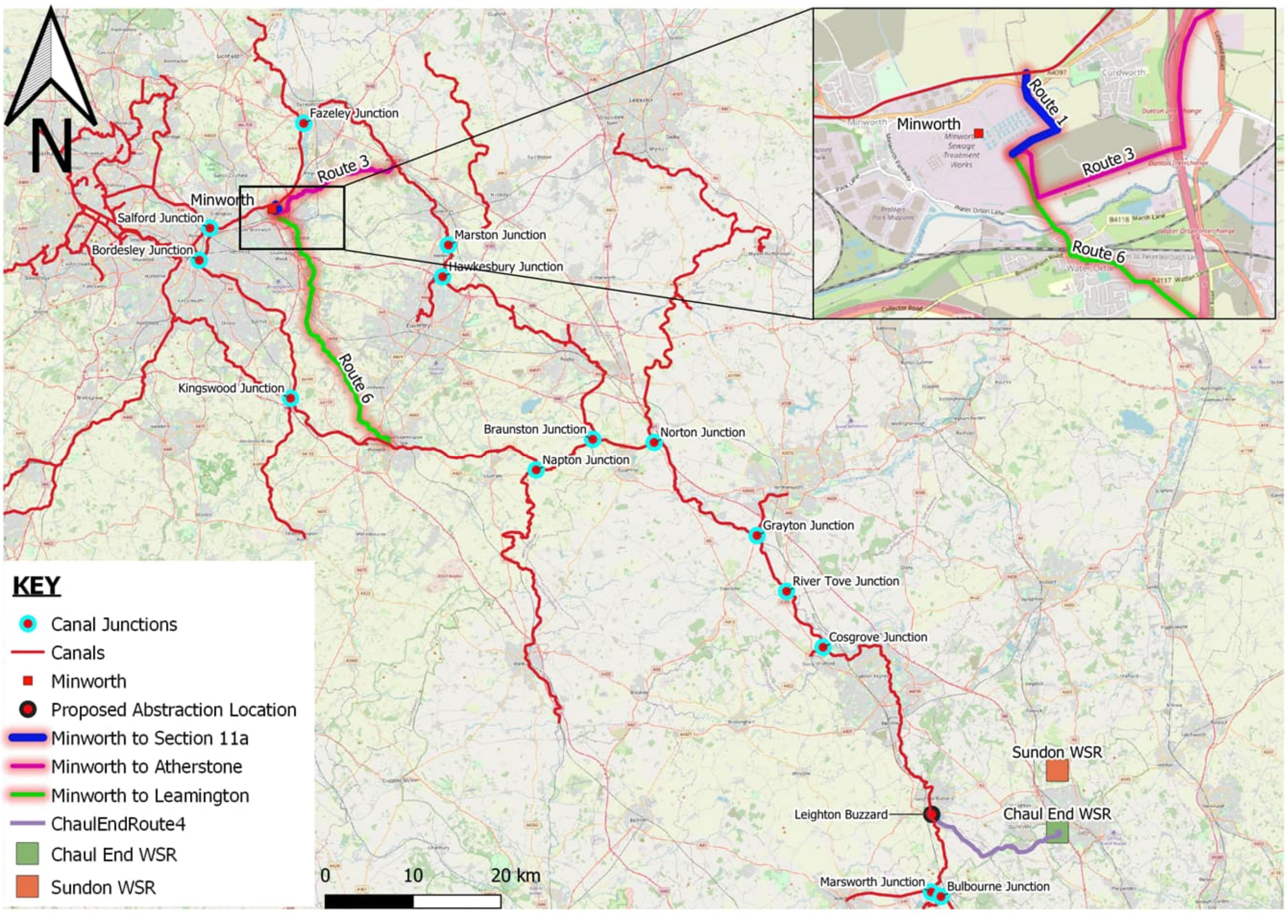
- Section 2: Route option comparison selection
- Section 3: Route option comparison
- Section 4: Summary

1.2 ROUTE DESCRIPTIONS

For this position paper, the SRO route has been divided into two distinct sections:

- A pipeline from Minworth WwTW to a suitable canal discharge point and then canal transfer to Braunston Junction.
- A canal transfer from Braunston Junction to Leighton Buzzard abstraction site.

Figure 1-1 - Minworth to Leighton Buzzard Plan (Sub-options 1, 3 and 6)



1.2.1 MINWORTH WWTW TO BRAUNSTON JUNCTION

1.2.1.1 Route 1: Birmingham-Fazeley Canal to Coventry Canal

Route 1 pipeline commences with a short section of rising main c1km long from Minworth northwards into the Birmingham and Fazeley Canal. The canal then flows by gravity eastwards to Fazeley Junction where it joins the Coventry Canal, passing over the River Tame via the historic (circa 1785) aqueduct. After passing over the Tame Aqueduct a series of four lock bypass pumping stations is then required to lift the flow approximately 30m from the Tame Aqueduct level to the top of the Atherstone Lock Flight. At this point Route 1 then follows the same route as Route 3. See Appendix A.2 for examples of typical pumping station and gravity by-pass layouts.

1.2.1.2 Route 3: Pipeline route to Atherstone and then Coventry Canal

Route 3 pipeline is a c15.3km transfer rising main eastwards from Minworth to the Coventry Canal at the top of Atherstone lock flight. Once outside the Minworth site, and past the M42 and HS2 corridors, the rising main passes through agricultural land until reaching the outskirts of Atherstone, a small market town within North Warwickshire. The rising main discharges into the canal from Coleshill Road via an existing access to the canal side and a new discharge structure sized to avoid deleterious velocities and shear flows.

Grid references redacted

Transferred water then progresses along the Coventry Canal, by gravity, into the Oxford Canal at Hawkesbury Junction. Flows will need to bypass the lock via a low lift pumping station.

The Oxford Canal will then convey the water to the GUC at Braunston Junction. Most of the flow along the Oxford Canal will be by gravity however a pumping station will be required to bypass the locks at Hillmorton.

1.2.1.3 Route 6: Pipeline route to Leamington Spa Trough on the GUC

Route 6 has the longest transfer pipeline from Minworth c33.6km southwards to Royal Leamington Spa. The first 14.7km of this transfer route follows a relatively congested corridor around Birmingham International Airport approximately in line with the M42 and HS2 corridors. The pipeline will require multiple major crossings and construction in major highways. After crossing the existing mainline railway at Hampton-in-Arden the route is semi-rural until crossing the A46 at Warwick. The remaining 2.7km is in highways around Warwick, crossing the canal at the A445 bridge and discharging to the canal via the entrance to the Warwick 11kV substation.

There is a relatively short section of canal that transfers flows by gravity to the first in a series of 11 lock bypass pumping stations that lift the flows approximately 50m to join the Oxford Canal at Napton Junction. From here the canal flows by gravity to Braunston Junction to join the common section the same as Route 1 and Route 3.

1.2.2 BRAUNSTON JUNCTION TOWARDS LONDON ON THE GUC

All routes are identical south of Braunston Junction.

At Braunston a bypass pumping station is required to lift flows from near Braunston Marina to the top lock just before Braunston Tunnel. From Braunston to the abstraction and treatment site at Leighton Buzzard four additional lock bypass pumping stations are required south of Milton Keynes at Fenny Stratford, Stoke Hammond, Three Locks and Leighton.

The GUC section also requires eight gravity bypasses around “downflow” locks at the Wilton Marine Lock Flight, Stoke Bruerne Lock Flight and Cosgrove Lock.

Flow will be abstracted from the GUC just south of the A4146 bridge (abstraction coordinates X49[redacted]:Y22[redacted]) adjacent to the River Ouzel. The proposed site for the treatment works is on relatively flat land slightly raised from the river and canal and adjacent to an operational sand quarry (Grovebury Road). Flow will therefore need to pass beneath the River Ouzel and be pumped into an operational raw water storage reservoir (5 days operational storage) before gravitating into the first stage of treatment. Additional interstage pumping in the treatment works will be required with final high lift pumps transferring potable treated water to a new clean water holding tank at the existing Chaul End Water Supply Reservoir (WSR).

It is possible, according to recent discussions with AWL, that a new tank will not be required at Chaul End as the GUC transfer water will be needed to replace water not available from other, sources. This will be confirmed by future work that will be undertaken at subsequent gates.

2 ROUTE OPTION COMPARISON SELECTION

As the routes south of Braunston Junction are identical, the selection approach has concentrated on the differences between the three alternative routes between Minworth and Braunston Junction.

The comparative assessment has been qualitative and has considered a breadth of factors that have been found to allow differentiation between the alternative routes, either during construction and/or operation. These factors are summarised below.

- **Engineering and design** – All three route options are feasible. Similarly, all three routes would equally be capable of adapting to meet future needs, such as supporting the digitisation of the network at a catchment level. Therefore, factors that might differentiate between them include those relating to the potential to minimise materials (measured by construction volumes), hydraulic efficiency of the routes (measured by a comparison of pumping heads and energy usage), construction risks and constructability issues, as well as the relative resilience of the routes to climate change and the ability to accommodate mitigation measures.
- **Environmental impact** – Factors that have been used to differentiate between the alternative routes, include: the relative potential risk to sites with environmental and/or heritage designations; the relative embedded and operational carbon for each alternative route; and flood risk.
- **Social impact** – Social factors that might differentiate between the alternative routes include the impact and disruption to local communities, as well as impacts on users of the canal network and non-motorised users such as walkers, cyclists, and equestrians.
- **Cost –** A comparison between the relative estimated costs for the alternative routes has been used to differentiate between the routes. A full cost benefit analysis will be undertaken at Gate 3 if considered necessary.
- **Programme** – A comparison between how each of the alternative routes might impact on the programme, considering their relative ease of construction, has been undertaken.
- **Value** – An initial review of opportunities to provide potential wider environmental and social benefits, that might differentiate between the routes; considering how opportunities could align with national and regional policies and strategies.

Further detail with respect to the route comparison and any assumptions made, can be found in the following sections of this route selection paper:

Section 3.1 Engineering and design

Section 3.2 Environmental impact

Section 3.3 Social impact

Section 3.4 Cost

Section 3.5 Programme

Section 3.6 Value – wider benefits

3 ROUTE COMPARISON

3.1 ENGINEERING AND DESIGN

All three alternative routes were subject to the same engineering and design assumptions. A copy of these can be found in Appendix A.1. Two contrasting volume delivery scenarios have also been considered/modelled, the associated material costs across the three routes under review have been summarised in Table 3-1 below.

POTENTIAL TO MINIMISE MATERIALS

Preliminary material quantities have been estimated for the following typical features, for the three alternative routes:

- Pipelines
- Pumping stations
- Bypass structures
- Canal and towpath works.

Copies of typical drawings can be found in Appendix A.2.

Table 3-1 – Summary of Preliminary Material Estimates for 57.5Ml/d scenario

Feature	Route 1	Route 3	Route 6
Minworth Transfer Pipeline (m)	1,042	15,369	33,617
Pipelines* (m)	5,818	4,051	6,001
Pumping stations (No)	11	7	16
Bypass structures (No)	15	8	8
Bridge construction (No)	13	0	0
Tunnel bypass (No)	1	0	0
New weirs (No)	52	30	48
Weir modifications (No)	47	41	36
Towpath works (m)	4,324	0	0

*for pumping station suction, delivery, and gravity bypass

NB for the 57.5Ml/d transfer bank raising works are not required for preferred route

Table 3-2 – Summary of Preliminary Material Estimates for 115Ml/d scenario

Feature	Route 1	Route 3	Route 6
Minworth Transfer Pipeline (m)	1,042	15,369	33,617
Pipelines* (m)	5,818	4,051	6,001
Pumping stations (No)	11	7	16
Bypass structures (No)	15	8	8
Bridge construction (No)	13	3	0
Tunnel bypass (No)	1	0	0
New weirs (No)	52	30	48
Weir modifications (No)	47	41	36
Towpath works (m)	135,185	101,687	42,984

*for pumping station suction, delivery, and gravity bypass

A detailed summary of each route is given in Appendix F.

Route 6 requires the most materials in all flow transfer scenarios.

Route 1 requires significantly less pipework than Route 3 (i.e. because of the shorter transfer route from Minworth to the canal) but requires significantly more material for canal sections and especially in the peak 115Ml/d scenario where significantly more canal bank raising is required.

During the lifetime of the transfer operation, it is unlikely that significant sections of pipeline will require replacing. Mechanical, electrical and instrumentation equipment (e.g. valves, pumps, and sensors) associated with pipelines will however need regular maintenance and periodic replacement). Canal banks and associated structures (e.g., weirs) will require progressive replacement as sections deteriorate due to weathering, vegetation and animal action and exposure to canal use (e.g., wave erosion, corrosion etc.).

Therefore Route 3 has the greatest potential to reduce material use over the life of the transfer scheme.

ROUTE HYDRAULIC COMPARISON

In simple terms the routes can be described as follows:

- Route 1 – shortest pipeline route but longest canal option, greatest total number of assets to build/amend
- Route 3 – intermediate pipeline and canal option, fewest new assets to build/amend
- Route 6 – longest pipeline but shortest canal option, greatest pumping required

Hydraulically, downstream of Braunston Junction, each option is the same.

Route 1 joins Route 3 at Atherstone Top Lock, therefore everything described for Route 3 below also applies to Route 1.

The comparison of hydraulic performance is based on a simple static model using GIS data and standard Manning's calculations using the Trust's guide to hydraulic design[1]. A more detailed model is being developed by JBA (using Aquator and Flood Modeller) for use in the design of the preferred option. This modelling exercise is yet to be concluded (expected late summer 2022) but weekly interaction between WSP and JBA has confirmed that assumptions being made at this stage using the static model are consistent with the more detailed analysis. The hydraulic model is to determine the canal works needed and for the purposes of this stage of design the static model is sufficient. Water elevation results from the JBA model can be fed directly into the project model of the canal (linking asset information and location with level data and cost/carbon assessment) to rapidly amend any results if required.

In assessing hydraulic constraints on the performance of route the following have been agreed:

- From experience[2], flow velocities through structures below 0.3m/s can be accommodated by most boats using the canal network. Above this, remedial work (e.g. widening or bypass) would be required to reduce velocities
- For fish spawning areas, velocities should be limited to below 0.05m/s
- Water level changes less than 50mm can be accommodated within the existing canal freeboard. Water level increases above this will require bank raising

Based on the simple static model the following comparisons can be made:

- At flows of 57.5Ml/d or less, only Route 1 requires canal bank raising.
- At all flow rates Route 6 requires the most energy for pumping
- At flows of 57.5Ml/d or less, Route 3 requires the least energy for pumping but at higher flows the increased velocity in the transfer pipeline, and hence losses, means Route 1 requires the least energy for pumping. The difference in both cases is not however significant (6% at 57.5Ml/d and 4% at 115Mld)
- At flows of 86.3Ml/d or less, only Route 1 has sections of the canal that exceed 0.3m/s
- At all transfer flow rates above baseline (e.g. normal canal flow), all routes have sections of canal that exceed the velocity limit for fish spawning. However, from velocity profile surveys undertaken by JBA, even at the higher flow rates there are sections of the canal (e.g. at bed level and marginal area) where velocities are below 0.05m/s.
- To accommodate peak transfer flows of 115Ml/d Route 1 would require bank raising of up to 250mm in places
- To accommodate peak transfer flows of 115Ml/d Route 3 would require bank raising of up to 200mm in places
- To accommodate peak transfer flows of 115Ml/d Route 6 would require bank raising of up to 125mm in places
- At the peak flow of 115Mld, it may not be possible to mitigate high velocities and freeboard issues at two structures on Route 1 (i.e., Curdworth Tunnel and Tame Aqueduct – see Appendix F).

[1] BW Approved Standard: Hydraulic Design of Canal Works. Richard Dun, 3rd February 2012
[2] The Hydraulic Response of Canals to Water Transfers, BW, Version 2.0, March 2005

Overall Route 3 has the fewest hydraulic issues.

CONSTRUCTION RISKS

The relative construction risks and constructability issues have been reviewed for the three alternative routes. These risks were identified in a series of working groups and in consultation with the Canal & River Trust during a presentation held on the 2nd of February 2022. They were then agreed with AWL in a meeting held on 27th April 2022.

A copy of the construction risk review summary sheet can be found in Appendix A.3. It provides a description of the risk item and the potential risk mitigation, for the transfer pipelines and canal routes. A summary of the number of risk items for each route is provided below in Table 3-3.

Table 3-3 – Summary of Construction Risks

<table>
<tr><th colspan="2">Number of Risk Items</th><th>Route 1</th><th>Route 3</th><th>Route 6</th></tr>
<tr><td colspan="2">Associated with Pipeline</td><td>2</td><td>8</td><td>11</td></tr>
<tr><td rowspan="3">Associated with canal route</td><td>Specific to route selected</td><td>16</td><td>0</td><td>13</td></tr>
<tr><td>Common to Route 1 & Route 3</td><td>5</td><td>5</td><td>0</td></tr>
<tr><td>Common Section South of Braunston</td><td>17</td><td>17</td><td>17</td></tr>
<tr><td colspan="2">Total</td><td>40</td><td>30</td><td>41</td></tr>
</table>

The risk items associated with the transfer pipelines typically related to issues such as the need to cross existing and planned infrastructure (including the route of the M6 toll, A446 and HS2) requiring directional drilling, their proximity to environmentally sensitive areas or the need to pass through built-up areas potentially requiring significant service diversions.

The risk items associated with the canal routes were more diverse. However, they can be split into several types of risks, typically associated with engineering, environmental impacts, and land constraints such as:

- The proximity of the routes to environmentally sensitive or flood risk areas.
- The ability of existing structures / canal routes to convey additional flow, without impacting on freeboard or 'air draft' requirements under bridges/tunnels.
- The need for gravity bypasses around locks.
- The need for pumping to transfer around either individual locks or lock-ladders.

Mitigation measures were again suggested for each of the items. These included measures such as widening the canal locally and providing cantilevered towpaths where space is limited, additional temporary works to stabilise foundations, and the consideration of alternative pumping/bypass arrangements.

The risk items do not specifically consider issues such as the need for access haul routes. However, due to the nature of the transfer pipelines and canal, these risks are likely to be largely common to all routes.

As would be expected, the shortest transfer option (Route 1) has the fewest risk items associated with the transfer pipeline. Whereas the longest transfer option (Route 6) has the greatest number of risk items. For the canal section, Routes 1 and 6 perform similarly from the perspective of the number of risk items.

Overall, Route 3 has the fewest construction risk items attributed to it.

RESILIENCE

Resilience is a measure of how a system can cope and recover from change. These changes can be:

- Fundamental gradual changes such as climate change, water usage demand etc.
- Catastrophic sudden events such as release of contamination or total loss of power etc.
- Routine fluctuations such as seasonal demand curves, diurnal temperatures etc.
- Turbulent disruptions such as storm events, drought periods etc.

A more resilient system will have:

- Fewer pumping stations - reduced points of potential failure
- Higher capacity to cope with fluctuations in flow - pound size
- Fewer external influences - e.g. flooding from rivers
- Greater capacity to monitor and respond to source water changes - pipe length and break tank
- Adaptability - climate change, transfer demands, change of use etc.

Downstream of Braunston Junction, each option is the same and therefore not included in the review of resilience.

Route 1 joins Route 3 at Atherstone Top Lock, therefore everything described for Route 3 below also applies to Route 1.

The resilience of each route can be summarised as follows:

Route 1

The section of the route from Kingsbury Water Park, Bodymoor Heath, to the River Tame Aqueduct at Fazeley (approximately 6.5km) is within the flood risk zone of the River Tame. A flood defence embankment has been constructed (approximately 700m long) to reduce the river flood water entering the canal and causing flooding further downstream[3]. However, there are still risks associated with increased flooding[4] due to climate change, storm water entering the canal along the Curdworth section (i.e. canal is in a deep cutting) and operation of waste weirs along the canal during high river levels.

The Glascote lock area (i.e. proposed pumping station location) is in the flood risk zone of Kettle Brook (tributary of the River Tame) where the brook passes under the canal via a culvert.

[3] Lower Tame Flood Scheme as described in Kingsbury Flood Risk Assessment – River Tame PAR, Environment Agency 23rd November 2012
[4] River Tame Flood Risk Management Strategy, Environment Agency, 2012

The discharge point into the canal at Broad Bulk Bridge, Curdworth, is only 1km from the proposed pumping station at the Minworth site. Without any additional buffer storage at Minworth there is a risk that any contamination or water quality failure would enter the canal before being detected and mitigation/isolation measure operating.

As highlighted in the hydraulic comparison section, there are multiple bridges in addition to Curdworth Tunnel and the River Tame Aqueduct that would limit the ultimate transfer capacity of this route.

Route 3

There are only two pumping stations along this route (excluding the common pumping stations down stream of Braunston junction) and these discharge into long canal pounds, 24km and 11km respectively, that provide large buffers for flow variations and other inputs (e.g. surface water etc.).

The transfer from Minworth to Atherstone is approximately 15km long and includes a break tank at approximately the 11km point (i.e. at the high point). This will give flexibility in monitoring and responding to changing water quality at Minworth.

Route 6

Route 6 has a string of eleven pumping stations along a relatively short length of canal route (i.e., all eleven fall within a 13.5km length) with short canal sections between each pumping station (e.g., typically 1km spacing). The locations of the pumping stations are rural and four of the locations are in the flood risk area of the River Leam and its tributaries. Therefore, the risk of failures (e.g. power outages) and transient flow issues (e.g. surge waves causing overflows etc.) is increased.

The transfer from Minworth to Leamington is approximately 34km long and includes a break tank at approximately the 20km point (i.e. at the high point). This will give flexibility in monitoring and responding to changing water quality at Minworth.

Route 3 is the more operationally resilient option.

3.2 ENVIRONMENTAL IMPACT

ENVIRONMENTAL RISKS

Geographical Information System (GIS) mapping has been used to identify and compare the relative potential environmental impact of the three alternative routes on sites within a 150m ecological impact assessment buffer either side of the route centreline.

The lengths considered during the comparison included the sections: Route 1 (11a, 6b, 7, 9, 30 and 31), Route 3 (6, 7, 9, 30 and 31) and Route 6 (8a, 12 and 13, 9, 30, 31,). These sections are shown in Figure B-1 and Figure B-2 (Appendix B). The section references are in both the Gate 1 paper and earlier studies[5]. They are used in this report for compatibility/comparison with previous studies.

[5] High Level Cost Estimate for Water Transfer Routes via thee Canal System, May 2016, B&V Report for The Canal & Rivers Trust

The comparison concentrated on sites with statutory and non-statutory environmental and heritage designations, using spatial data available under Open Government Licence[6], including:

Sites with International Designations

- World Heritage Sites
- Ramsar England: A Ramsar site is the land listed as a Wetland of International Importance under the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the Ramsar Convention) 1973.

Sites with European Statutory Designations

- Special Protection Area: A Special Protection Area (SPA) is the land classified under Directive 79/409 on the Conservation of Wild Birds.
- Special Areas of Conservation: A Special Area of Conservation (SAC) is the land designated under Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.

Sites with National Statutory Designations

- Scheduled Monuments: Scheduled monuments are nationally important monuments and sites. The aim of scheduling is to preserve sites and monuments as far as possible in the form in which they have come down to us today. They are legally protected through the Ancient Monuments and Archaeological Areas Act 1979.
- Listed Buildings: Listing marks and celebrates a building's special architectural and historic interest and brings it under the consideration of the planning system, so that it can be protected for future generations.
- Sites of Special Scientific Interest: A Site of Special Scientific Interest (SSSI) is the land notified as an SSSI under the Wildlife and Countryside Act 1981, as amended.
- Areas of Outstanding Natural Beauty (AONB): Areas of Outstanding Natural Beauty (AONB) are designated areas where protection is afforded to protect and manage the areas for visitors and local residents.
- National Nature Reserves England: A National Nature Reserve (NNR) is the land declared under the National Parks and Access to the Countryside Act 1949 or Wildlife and Countryside Act 1981 as amended.
- Locations of ponds surveyed as part of the Natural England 2013 Great Crested Newt Evidence Enhancement Project (Crested Newt Pond Surveys & Great Crested Newt Class Survey)

Other Local Designations

- Historic Parks and Gardens
- Local Nature Reserves
- Country Parks England
- Ancient Woodland England
- National Trails England.

[6] Search Results - data.gov.uk

The number of sites that were identified as being located wholly or partly within the buffer for each type of designation are summarised in Table 3-4. Further detail can be found in Appendix B.1.

Table 3-4 – Summary of Number of Designated sites intersected by each Route Buffer

Designation	Route 1	Route 3	Route 6
International	0	0	0
European	0	0	0
National	414	344	360
Other	32	21	18
Total	**446**	**365**	**378**

There are no designated sites within the International or European designations 1000m buffer of the scheme. There are however several sites with National or other local designations.

As shown on Table 3-4, Route 1 has the greatest potential to impact environmental designations.

Route 3 has the fewest potential environmental and heritage sites that might be impacted by the proposals.

A detailed breakdown of Table 3-4 is given in Appendix B.

CARBON ASSESSMENT

A preliminary carbon assessment has been undertaken using the WSP Carbon Calculator, utillising quantities (see Section 3.1) which have been estimated for the following typical features:

- Pipelines
- Pumping stations
- Bypass structures
- Canal and towpath works.

Table 3-5 – Preliminary Carbon Assessment Comparison for 115 Megalitres Per Day (Ml/d) Transfer Rate

Feature	Route 1 ($kgCO_{2e}$)	Route 3 ($kgCO_{2e}$)	Route 6 ($kgCO_{2e}$)
Canal Raising	14,376.64	13,297.88	10,249.34
Upgraded Weirs	1,761,018.55	1,310,026.00	2,169,059.44
Access	329.87	412.33	536.03
Rising Mains	47,990.51	58,614.76	105,983.36
Inlet to pumping stations	75,594.47	62,995.39	91,343.32
For pumping stations	14,377.06	11,980.89	17,372.28
Environmental	7,099.91	4,207.35	3,918.10
Bridge Widening	104,992.00	63,514.52	63,514.52
Bridge replacement	4,934,624.00	4,514,656.00	4,304,672.00
Discharge points	2,519.82	2,099.85	3,044.78
Clearing of debris at P/Stn	32,277.27	26,897.72	39,001.70
Break Tank	0	150,870.04	150,870.04
Intermediate Locks	2,519.82	2,099.85	3,044.78
Total Embodied Carbon	**6,997,719.92**	**6,221,672,58**	**6,962,609.69**
Total Operational carbon	11,031,277.11	9,745,930.33	15,137,459.80

Route 6 is clearly the worst option, driven by the whole life carbon from pumping, based on the operational regime currently assumed.

Routes 1 & 3 are similar, but Route 3 has higher construction and renewal carbon (e.g., pump replacement et.). The whole life carbon figures are therefore not significantly different between the routes and slightly in favour of Route 3.

There is also the potential to generate at least 3,250MW per year at Atherstone (under 115Ml/d transfer rate) which could reduce the Nett annual electricity cost for Route 3.

Route 3 has a more favourable carbon cost, especially when taking into consideration potential energy recovery at Atherstone.

FLOOD RISK

Route 1

The River Tame Flood Risk Management Strategy[4], although it identifies the need to investigate flood water entering the canal and flowing downstream into Fazeley, does not intend to significantly reduce flooding in the area. Instead, other than targeted flood route management (e.g., Lower Tame Flood Scheme[3]), the intention is to encourage wetlands habitat and improved water quality. Specific issues raised in the strategy supporting documents (e.g. Statement of Environmental Particulars) that the canal transfer would have to address are:

- Overflows from the canal into wetland areas - there are five waste weirs and sixteen bypass weirs along the affected section
- Pollution from flood events entering the canal - specifically from the sediment pools in the Kingsbury area (e.g. Lea Marston Purification Lakes etc.)
- Impact during construction and maintenance on sensitive species - particularly wading birds in the RSPB Middleton Lakes area
- Impact of raising canal banks on flood route - especially diverting flow into at risk areas around Fazeley.

From Polesworth, Route 1 also runs parallel to the River Anker and interacts with the river flood plain, especially between the village of Grendon and the outskirts of Atherstone, where the canal is fully within the flood risk area.

Route 3

Although the canal crosses several water courses (i.e. brooks and streams culverted under the canal) there are no significant assets or canal lengths within flood risk zones.

Route 6

Of the eleven pumping stations on this route, four are within the flood risk zone of tributaries of the River Leam and approximately 5km of canal. There has been reported overtopping of the canal[7] due to storm event activity at locations upstream of the proposed discharge point at Leamington Trough Pound. Storm events caused flooding in Warwick and Leamington Spa. It is likely that the canal also overtopped in other locations in the rural areas to the east but there is less risk of flooding properties in this area.

Route 3 has the lowest flood risk.

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[7] Warwick District Council Level 1 Strategic Flood Risk Assessment 2013

3.3 SOCIAL IMPACT

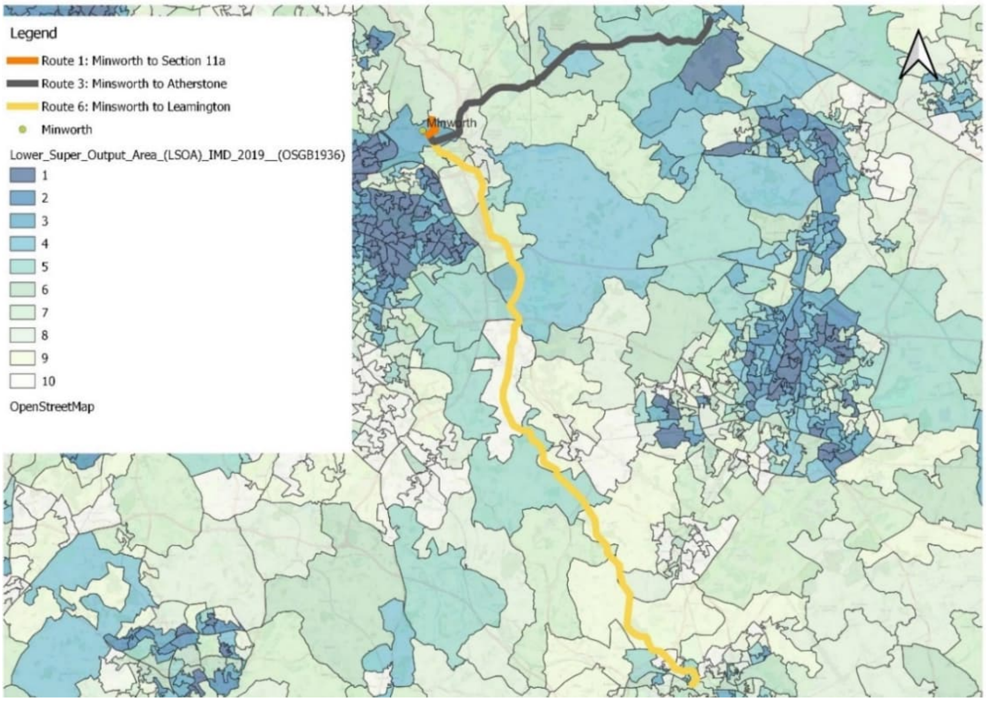
As defined by the International Association for Impact Assessment (IAIA), a "Social Impact Assessment includes the processes of analysing, monitoring, and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions…"

BASELINE SITUATION IN THE VICINITY OF THE ALTERNATIVE TRANSFER PIPELINE ROUTES

The English Indices of Multiple Deprivation (IMD2019) has been used to understand what the current (baseline) situation is in the vicinity of the alternative routes. This index considers seven domains of deprivation in combination: Income; Employment; Education; Health; Crime; Barriers to Housing and Services; and Living Environment.

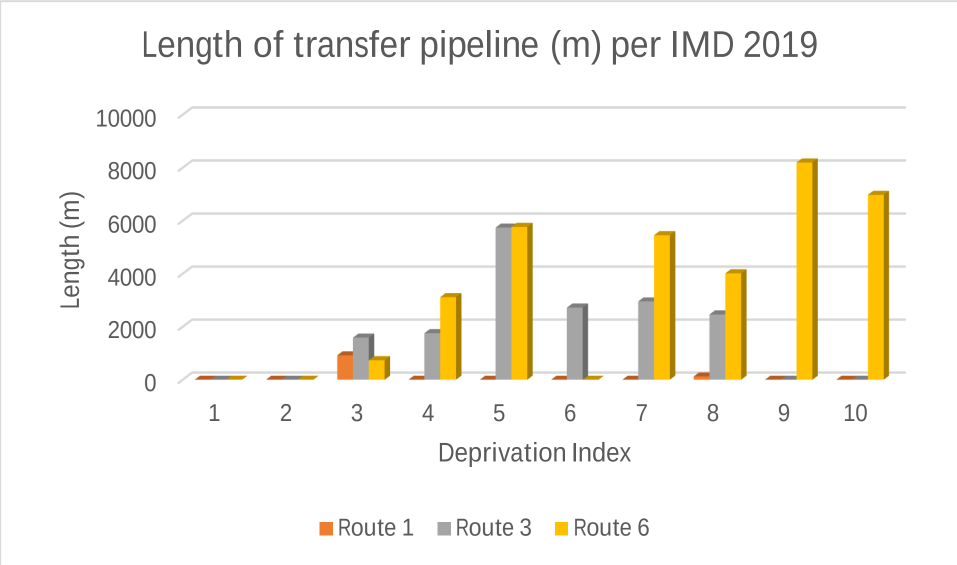
The relative levels of deprivation in the vicinity of the routes, mapped by Lower layer Super Output Areas (LSOAs), can be seen on Figure 3-1. The areas are ranked from the most deprived (indicated by the areas with the lowest indices in dark blue) to the least deprived (indicated by the areas with the highest indices in pale green). [8]

Figure 3-1 - Levels of relative deprivation in the vicinity of the routes



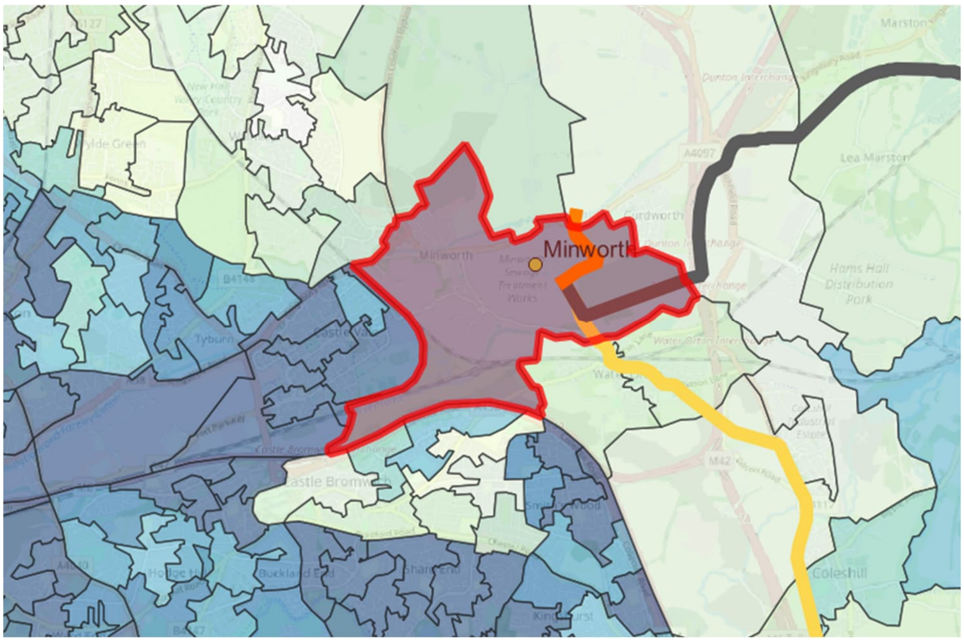
8 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/833959/IoD2019_Infographic.pdf

Figure 3-2 – Shows a comparison of the relative lengths of transfer pipeline within LSOA areas with highest levels of deprivation (1) to the lowest levels of deprivation (10)



All three routes affect LSOA that make up some of the most deprived areas in the country. LSOA neighbourhood data[9] for those LSOAs affected by the pipeline routes, with Multiple Indices of Deprivation of 3 and 4, are summarised below.

Figure 3-3 – Location of Birmingham 021B LSOA (6654 out of 32844 LSOAs in England)

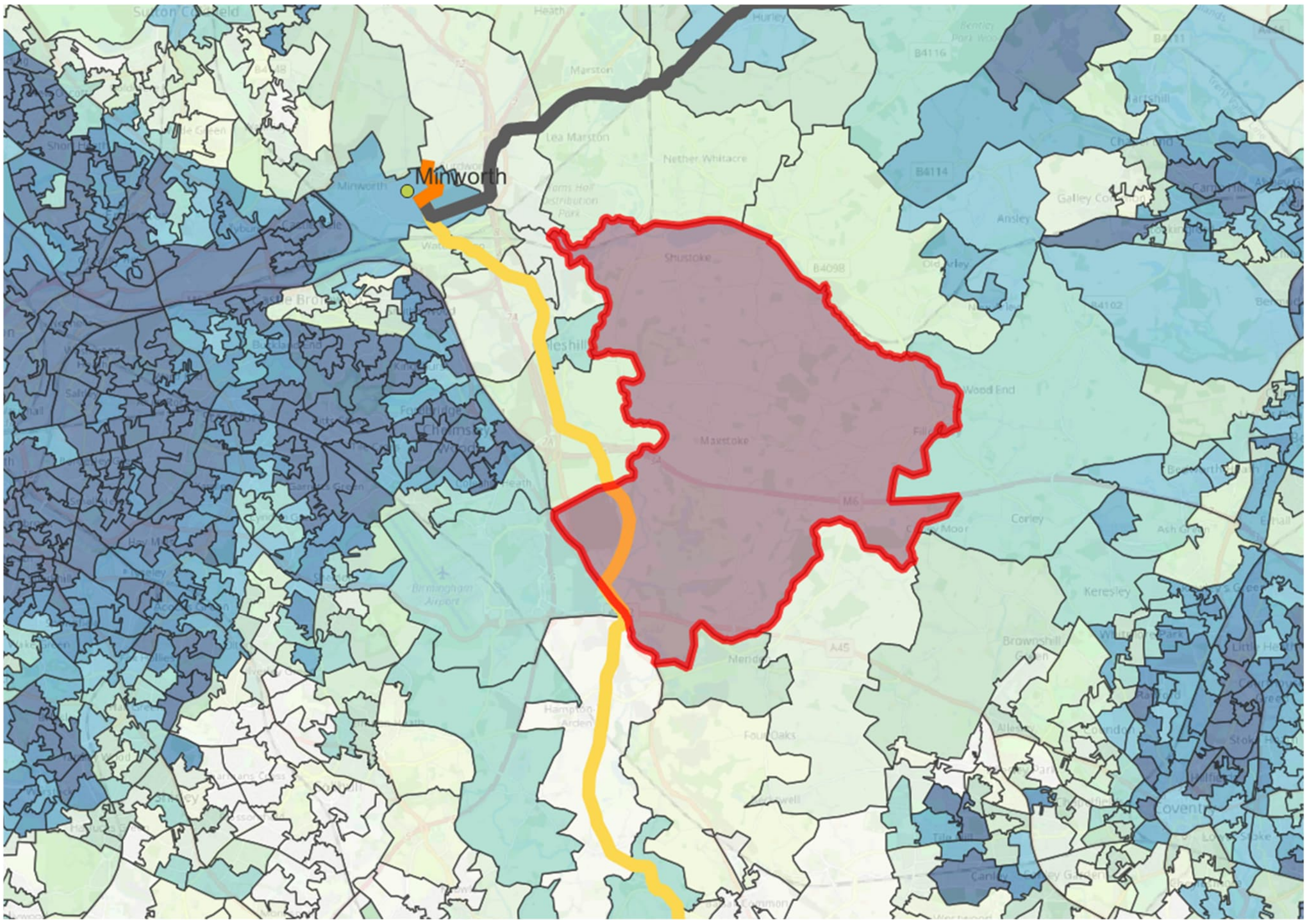


[9] Indices of Deprivation 2015 and 2019 (communities.gov.uk)

All three routes (1, 3 and 6), as shown on Figure 3-3, originate within Birmingham 021B LSOA. This area has an overall Index of Multiple Deprivation of 3, meaning that it falls within the decile of 30% most deprived areas in the country. It is located within the Sutton Walmley and Minworth Ward and Birmingham local authority district. In 2019, it was ranked 6654 out of 32844 LSOAs in England. The most significant issues in the neighbourhood relate to the lack of attainment of education, skills, and training (20% most deprived), health and disability (30% most deprived), barriers to housing and services (10% most deprived) and quality of living environment (30% most deprived).

As illustrated in Figure 3-4, Routes 6 passes through part of North Warwickshire 007D LSOA, which has an overall Index of Multiple Deprivation of 4, meaning that it falls within the decile of 40% most deprived areas in the country. It is located within the Hurley and Wood End ward and the North Warwickshire local authority district. In 2019, it was ranked 11143 out of 32844 LSOAs in England. The most significant issues in the neighbourhood relate to crime (30% most deprived), barriers to housing and services (10% most deprived) and living environment (10% most deprived).

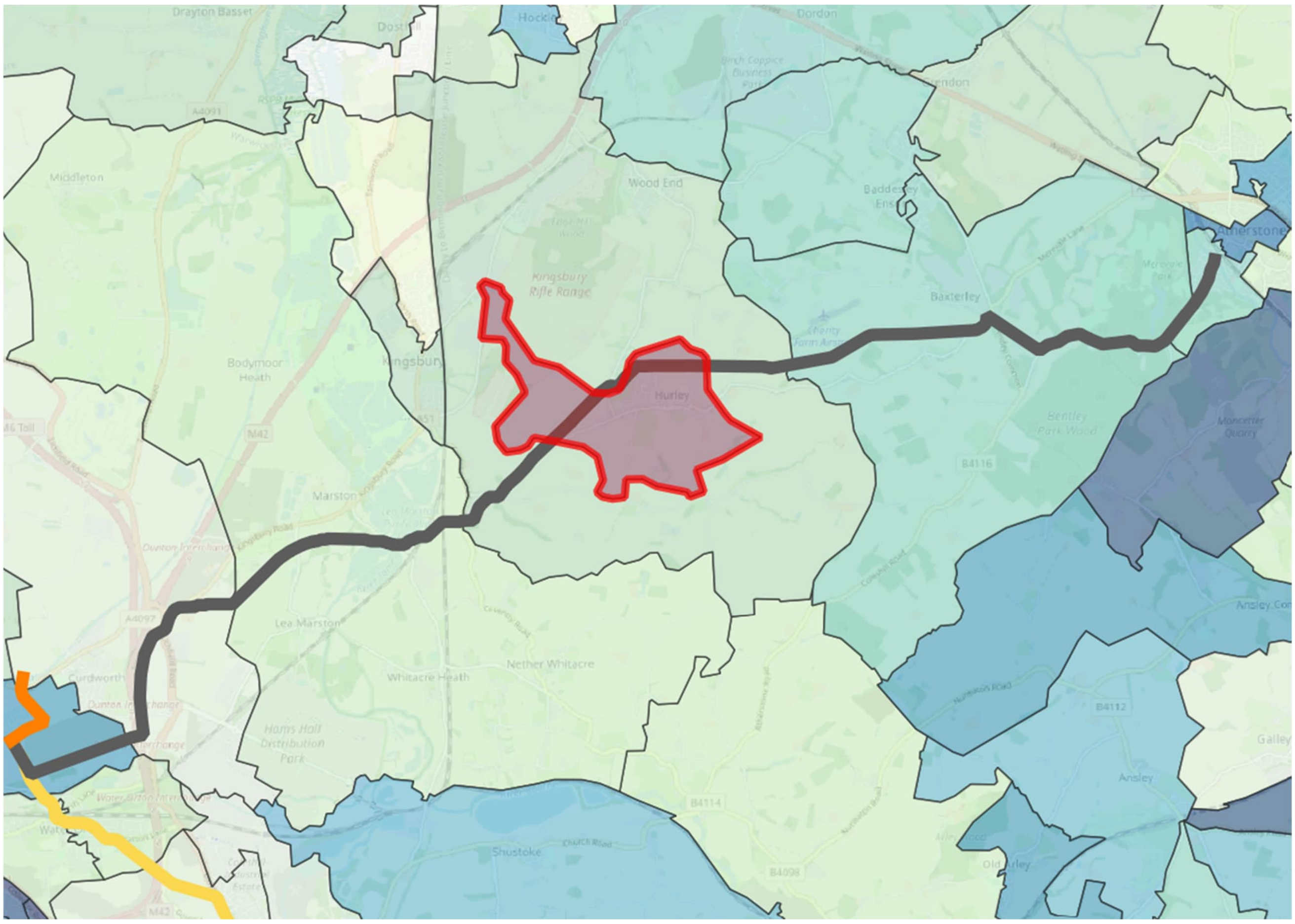
Figure 3-4 – Location of North Warwickshire 007D LSOA (11143 out of 32844 LSOAs in England)



Route 3 passes further to the north, as shown on Figure 3-5, through the centre of North Warwickshire 002E LSOA. This area has an overall Index of Multiple Deprivation of 4, meaning that it falls within the decile of 40% most deprived areas in the country. It is located within the Hurley and Wood End ward and the North Warwickshire local authority district. In 2019, it was ranked 12560 out of 32844 LSOAs in England. The most significant issues in the neighbourhood relate to employment

(30% most deprived) and the lack of attainment in education, skills, and training (20% most deprived).

Figure 3-5 – Location of North Warwickshire 002E LSOA (12560 out of 32844 LSOAs in England)



COMPARISON OF POTENTIAL SOCIAL IMPACT

The following social factors have been considered, when making a comparison of the three alternative routes. These are factors that are considered most likely to differentiate between the routes and primarily relate to the potential impact and disruption to local communities, as well as users of the canal network and non-motorised users such as walkers, cyclists, and equestrians. It is recognised that most of these impacts are likely to occur during construction.

- People's way of life on a day-to-day basis, including impacts affecting access to amenities, services, and employment. In particular, works could cause disruption when the transfer pipelines are laid through built up areas. Additionally, the proposals could impact both active travel and vehicular routes.
- Community, including cohesion, character, and impact on services/amenities within the community.
- Environment – Including impacts related to the risk of pollution (such as noise, air, or water pollution) and/or loss of habitats. For comparison, it has been assumed that the environmental impact would be directly proportionate to the environmental risks identified in Section 3.2.

- Health and well-being – Including health related impacts, such as stress or the reduced likelihood of people exercising and enjoying the local environment, open spaces (such as the canal, cycleways, bridleways, and footpaths).
- Personal and property rights – for example loss of land ownership or third-party rights. It is assumed for the purpose of the comparison that, apart from private moorings, the greatest impact would be associated with the transfer pipeline as most of the land along the canal route is owned by the Canal & River Trust. Most of the private moorings are located on the section of the GUC, to the south of Braunston Junction.

Social impacts such as those related to culture and political systems would be affected similarly by all the routes, and therefore would not be differentiating factors. Similarly impacts such as personal safety would be subject to mitigation.

Table 3-6 – Summary of potential social impacts

Social factor	Route 1	Route 3	Route 6
People's way of life	Most of the work will be undertaken on-line to the existing canal.	Although not as urban as Route 6, the Route 3 transfer pipeline passes through the outskirts of Atherstone.	Due to the urban nature of the transfer pipeline, Route 6 has the greatest potential to impact on people's lives, especially during construction when significant service diversions would be required.
Community	The pumping stations are all remote from communities, so the possibility of positive impact is limited.	The construction of the pumping stations has been identified as having the potential for significant positive impact	The pumping stations are all remote from communities, so the possibility of positive impact is limited.
Environment		Route 3 has the least environmental risk of the three routes compared.	
Health and well-being	No differentiator identified for this criterion		
Personal and property rights	Route 1 would affect the smallest number of parties with freehold, leasehold ownership or third-party interests in the affected land.	It is anticipated that Route 3 would affect several parties with freehold, leasehold ownership or third-party interests in the affected land.	Route 6 consists of the longest transfer pipeline. This therefore has the greatest potential to interfere with peoples' personal and property rights.

3.4 COST

A preliminary cost estimate has been produced using the quantities (see Section 3.1) which have been estimated for the following typical features:

- Pipelines
- Pumping stations
- Bypass structures
- Canal and towpath works

Table 3-7 – Preliminary CAPEX Cost Estimate

Feature	Route 1	Route 3	Route 6
Pipelines	£ 3,615,752	£ 43,641,192	£ 96,891,246
Pumping stations	£ 133,118,264	£ 30,765,370	£ 140,577,294
Bypass structures	£ 72,999,326	£ 63,715,260	£ 79,101,732
Canal and towpath works	£ 41,940,212	£ 39,119,248	£ 28,889,829
Total	£ 251,673,553	£ 177,241,070	£ 345,460,101

Please refer to Appendix D for more detail on Table 3-7 including source of costs/prices/rates.

Table 3-8 – Preliminary OPEX Cost Estimate

Route 1	Route 3	Route 6
£3,439,971.60	£3,600,291.32	£6,723,164

Please refer to Appendix D for more detail on Table 3-8.

The lowest overall cost is Route 3; however Route 1 has a slightly lower estimated annual OPEX.

3.5 PROGRAMME

The common section below Braunston Junction and the works at Minworth has not been considered as this is not a differentiator in route selection.

Pipeline construction programmes are generally proportional to length and complexity. Route 1 is the shortest and simplest, Route 3 is longer and has a more complex route for the first 6km as it passes out of the urban areas (M6 and HS2 crossings) into agricultural land. Route 6 is both the longest and most complex with over 50% of its route in urban areas and requiring multiple HS2 and motorway/trunk road crossings. Pipeline construction is not affected by phasing of flows (i.e., the whole pipeline is required regardless of whether 57.5 Ml/d or 115Ml/d is required.

Canal construction programme is sensitive to how the flow requirement may be phased. At flows of 57.5Ml/d or less, no canal bank raising and only two pumping stations are required for Route 3. At flows of 57.5Ml/d or less Route 1 requires up to 6km of bank raising and 6 pumping stations. Route 6 requires eleven pumping stations irrespective of the flow phasing. As flow transfer volumes increase above 57.5Ml/d then the common section of canal beyond Braunston Junction requires canal bank raising and therefore no route has a significant advantage over any other in this section.

Routes 1 and 6 will require more construction in sensitive areas (e.g. HS2, M6, flood risk zones, sensitive habitats, and rural pumping stations etc.), land purchase and therefore pre-construction and permit application work will take longer (e.g. construction access, compounds, permits to work adjacent to rivers etc.).

Power supplies for the Route 1 and Route 6 may be a critical factor for pumping station construction programmes. Most of the proposed sites are remote (i.e. over 1km from an existing public road) with no existing suitable power supply. Typically the time from requesting a supply to having a connection made in these situations is greater than 42 weeks. This assumes that the local network can cope with multiple connections (i.e. up to 11 for Route 6) and the supply is able to provide them concurrently. It is however more likely that the energy supplier would want to provide connections sequentially, adding further to the construction programme.

The two pumping stations for Route 3 are adjacent to existing developments and suitable power connections. It would be expected to have a connection within 20 weeks, and it should be straightforward for the supplier to provide them concurrently.

Pumping stations for Route 3 could be constructed simultaneously as they are sufficiently separate from each other that there will be no interference (e.g. traffic management etc). Route 6 and Route 1 are likely to have some pumping stations constructed sequentially, both for efficiency of working (i.e. unlikely that 11 separate construction sites operating concurrently will be efficient from material delivery, staff availability etc.), and reduced impact on the local community and canal users.

Construction programmes for the Minworth and Leighton Buzzard treatment sites are however the ultimate limiting factor as the transfer route cannot be fully tested, commissioned, and operated without both a source and a sink for the transfer water.

Route 3 has the least risk to the construction programme, especially if the flow transfer volumes are phased from 57.5Ml/d to 115Mld.

Overall the works which will define the durations for completion and handover are likely to be the bypass pumping stations and/or the canal bank works. If it is assumed that the bypass pumping stations take 8 months each but can be grouped into sets of 2-3 then Route 1 and Route 6 would take c40-50 months having 10 and 16 stations respectively. Route 3 has 8 stations and could be built commensurately faster (say 24-30 months) if grouped similarly.

The canal bank works have similar lengths given that that overall amount of work is dominated by the long common section from Braunston south. These works, subject to any constraints applied by the Trust in terms of locations of work, can be operated to complete within the same time frame as the pumping stations. For example if the average rate of work is 80m/day then use of between 2 and 3 teams would allow completion of up to 120km of works within 3 years.

3.6 VALUE – WIDER BENEFITS

An initial review has been undertaken to identify opportunities to provide potential wider benefits, that might differentiate between the routes. This has included a review of relevant guidance and other documents to consider how these opportunities could align with national and regional policies and strategies. A copy of this review can be found in Concept Design Report Appendix D. (See Annex A1).

The key relevant policy documents that cover the geographical extent of the three alternative routes include:

- Draft National Policy Statement for Water Resources Infrastructure (Nov 2018)
- Affinity Water, Water Resources Management Plan 2020-2080 (April 2020)
- Severn Trent Water, Water Resources Management Plan 2019-2044 (August 2019)
- UK Government Levelling-up policy:
  - 'Build Back Better: our plan for growth' (March 2021)
  - 'Levelling up the United Kingdom' white paper' (February 2021)

The aim of the policy described in the white paper is to address geographical disparities, by means of a programme of change based on the following medium-term (2030) missions to boost productivity, pay, jobs and living standards; spread opportunities and improve public services; restore a sense of community, local pride and belonging; and empower local leaders and communities.

- West Midlands Combined Authority (WMCA) Community Recovery Prospectus (November 2020).

The West Midlands Combined Authority (WMCA) is made up of 18 local councils and 3 local enterprise partnerships. In November 2020, the WMCA[10] published a roadmap[11] to address the issues that are causing concern to communities across the West Midlands. The six priorities identified include:

1. Living safely with coronavirus;

2. Accessing healthcare and improving physical health;

3. Mental health support and awareness;

4. Education and young people;

5. Jobs and training; and

6. Local businesses and high streets.

Both the levelling up policy and the WMCA road map identify opportunities that might align with some of the wider benefits that could be delivered through this project.

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[10] Home (wmca.org.uk)
[11] https://www.wmca.org.uk/media/4376/community-recovery-prospectus-nov-20.pdf

Wider benefits considered include opportunities for environmental improvements (such as flood risk, biodiversity, and carbon sequestration) and social enhancements that could improve people's health, wellbeing and understanding of the natural environment.

The differences between the routes can be summarised as follows:

Route 1

A total of 10 potential benefits beyond water transfer were identified specifically to Route 1. These are primarily linked to improved access for existing developments and therefore of limited scale and impact. Other than short sections through densely developed housing estates on the edge of Tamworth the canal passes through environmental areas sensitive to development (e.g. River Tame and River Anker flood plains). Any significant benefits, beyond minor access improvements, are only achieved in the common section of the various routes downstream of Atherstone.

Route 3

At least 17 areas have been identified that could provide additional benefits beyond water transfer. Due to the larger urban conurbations that Route 3 passes through (e.g. Atherstone, Nuneaton, Coventry, and Rugby) the potential scale and impact could be significant. For example, the community around the proposed Hillmorton pumping station would benefit significantly from both improved access and the ability to expand Canalside services but also there is the potential to significantly improve biodiversity along the section impacted by construction work.

Route 6

Only 9 potential benefits beyond water transfer were identified. These are primarily linked to improved access for existing developments and therefore of limited scale and impact. Other than the first 4km that pass through the housing estates on the outskirts of Warwick, the canal passes through rural areas with limited potential. In contrast, the construction of the eleven pumping stations is more likely to have a negative impact unless suitable mitigation can be identified.

Route 3 has the potential to achieve significantly more benefits, if implemented, than Route 6 and can achieve similar potential benefits to Route 1 but with lower total (CAPEX and OPEX) cost and less risk.

4 SUMMARY

The preferred option is Route 3 and has been chosen to be taken forward for further development. The route has major advantages over the others considered that can be summarised as follows:

- Lowest overall risks especially considering:
  - fewer and easier to construct pumping stations,
  - a shorter and easier to construct pipeline than Route 6
  - avoids the difficult canal section from Minworth to Atherstone via Fazeley for Route 1
- Shortest overall programme
- Lowest overall cost
- Significantly higher number of benefits for associated communities

Route 1 has significant negative issues under the following headings:

- Hydraulics – there are several sections that will limit the capacity to transfer flow and there may not be suitable mitigation measure to achieve the target peak flow of 115Mld
- Environmental Impacts – the additional negative impacts through the River Tame and River Anker flood plains may be unacceptable
- Flood Risk – the addition of transfer flows into the canal may be unacceptable from a flood risk perspective.

Route 6 has significant negative issues under the following headings:

- Material use – this option requires the most material for initial construction regardless of flow transfer volumes.
- Carbon – the additional pumping requirement results in much higher carbon costs that cannot be mitigated sufficiently to make this option positive compared to the other options.
- Costs – linked to the number of pumping stations, the maintenance and electricity costs cannot be mitigated sufficiently to make this option positive compared to the other options.
- Resilience – operationally this option has more points of failure, is more difficult to operate to minimise negative fluctuations and would be more difficult to adapt to long term trends (e.g. climate change).

Appendix A

ENGINEERING AND DESIGN

Appendix A.1

ENGINEERING AND DESIGN ASSUMPTIONS

ENGINEERING AND DESIGN ASSUMPTIONS

- Assumed simple raising of footpath for predicted water level increases of 100mm or less.
- Where towpath width allows this method could be used up to 150mm – but requires towpath greater than 2m wide.
- Structural towpath raising required above 150mm - canal integrity and public safety
- Assume non-towpath side of canal raised by standard embankment work.
- Assume management and resolution of existing canal defects part of The Trust Business as Usual (BAU) repairs
- Assumed no working in water so no allowance for sheet piling or dewatering etc.
- Edge details at moorings, slipways, marinas etc to be agreed - currently assumed allowed for in general items and Optimism Bias.
- Require consultation with fishing groups regarding pegs/spots and private owners regarding moorings.
- Maintaining both banks assumed to be similar to standard EA flood embankments
- Pumping stations assumed submersible type with small adjacent brick building for Motor Control Centre (MCC) and power supply.
- Assumed access for maintenance by transit or small hiab
- Assumed no instruments at weirs - controls and instruments limited to pumping stations only.
- Assumed manual penstock on bypass only
- Weirs are designed as side weirs with non-modular flow
- Historic land use at locks - check historic maps
- Assumed temporary access and space for construction can be agreed and planning granted
- Nominal sum allowed for limited crossings of services in pipeline rates. Major crossings itemised. Actual number to be reviewed at detail design
- Velocity at bypass weirs assumed not an issue for fish as any approaching weirs will get flushed through to downstream end.
- Bridge bypass required to limit velocity increases - avoids closing canal, minimising in channel work and risk to bridge abutments. Preserves character of canal. Assumed weir bypass construction as per down flow locks.
- Bridges with headroom issues cannot be mitigated - loss of headroom a function of pound length and therefore cumulative head loss. Discussion required with canal users' group.

Appendix A.2

TYPICAL LAYOUT DRAWINGS

Figure A-1 - Typical Bypass Pumping Station Layout

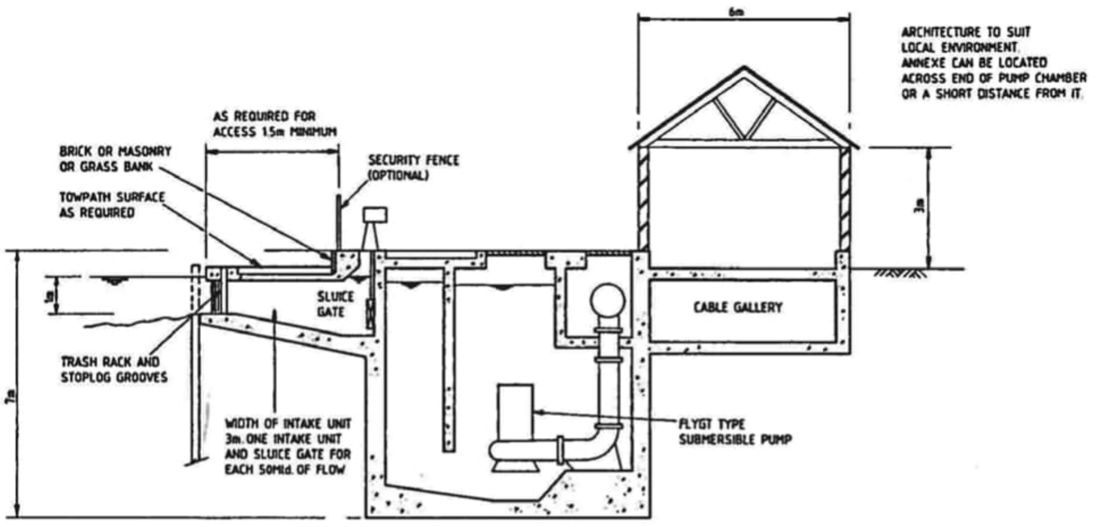


Figure A-2 - Typical Bypass weirs

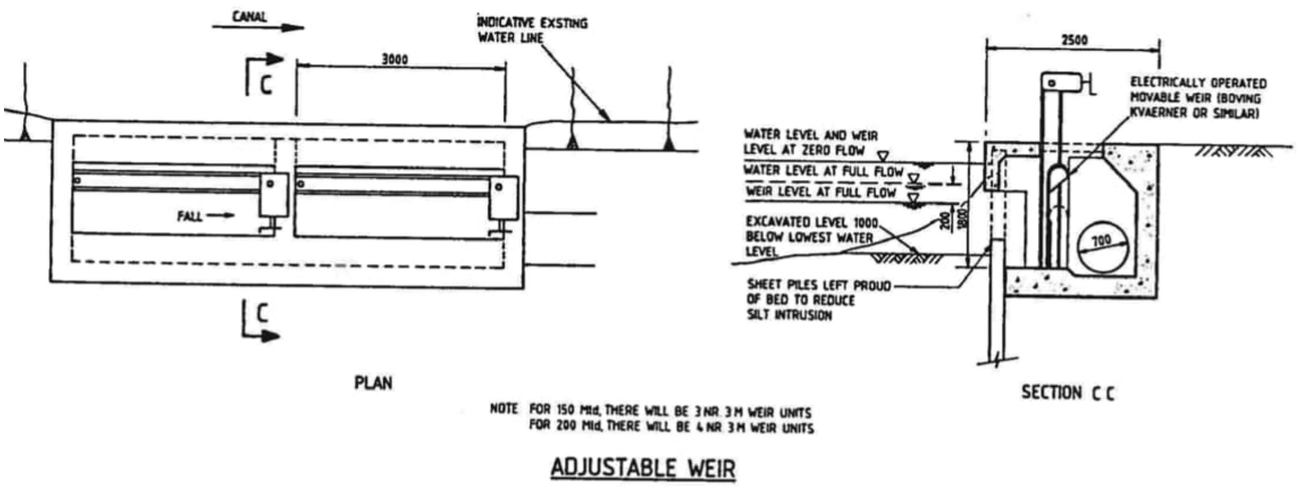


Figure A-3 - Typical canal bank raising - towpath side

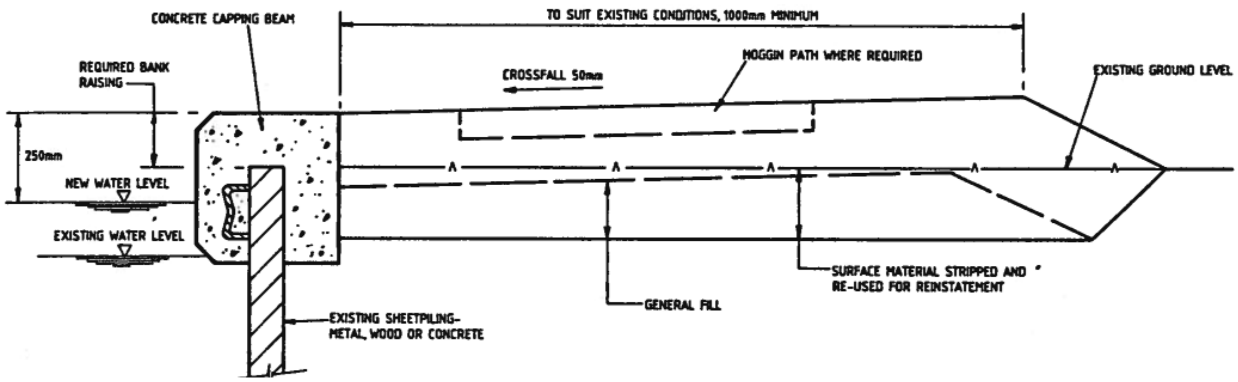


Figure A-4 - Typical canal bank raising - non towpath side

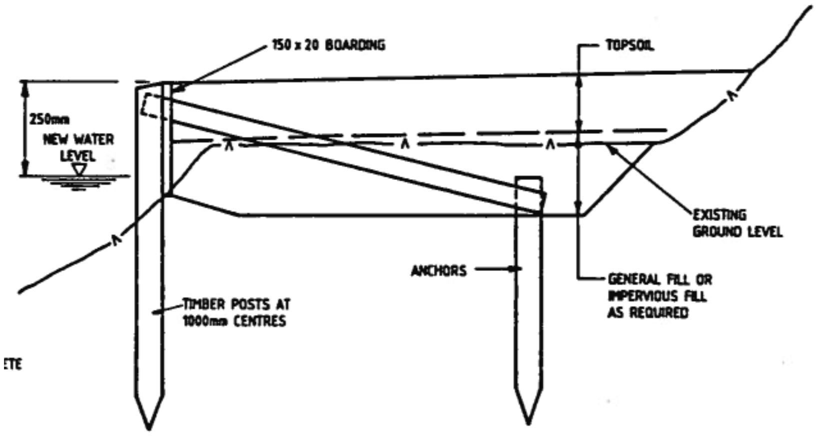
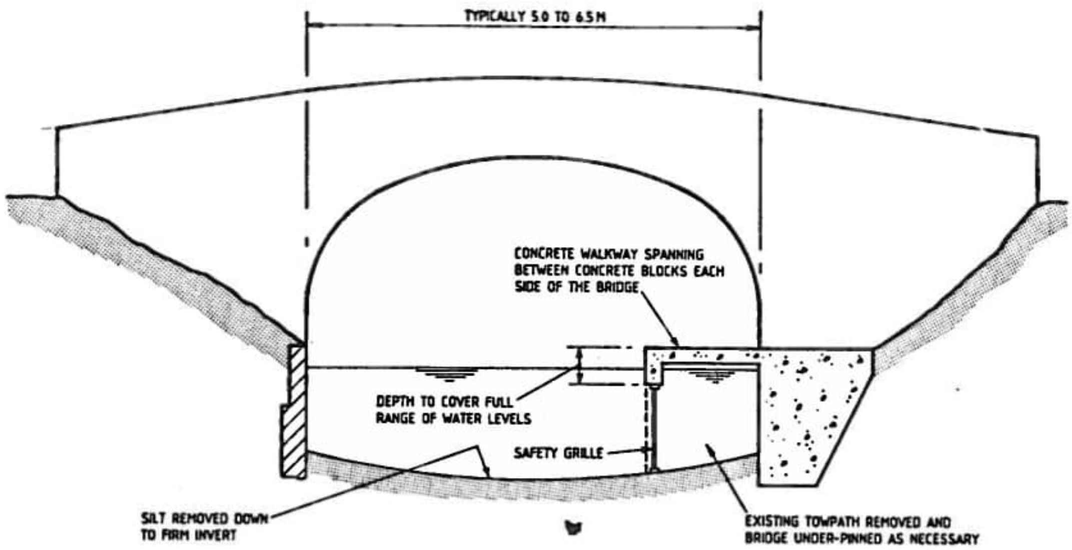


Figure A-5 - Typical arrangement for bridge towpath widening



Appendix A.3

CONSTRUCTION RISK

CONSTRUCTION RISK REVIEW SUMMARY SHEET

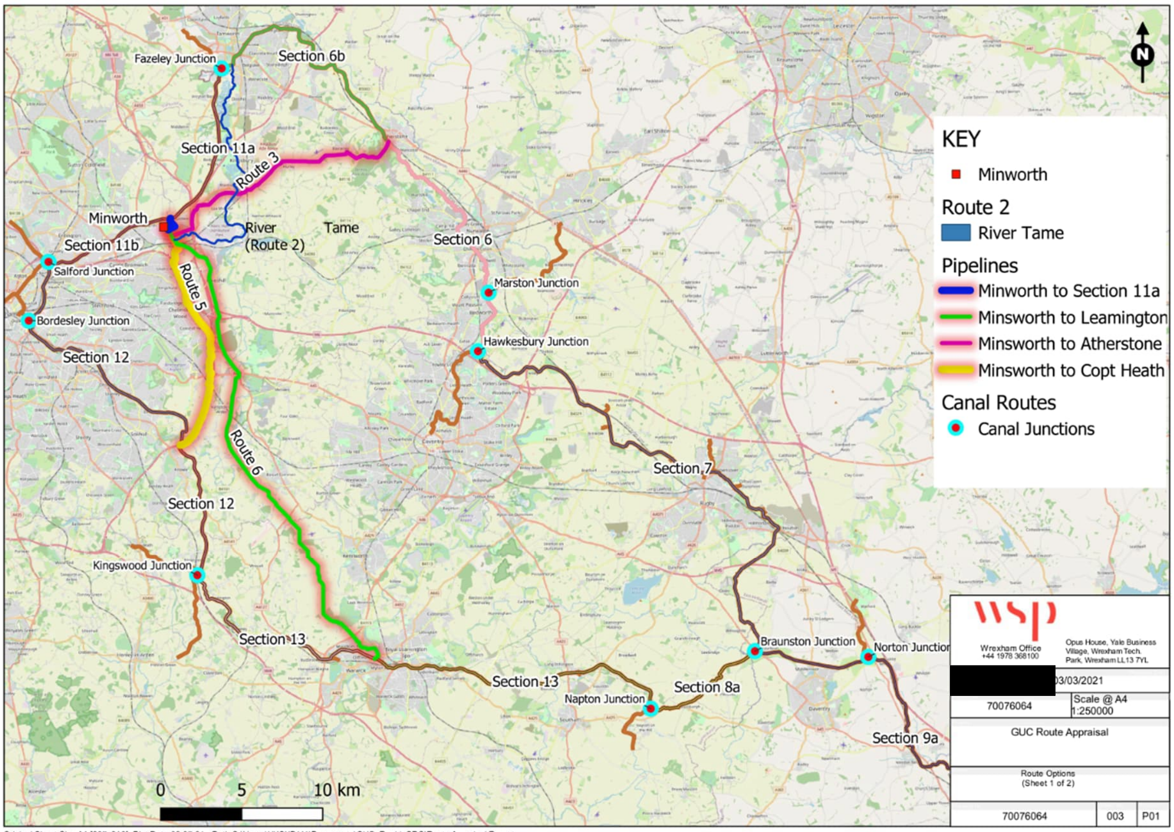
Transfer Pipelines				
ID	Option Ref	Risk Description	Risk Mitigation	Image
R1.1	Route 1	Existing service crossing within Minworth treatment site. Potential to contain the majority of the route within STW Minworth site. However the risk is, especially around aeration lanes and settlement tanks (see image), there is issuficient space in the narrow site road or verge without significant service crossing/diversions.	Current route therefore shown in farm track outside boundary fence.	Route1_Risk_001.PNG
R1.2		Crossing point for A4097 is dual carriageway approximately 22m wide	Assumed no dig crossing - auger or thrust bore.	
R3.1	Route 3	Route through historic gravel pit and sludge drying bed area of Minworth works. Potential unsuitable ground conditions and buried obstructions.	Site investigation and experience/knowledge of Severn Trent Minworth site team. Flexibility in pumped pipeline route to avoid obstructions.	Route3_Risk_001.PNG
R3.2		Crossing M6 Toll	Investigate existing culverted flood relief channel crossing - any space for pipeline. Worst case tunnelling	Route3_Risk_002.PNG
R3.3		A446 Dual Carriageway crossing	Directional drill	
R3.4		Crossing HS2 Phase 1 Route	Directional drill	Route3_Risk_003.PNG
R3.5		Crossing River Tame flood plain - environmental sensitive area and flood risk area.	Existing road crosses therefore route pipeline along verge. Road crosses river at culverted structures - pipeline crossing via pipe bridge or attached to existing structure.	Route3_Risk_004.PNG
R3.6		Two number railway crossings	Directional drill	
R3.7		Environmentally sensitive area around Atherstone	Pipeline route follows Coleshill Road	Route3_Risk_005.PNG
R3.8		Connection to canal from Coleshill Road	Potential opportunity for regeneration	Route3_Risk_006.PNG
R6.1	Route 6	Route has to cross existing Minworth outfall channels and through area of abandoned structures/chambers	Site investigation and experience/knowledge of Severn Trent Minworth site team. Flexibility in pumped pipeline route to avoid obstructions. Pipe bridges across existing channels.	Route6_Risk_001.PNG
R6.2		Crossing River Tame at historic (listed) bridge and through narrow residential roads	Potentially only suitable crossing point is downstream at WHS Plastics private estate - significantly increases complexity of crosssing and work along HS2 route.	Route6_Risk_002.PNG
R6.3		Crossing railway at Water Orton station - weak bridge, limited alternatives (none to west, more difficult to the east).		Route6_Risk_003.PNG
R6.4		Route down New Road - Service diversions	Increased temporary works to manage risks.	
R6.5		Crossing HS2 Phase 1 Route x2, M6 Toll and services	Long tunnel section - potentially difficult easment arrangement as will be in HS2 juncction area.	Route6_Risk_004.PNG
R6.6		Route along the A446 and crossing M6 and M6 Toll at A446 interchange.	Significant service diversions and multiple directional drilling for crossings	Route6_Risk_005.PNG
R6.7		Crossing A45/A452 interchange and HS2 route	Significant service diversions and multiple directional drilling for crossings	Route6_Risk_006.PNG
R6.8		Cross railway at village of Hapton in Arden	Directional drill	Route6_Risk_007.PNG
R6.9		Route through hamlet of Balsall	Follow B4101	Route6_Risk_008.PNG
R6.10		Route through Warwick - A46 dual carriageway, residential roads and A445	Significant service diversions and multiple directional drilling for crossings	Route6_Risk_009.PNG
R6.11		Connection to canal from A445	Will need to cross A445 bridge and connect to canal from the Tesco superstore site..	Route6_Risk_010.PNG
R6.12				Route6_Risk_011.PNG
R6.13				Route6_Risk_012.PNG
Canal Routes				
R1.3	Route 1	Curdworth Tunnel - fixed brick towpath, Grade II listing. Narrow therefore velocity issue	In cuttting with steep heavily wooded slopes accessable only by narrow towpath. May not be a straight forward solution. Worst case assume route 1 pipeline extended to downstream of the tunnel.	
R1.4		14 narrow arch bridges with velocity issues on Section 11a to Fazeley Junction	5 are listed but assumption is solid towpath can be removed an replaced by cantilever path.	
R1.5		Secrion 11a embankment No 7 is incorporated into flood defences for River Tame	Section contains 3 bridges for twopath widening and twopath raising by 50-100mm. Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route1_Risk_002.PNG
R1.6		Trent & Mersey branch from Fazeley Junction	Listed brick footbridge but assumption is solid towpath can be removed an replaced by cantilever path.	Route1_Risk_003.PNG
R1.7		Narrow aqueduct and embankments for crossing River Tame - velocity and difficulty of widening channel (listed structure with solid towpath)	Assumption is solid towpath can be removed an replaced by cantilever path.	Route1_Risk_004.PNG
R1.8		Condition of aqueduct	Assumed additional flow does not increase loading	Route1_Risk_005.PNG
R1.9		Narrow towpath in urban area for lock bypass pipework at Glascote Locks and limited space adjacent local nature reserve for pumping station	Alternative pumping station location and bypass identified but increases cost.	Route1_Risk_006.PNG
R1.10		Narrow arch bridges (listed structures) in urban area (Section 6b) - velocity issues with difficult bypass due to space	Assumption is solid towpath can be removed an replaced by cantilever path.	Route1_Risk_007.PNG
R1.11		Structural integrity issues of excavation adjacent to properties and weak bridges.	Assume additional temporary and permanent works to stabilise foundations.	Route1_Risk_008.PNG
R1.12		Section 6b through sensitive environemnt area of Pooley Country Park	Nett biodiversity gain identified for loss during twopath raising and bridge work	
R1.13		Section 6b, Embankment 4, Pooley Hall, flood defence against River Anker	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	
R1.14		Section 6b, Embankment 3, flood defence against River Anker	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	
R1.15		Polesworth STW	Assume discharge does not impact transfer water quality	Route1_Risk_009.PNG
R1.16		Access & power to Lock 11 Atherstone Lock for new pumping station	Extended access and route for power supply identified and cost allowance	Route1_Risk_010.PNG
R1.17		Access & power to Lock 9 Atherstone Lock for new pumping station	Extended access and route for power supply identified and cost allowance	Route1_Risk_011.PNG
R1.18		Restricted space through urban area for bypass pipework Atherstone Lock 5 to Lock 1 (Top Lock)	Alternative pumping station location and bypass identified but increases cost.	Route1_Risk_012.PNG
R1_3.1	Route 1 & 3	Within flood zone of River Anker and Bar Pool Brook through Nuneaton. Section 6 between Tuttle Hill Bridge (B4114) and Wash Lane Bridge (B4102)	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route1_Risk_013.PNG
R1_3.2		Runs parrallel and in flood zone of Wem Brook from Griff Quarry (Marston Junction with Ashby Canal) and Buckington Road (B4029) Bedworth.	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route1_Risk_014.PNG
R1_3.3		Hawkesbury Junction Lock has only 150mm lift.	Alternative pumping station layout identified.	Route1_Risk_015.PNG
R1_3.4		Canal, Section 7 from Hillmorton Lane to Hilmorton Locks, is within the flood zone of Clifton brook.	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route1_Risk_016.PNG
R1_3.5		Access to Hillmorton Bottom Lock for construction of bypass pumping station	Alternative pumping station location and bypass identified but increases cost.	Route1_Risk_017.PNG
R1_3_6.1	Route 1,3 & 6	Canal, Section 9a from Braunston Marina to Lock 3, within flood zone of River Leom.	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route1_Risk_018.PNG
R1_3_6.2		Space and access to Braunston Lock 1 to construct bypass pumping station and pipework. Site is historic steam engine building and canal is within narrow cutting on approach to Braunston Tunnel.	Alternative pumping station location and bypass identified but increases cost.	Route1_Risk_019.PNG
R1_3_6.3		Space for new bypass weir return flow at Top Lock (Lock 7) at A5 Watling Street Bridge.	Assume additional temporary and permanent works to stabilise foundations.	Route1_Risk_020.PNG
R1_3_6.4		Space for new bypass weir return flow at Lock12 Wilton Lock Bridge.	Assume additional temporary and permanent works to stabilise foundations.	Route1_Risk_021.PNG
R1_3_6.5				Route1_Risk_022.PNG
R1_3_6.6		Space for new bypass weir return flow at Lock13 downstream of Wilton Lock Bridge.	Assume additional temporary and permanent works to stabilise foundations.	Route1_Risk_023.PNG
R1_3_6.7		Section 9a, Daventry - Braunston Summit weir, in flood zone of Daventry Reservoir	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route1_Risk_024.PNG
R1_3_6.8		Space for new bypass weir return flow at Lock14 Bridge Road Stoke Bruerne.	Assume additional temporary and permanent works to stabilise foundations.	Route1_Risk_025.PNG
R1_3_6.9				Route1_Risk_026.PNG
R1_3_6.10		Space for new bypass weir return flow at Lock18 Northampton Road A508	Assume additional temporary and permanent works to stabilise foundations.	Route1_Risk_027.PNG
R1_3_6.11		River Tove Junction	Nett biodiversity gain identified for loss during twopath raising and bridge work	Route1_Risk_028.PNG
R1_3_6.12		Cosgrove Junction - access and space for pumping station	Alternative pumping station location and bypass identified but increases cost.	Route1_Risk_029.PNG
R1_3_6.13		Cosgrove aueduct (Iron Trunk) and embankents in flood risk zone of River Great Ouze	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route1_Risk_030.PNG
R1_3_6.14		Only 300mm level difference at Lock 22, Fenny Stratford Lock	Alternative pumping station layout identified.	
R1_3_6.15		Access and space for Stoke Hamond Lock pumping station and bypass	Alternative pumping station location and bypass identified but increases cost.	Route1_Risk_031.PNG
R1_3_6.16		Access and space for Three Locks bypass	Alternative pumping station location and bypass identified but increases cost.	Route1_Risk_032.PNG
R1_3_6.17				Route1_Risk_033.PNG
R1_3_6.18		Access and space for Leighton Lock pumping station and bypass	Alternative pumping station location and bypass identified but increases cost.	Route1_Risk_034.PNG
R1_3_6.19				Route1_Risk_035.PNG
R1_3_6.20		Canal, Section 30, follows flood risk zone for more than 12km	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route1_Risk_036.PNG
R1_3_6.21		Space between canal and River Ouzel for abstraction point	Increased temporary works to manage risks. Assumed permit granted for treatment works loacation.	Route1_Risk_037.PNG
R1_3_6.22				Route1_Risk_038.PNG
R6.14	Route 6	Canal Section13, from pipeline discharge to Aqueduct, and Embankment 19 (Tesco Site) in flood risk zone of River Avon.	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route6_Risk_013.PNG
R6.15		Conditiona and freeboard of aqueduct	Assumed additional flow does not increase loading	Route6_Risk_014.PNG
R6.16		Canal, Section 13, from Aqueduct 9 to Lock 19 (Wood Lock) in flood risk zone of River Leom and tributories.	Assumed permit to work on flood defences will be granted additional modelling and work will be required prior to commencing.	Route6_Risk_015.PNG
R6.17		Space and accesss to pumping station and bypass at Radford Bottom lock (lock 23)	Extended access and route for power supply identified and cost allowance	Route6_Risk_016.PNG
R6.18		Space and accesss to pumping station and bypass at lock 22	Extended access and route for power supply identified and cost allowance	Route6_Risk_017.PNG
R6.19		Space and accesss to pumping station and bypass at lock 20	Extended access and route for power supply identified and cost allowance	Route6_Risk_018.PNG
R6.20		Space and accesss to pumping station and bypass at lock 19	Extended access and route for power supply identified and cost allowance	Route6_Risk_019.PNG
R6.21		Space for pumping station and bypass at lock 18	Extended access and route for power supply identified and cost allowance	Route6_Risk_020.PNG
R6.22		Space and accesss to pumping station and bypass at lock 17	Extended access and route for power supply identified and cost allowance	Route6_Risk_021.PNG
R6.23		Space and accesss to pumping station and bypass at lock 13	Extended access and route for power supply identified and cost allowance	Route6_Risk_022.PNG
R6.24		Space and accesss to pumping station and bypass at lock 12	Extended access and route for power supply identified and cost allowance	Route6_Risk_023.PNG
R6.25		Space and accesss to pumping station and bypass at lock 11	Extended access and route for power supply identified and cost allowance	Route6_Risk_024.PNG
R6.26		Space and accesss to pumping station and bypass at lock 3	Extended access and route for power supply identified and cost allowance	Route6_Risk_025.PNG

Appendix B

ENVIRONMENTAL IMPACT

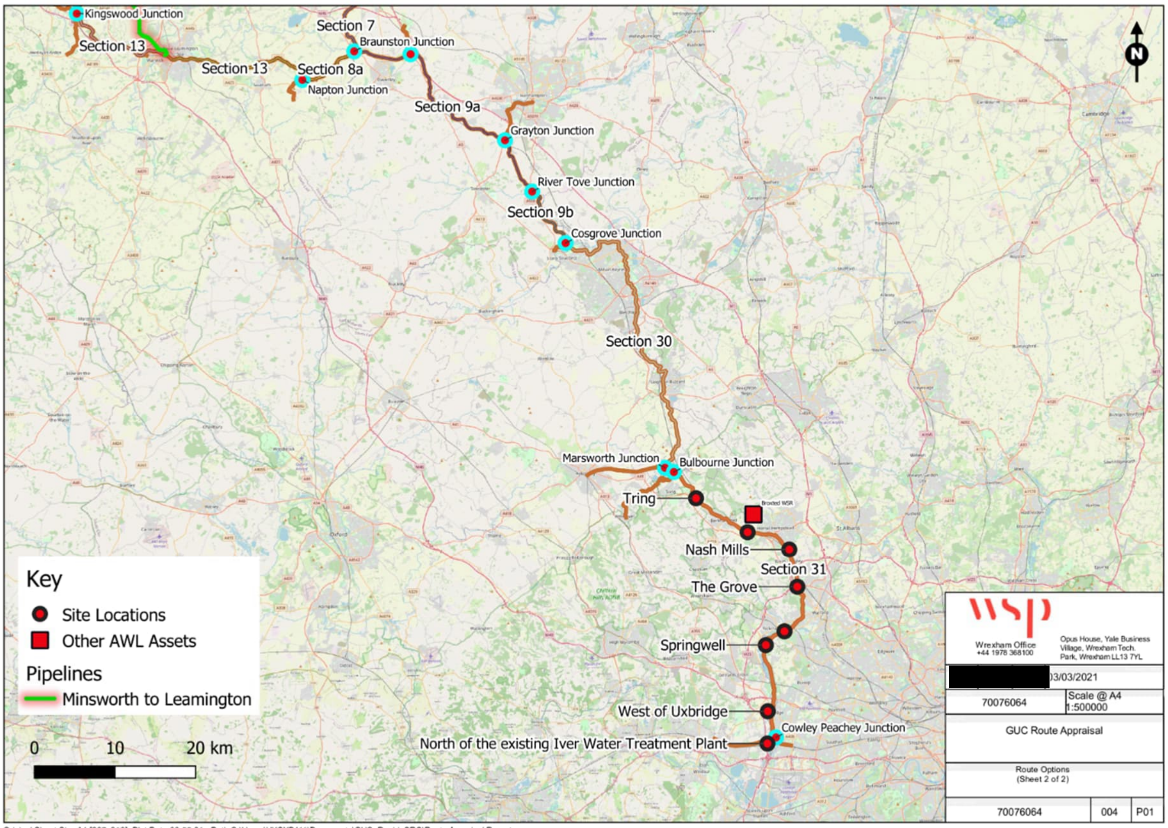
Figure B-1 - Gate 1 Route Options Plan 1 of 2

Author names redacted



Original Sheet Size A4 [297x210] Plot Date 03.37.21 Path C:\Users\UKSXB111\Documents\GUC_Rapid_SRO\Route Appraisal Report

Figure B-2 - Gate 1 Route Options Plan 2 of 2



Original Sheet Size A4 [297x210] Plot Date 03.55.21 Path C:\Users\UKSXB111\Documents\GUC_Rapid_SRO\Route Appraisal Report

Appendix B.1

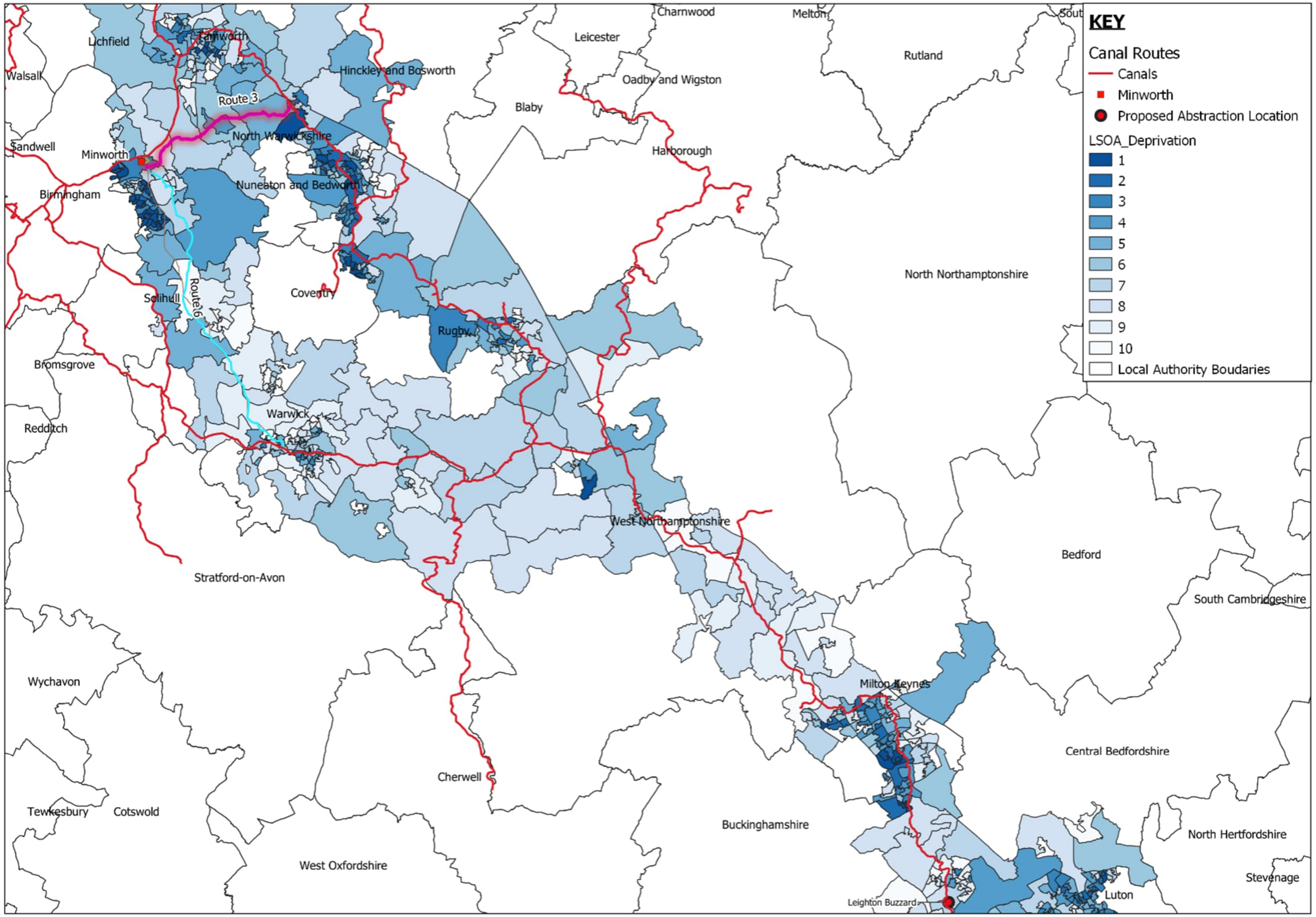
ENVIRONMENTAL AND HERITAGE SITE RISK REVIEW

SUMMARY OF NUMBER OF SITES WITH HERITAGE AND ENVIRONMENTAL DESIGNATIONS

Criteria	Canal Section (from North to South)									
	11a	6b	7	9	30	31	8a	11b	12	13
World Heritage Sites	0	0	0	0	0	0	0	0	0	0
Special Protection Areas	0	0	0	0	0	0	0	0	0	0
Special Areas of Conservation	0	0	0	0	0	0	0	0	0	0
Scheduled Monuments	0	3	0	1	7	6	3	0	0	0
Ramsar England	0	0	0	0	0	0	0	0	0	0
Parks and Gardens	0	1	0	1	1	2	0	0	0	0
Local Nature Reserves	0	5	4	0	0	7	0	1	1	4
Country Parks England	1	2	2	0	0	1	0	1	1	0
Areas of Outstanding Natural Beauty	0	0	0	1	1	1	0	0	0	0
Ancient Woodland England	0	2	1	0	0	0	0	0	0	0
National Trails England	0	0	0	0	1	1	0	0	0	0
National Nature Reserves England	0	0	0	0	1	1	0	0	0	0
Great Crested Newt Pond Surveys	0	1	0	3	3	0	0	0	0	0
Great Crested Newt Class Survey	0	1	0	0	2	0	0	0	0	0
Listed Buildings	16	41	25	77	91	116	9	4	19	26
Sites of Special Scientific Interest	1	7	0	0	3	5	0	0	1	3
Total Per Canal Section*	18	63	32	83	110	140	12	6	22	33
Route 1 total = 446										
Route 3 total = 365										
Route 6 = 378										

Appendix C

SOCIAL IMPACT


KEY
Canal Routes
Canals
Minworth
Proposed Abstraction Location
LSOA_Deprivation
1
2
3
4
5
6
7
8
9
10
Local Authority Boudaries
Lichfield
Tamworth
Walsall
Hinckley and Bosworth
Leicester
Charnwood
Melton
Rutland
Oadby and Wigston
Blaby
Route 3
North Warwickshire
Sandwell
Minworth
Harborough
Birmingham
Nuneaton and Bedworth
North Northamptonshire
Coventry
Solihull
Route 6
Rugby
Bromsgrove
Redditch
Warwick
West Northamptonshire
Bedford
Stratford-on-Avon
South Cambridgeshire
Wychavon
Milton Keynes
Central Bedfordshire
Cherwell
Tewkesbury
Cotswold
Buckinghamshire
North Hertfordshire
West Oxfordshire
Stevenage
Luton
Leighton Buzzard

Appendix D

COST

Route 1 - Minworth canal route to Leighton Buzzard WTW 115MlD

CAPEX

Row Labels	Sum of Civil2	Sum of Mech2	Sum of ICA2	Sub Total
Design	£ 14,011,130.33	£ 8,173,159.36	£ 1,167,594.19	£ 23,351,884
Power Supply	£ 150,990.84	£ 1,962,880.97	£ 905,945.06	£ 3,019,817
Site Investigation	£ 60,000.00	£ -	£ -	£ 60,000
Abstraction & Treatment	£ -	£ -	£ -	£ -
Canal Pumping	£ 103,400,400.24	£ 10,266,237.73	£ 1,412,493.96	£ 115,079,132
Embankments	£ 34,935,281.25	£ -	£ -	£ 34,935,281
Environmental	£ 4,487,080.00	£ -	£ -	£ 4,487,080
Lock Weirs	£ 17,800,473.90	£ 2,094,173.40	£ 1,047,086.70	£ 20,941,734
Planning	£ 59,562.00	£ -	£ -	£ 59,562
Structures	£ 45,672,016.00	£ 520,000.00	£ 260,000.00	£ 46,452,016
Transfer	£ 2,874,199.58	£ 363,404.74	£ 49,442.81	£ 3,287,047
Grand Total	£ 223,451,134.14	£ 23,379,856.20	£ 4,842,562.72	£ 251,673,553

Row Labels	Sum of Civil2	Sum of Mech2	Sum of ICA2	% of Total
Design	6.27%	34.96%	24.11%	9%
Power Supply	0.07%	8.40%	18.71%	1%
Site Investigation	0.03%	0.00%	0.00%	0%
Abstraction & Treatment	0.00%	0.00%	0.00%	0%
Canal Pumping	46.27%	43.91%	29.17%	46%
Embankments	15.63%	0.00%	0.00%	14%
Environmental	2.01%	0.00%	0.00%	2%
Lock Weirs	7.97%	8.96%	21.62%	8%
Planning	0.03%	0.00%	0.00%	0%
Structures	20.44%	2.22%	5.37%	18%
Transfer	1.29%	1.55%	1.02%	1%
Grand Total	100.00%	100.00%	100.00%	100%

Pipelines	£ 3,615,752
Pumping stations	£ 133,118,264
Bypass structures	£ 72,999,326
Canal and towpath works	£ 41,940,212
	£ 251,673,553

Capex Total	£ 251,673,553	
0%	£ -	Abstraction & Treatment
91%	£ 228,321,669	Transfer & Canal
9%	£ 22,832,167	Design

Of Transfer & Canal Works

Minworth to Canal =	1%
Canal to Abstraction Point =	99%

Opex Transfer	£ 150,062	
Opex Abstraction & Treatment	£ -	
Opex Canal	£ 3,289,910	
OPEX Total	£ 3,439,972	per annum

OB	36%	applied to Capex
Capex	£ 342,276,032	
Opex	£ 4,678,361	
Total	£ 346,954,394	

Asssuming operation 365 days per annum

Total volume move =	36,500,000,000	litres per year
Price per Litre moved =	£ 0.000094	per annum of OPEX cost
Price per m^3 moved =	£ 0.094246	per annum of OPEX cost

Route 3 - Pipeline Minworth to Atherstone, canal route to Leighton Buzzard WTW 115MID

CAPEX

Row Labels	Sum of Civil2	Sum of Mech2	Sum of ICA2	Sub Total
Design	£ 9,667,694.73	£ 5,639,488.59	£ 805,641.23	£ 16,112,825
Power Supply	£ 62,172.70	£ 808,245.10	£ 373,036.20	£ 1,243,454
Site Investigation	£ 50,000.00	£ -	£ -	£ 50,000
Abstraction & Treatment	£ -	£ -	£ -	£ -
Canal Pumping	£ 19,826,899.38	£ 4,195,506.83	£ 505,902.87	£ 24,528,309
Embankments	£ 33,253,156.65	£ -	£ -	£ 33,253,157
Environmental	£ 2,624,640.00	£ -	£ -	£ 2,624,640
Lock Weirs	£ 13,241,815.95	£ 1,557,860.70	£ 778,930.35	£ 15,578,607
Planning	£ 138,252.00	£ -	£ -	£ 138,252
Structures	£ 43,355,516.00	£ 455,000.00	£ 227,500.00	£ 44,038,016
Transfer	£ 37,780,995.39	£ 1,720,747.95	£ 172,067.43	£ 39,673,811
Grand Total	£ 160,001,142.80	£ 14,376,849.18	£ 2,863,078.08	£ 177,241,070

Row Labels	Sum of Civil2	Sum of Mech2	Sum of ICA2	% of Total
Design	6.04%	39.23%	28.14%	9%
Power Supply	0.04%	5.62%	13.03%	1%
Site Investigation	0.03%	0.00%	0.00%	0%
Abstraction & Treatment	0.00%	0.00%	0.00%	0%
Canal Pumping	12.39%	29.18%	17.67%	14%
Embankments	20.78%	0.00%	0.00%	19%
Environmental	1.64%	0.00%	0.00%	1%
Lock Weirs	8.28%	10.84%	27.21%	9%
Planning	0.09%	0.00%	0.00%	0%
Structures	27.10%	3.16%	7.95%	25%
Transfer	23.61%	11.97%	6.01%	22%
Grand Total	100.00%	100.00%	100.00%	100%

Pipelines	£	43,641,192
Pumping stations	£	30,765,370
Bypass structures	£	63,715,260
Canal and towpath works	£	39,119,248
	£	177,241,070

Capex Total	£	177,241,070	
0%	£	-	Abstraction & Treatment
91%	£	161,128,246	Transfer & Canal
9%	£	16,112,825	Design

Of Transfer & Canal Works

Minworth to Canal =	25%
Canal to Abstraction Point =	75%

Opex Transfer	£	1,315,501	
Opex Abstraction & Treatment	£	-	
Opex Canal	£	2,284,790	
OPEX Total	£	3,600,291	per annum

OB		35%	applied to Capex
Capex	£	239,275,445	
Opex	£	4,860,393	
Total	£	244,135,838	

Asssuming operation 365 days per annum

Total volume move =		36,500,000,000	litres per annum
Price per Litre moved =	£	0.000099	per annum of OPEX cost
Price per m^3 moved =	£	0.098638	per annum of OPEX cost

Route 6 - Pipeline Minworth to Leamington, canal route to Leighton Buzzard WtW 115MlD

CAPEX

Row Labels	Sum of Civil2	Sum of Mech2	Sum of ICA2	Sub Total
Design	£ 19,126,760.19	£ 11,157,276.78	£ 1,593,896.68	£ 31,877,934
Power Supply	£ 153,951.45	£ 2,001,368.83	£ 923,708.69	£ 3,079,029
Site Investigation	£ 72,500.00	£ -	£ -	£ 72,500
Abstraction & Treatment	£ -	£ -	£ -	£ -
Canal Pumping	£ 108,343,201.46	£ 12,566,742.37	£ 1,711,567.66	£ 122,621,511
Embankments	£ 23,886,570.00	£ -	£ -	£ 23,886,570
Environmental	£ 1,788,000.00	£ -	£ -	£ 1,788,000
Lock Weirs	£ 21,923,256.95	£ 2,579,206.70	£ 1,289,603.35	£ 25,792,067
Planning	£ 143,682.00	£ -	£ -	£ 143,682
Structures	£ 47,823,356.00	£ 195,000.00	£ 97,500.00	£ 48,115,856
Transfer	£ 86,720,640.49	£ 1,221,144.19	£ 141,166.69	£ 88,082,951
Grand Total	£ 309,981,918.53	£ 29,720,738.86	£ 5,757,443.07	£ 345,460,100

Row Labels	% of Civil	% of Mech	% of ICA	% of Total
Design	6.17%	37.54%	27.68%	9%
Power Supply	0.05%	6.73%	16.04%	1%
Site Investigation	0.02%	0.00%	0.00%	0%
Abstraction & Treatment	0.00%	0.00%	0.00%	0%
Canal Pumping	34.95%	42.28%	29.73%	35%
Embankments	7.71%	0.00%	0.00%	7%
Environmental	0.58%	0.00%	0.00%	1%
Lock Weirs	7.07%	8.68%	22.40%	7%
Planning	0.05%	0.00%	0.00%	0%
Structures	15.43%	0.66%	1.69%	14%
Transfer	27.98%	4.11%	2.45%	25%
Grand Total	100.00%	100.00%	100.00%	100%

Pipelines	£ 96,891,246
Pumping stations	£ 140,577,294
Bypass structures	£ 79,101,732
Canal and towpath works	£ 28,889,829
	£ 345,460,101

Capex Total	£ 345,460,100	
0%	£ -	Abstraction & Treatment
91%	£ 313,582,167	Transfer & Canal
9%	£ 31,358,217	Design

Of Transfer Works

Minworth to Canal =	28%
Canal to Abstraction Point =	72%

Opex Transfer	£ 904,457	
Opex Abstraction & Treatment	£ -	
Opex Canal	£ 5,818,707	
OPEX Total	£ 6,723,164	per annum

OB	36%
Capex	£ 469,825,737
Opex	£ 9,143,504
Total	£ 478,969,240

Asssuming operation 365 days per annum

Total volume move =	36,500,000,000	litres per year
Price per Litre moved =	£ 0.000184	per annum of OPEX cost
Price per m^3 moved =	£ 0.184196	per annum of OPEX cost

Appendix E

PROGRAMME

WBS	Task	Start	End	Work Days
1	Route 1	Wed 1/01/25	Thu 4/12/29	1117
1.1	Detail site investigations	Wed 1/01/25	Tue 7/29/25	150
1.2	Major crossing agreements	Wed 7/30/25	Tue 10/21/25	60
1.3	Environmental surveys	Wed 10/22/25	Tue 5/19/26	150
1.4	Land notices for construction	Tue 7/29/25	Mon 10/20/25	60
1.4.1	Enabling works	Tue 10/21/25	Mon 12/01/25	30
1.4.1.1	Transfer pipeline	Mon 12/01/25	Fri 1/02/26	25
1.4.1.2	Pumping stations	Mon 12/01/25	Fri 7/31/26	175
1.4.1.3	Canal work	Mon 12/01/25	Fri 8/04/28	700
1.5	Power Supplies	Fri 1/30/26	Thu 2/25/27	280
1.6	Minworth	Sun 6/01/25	Fri 10/23/26	365
1.6.1	Testing & Commissioning	Fri 8/04/28	Thu 12/07/28	90
1.7	Final reinstatement, Snagging etc	Fri 12/08/28	Thu 4/12/29	90
1.8	*[Insert Rows above this one, then Hide or Delete this row]*			
2	Route 3	Wed 1/01/25	Thu 9/28/28	977
2.1	Detail site investigations	Wed 1/01/25	Tue 10/21/25	210
2.2	Major crossing agreements	Wed 10/22/25	Tue 4/07/26	120
2.3	Environmental surveys	Wed 4/08/26	Tue 11/03/26	150
2.4	Land notices for construction	Tue 10/21/25	Mon 1/12/26	60
2.4.1	Enabling works	Tue 1/13/26	Mon 2/23/26	30
2.4.1.1	Transfer pipeline	Mon 2/23/26	Mon 3/01/27	267
2.4.1.2	Pumping stations	Mon 2/23/26	Tue 9/15/26	147
2.4.1.3	Canal work	Mon 2/23/26	Fri 1/21/28	500
2.5	Power Supplies	Fri 4/24/26	Thu 2/11/27	210
2.6	Minworth	Sun 6/01/25	Fri 10/23/26	365
2.6.1	Testing & Commissioning	Fri 1/21/28	Thu 5/25/28	90
2.7	Final reinstatement, Snagging etc	Fri 5/26/28	Thu 9/28/28	90
2.8	*[Insert Rows above this one, then Hide or Delete this row]*			
3	Route 6	Wed 1/01/25	Wed 4/18/29	1121
3.1	Detail site investigations	Wed 1/01/25	Tue 5/19/26	360
3.2	Major crossing agreements	Wed 5/20/26	Tue 11/03/26	120
3.3	Environmental surveys	Wed 11/04/26	Tue 6/01/27	150
3.4	Land notices for construction	Tue 5/19/26	Mon 8/10/26	60
3.4.1	Enabling works	Tue 8/11/26	Mon 9/21/26	30
3.4.1.1	Transfer pipeline	Mon 9/21/26	Wed 12/13/28	583
3.4.1.2	Pumping stations	Mon 9/21/26	Thu 7/29/27	224
3.4.1.3	Canal work	Mon 9/21/26	Fri 7/30/27	225
3.5	Power Supplies	Fri 11/20/26	Thu 12/16/27	280
3.6	Minworth	Sun 6/01/25	Fri 10/23/26	365
3.6.1	Testing & Commissioning	Thu 12/14/28	Wed 4/18/29	90
3.7	Final reinstatement, Snagging etc	Thu 4/19/29	Wed 8/22/29	90

Appendix F

DETAILED ROUTE DESCRIPTIONS

Appendix F.1

ROUTE 1

Author names redacted

Grid references redacted

TECHNICAL NOTE – Route 1

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 1 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

INTRODUCTION

A review has been undertaken to identify key issues and risks associated with Route 1 (Birmingham-Fazeley Canal to Coventry Canal).

The length that has been examined as part of this technical note extends from the point where the transfer pipeline discharges into the canal near to Broad Bulk Bridge, up to the point at which Route 3 (Minsworth to Atherstone) joins Coventry Canal.

KEY ISSUES AND RISKS IDENTIFIED

The following sections detail the key issues and risks identified, for works that might be required along the affected length of canal.

Pumped transfer discharge near Broad Bulk Bridge (low impact on route feasibility)

The construction of a discharge structure is required near to Broad Bulk Bridge, at coordinates 41[redacted],29[redacted]. This will require vehicular access from Kingsbury Road, either across the field or along the track to Broad Bulk Bridge. Tree clearance may be required. The issues associated with the location are anticipated to introduce a low impact on the feasibility of the route.

Figure 1: View towards Birmingham-Fazeley Canal from Kingsbury Road towards Broad Bulk Bridge. Source @2022 Google

Author names redacted

Grid references redacted

TECHNICAL NOTE – Route 1

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 1 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

Footbridge 77, located to the east of the junction between the Birmingham and Fazeley Canal and the Coventry Canal (potential high detrimental impact on route feasibility)

Bridge 77 is located to the east of the junction between the Birmingham and Fazeley Canal and the Coventry Canal at coordinates 42[redacted], 30[redacted]. It is classified as a listed building. Initial hydraulic analysis has flagged up that this footbridge may act as a constriction in the network. If further investigation finds that this is the situation, works may be required to transfer some of the flows to downstream of the footbridge.

Figure 2: View along the Birmingham-Fazeley Canal towards the junction with the Coventry Canal and Bridge 77. Source @2022 Google

Due to the constrained nature of the site, it would not be feasible to widen the opening to the south side of the footbridge adjacent to the Fazeley Sawmill. It is unclear if there is sufficient space on the northern bank. However, if there is, works to widen canal could potentially utilise an existing access point on the opposite bank to the bridge from Suffolk Way, Tamworth.

Alternatively, if this is not feasible, or if it is found it would provide insufficient capacity, a pipeline may be required. A potential route has been identified, with an outlet located near to Tolsons Footbridge. This would allow the pipeline to avoid St Paul's Church graveyard (at Fazeley). The pipeline would then run along Colehill St (A4091), where it could discharge near to Bridge 76 on Coventry Canal upstream of bridge 77.

Author names redacted

Grid references redacted

TECHNICAL NOTE – Route 1

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 1 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

It is anticipated that issues associated with the location could have the potential to introduce a high detrimental impact on the feasibility of the route.

Alvecote Pools SSSI, west of Alvecote Bridge (potential medium impact on route feasibility)

A constriction in the width of the Coventry canal has been identified at coordinate 42[redacted],30[redacted]. As shown on **Figure 3** it is located to the west of Alvecote Bridge, at the upstream end of the section of the Alvecote Pools SSSI which extends along the northern side of the Coventry canal. To avoid the SSSI, it would be necessary to undertake work to address the constriction on the southern side of the canal. It is assumed that this work would consist of widening of the canal locally.

There is no existing vehicular access for construction. However, it may potentially be possible to create access private land via the new housing development (for example from Lapley Avenue, Hopton Close or Hollington Close B77 4GU). Tree clearance would be required.

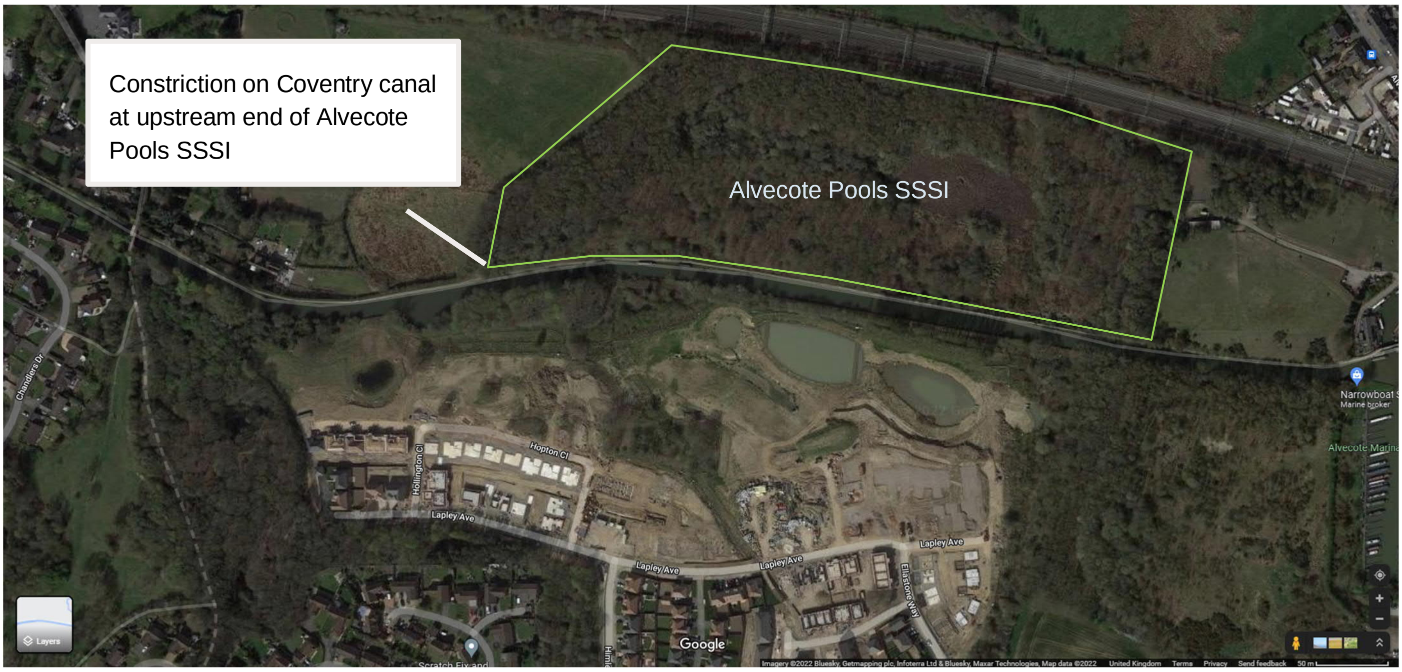


Figure 3: Location of constriction of Coventry Canal at Alvecote Pools SSSI. Source @2022 Google

The issues associated with the location are anticipated to introduce a medium impact on the feasibility of the route.

TECHNICAL NOTE – Route 1

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
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PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

Alvecote Pools SSSI, south-east of Alvecote Bridge (potential high impact on route feasibility)

Two further constrictions have been identified to the south-east of Alvecote Bridge at coordinates 42[redacted],303[redacted] and 42[redacted],30[redacted]. As shown on **Figure 4** the constrictions are located where Alvecote Pools SSSI and Pooley Country Park extend along the northern side of the Coventry canal. It is assumed that the required work to address the constriction would consist of widening the canal locally.

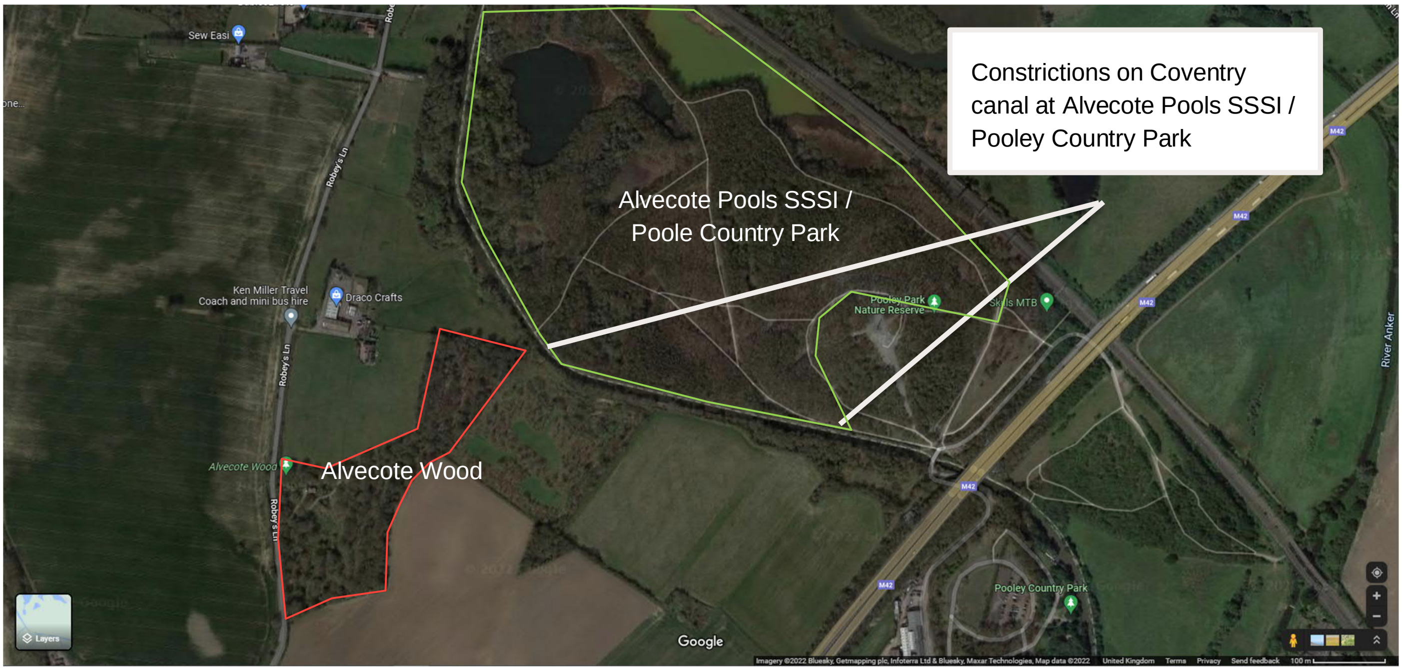

Figure 4: Location of constrictions of Coventry Canal at Alvecote Pools SSSI/Pooley Country Park. Source @2022 Google

There are no known existing vehicular accesses for construction. Depending on the extent of the works and the size of the plant required, it may be feasible to access the two locations utilising existing footway routes within the country park. The works may require the temporary closure and alteration to the existing towpath. This is likely to require tree clearance to be undertaken and would result in disruption within the SSSI and country park.

To avoid affecting the SSSI, it would be necessary to undertake work to address the constrictions on the south-western side of the canal. Access would need to be gained either across private land, avoiding Alvecote Wood (ancient woodland) shown outlined in red on **Figure 4.** Potentially it could be achieved by utilising Draco Crafts access to the north of Alvecote Wood. Access would then run along the northern boundary of the wood and the edge of the canal. Again, tree clearance would be required.

The issues associated with the locations are anticipated to have the potential to introduce a high impact on the feasibility of the route.

Author names redacted

Grid references redacted

TECHNICAL NOTE – Route 1

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 1 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

Atherstone flight of locks (potential medium impact on route feasibility)

At Atherstone, the flight of locks flow in the opposite direction to the desired transfer of water resources. Therefore, it would be necessary to pump and construct a pipeline from downstream of Lock 11 (also known as Atherstone Bottom Lock), which is located at coordinate 42[redacted],29[redacted]. The pipe outlet would then be located upstream of Lock 8, which is located at coordinate 42[redacted], 29[redacted].

The Environment Agency flood risk mapping indicates that due to the canal's close proximity to the main river, the River Anker, the Atherstone Bottom Lock is located within Flood Zones 2 and 3. This introduces the risk that fluvial flood water could be entering the canal at this location during flood events. It is critical that the resilience of the infrastructure is safeguarded to ensure continued operation. It is therefore proposed that the pumping station is located outside of the Flood Zone in the vicinity of Lock 10.

There is no existing vehicular access to Lock 11 (the Atherstone Bottom Lock) or Lock 10. To the north-east of the canal, the closest vehicular access is off Spon Lane, approximately 600m to the north-west. Access to the site would potentially require clearance of existing trees both for the length where there is a pinch point between the river and canal, as well as field boundaries.

Alternatively, if the inlet / pipeline located on the south-west of canal, vehicular access could be via Green Lane which is located approximately 370m to the north-west. This would reduce the need for tree clearance.

Figure 5: Location of the Atherstone Bottom Lock and Lock 10 on the Coventry Canal. Source @2022 Google

TECHNICAL NOTE – Route 1

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SUBJECT:	G2 Route Selection - Route 1 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

The pump outlet would be located upstream of Lock 8. Whether the pipeline runs to the north or south of the canal, it would need to cross a watercourse which is a tributary of the River Anker.

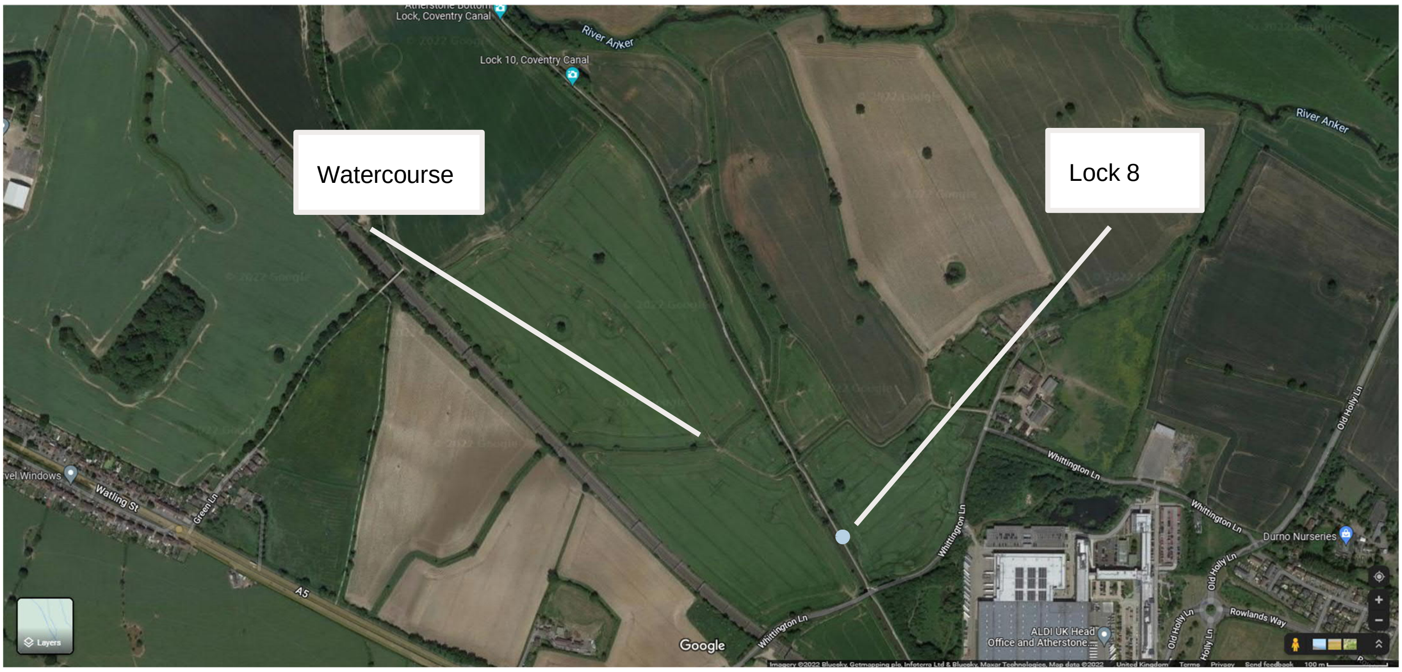

Figure 6: Location of the Atherstone Top Lock on the Coventry Canal. Source @2022 Google

Again, there is no existing vehicular access to Lock 8. The closest vehicular access is off Whittington Lane, approximately 130m to the south-east of Lock 8. On the south-west side of the canal, there is an existing field opening onto Whittington Lane.

The issues associated with the location of the inlet/outlet and pumping station, plus route of the transfer pipeline, are anticipated to have the potential to introduce a medium impact on the feasibility of the route.

Flight of locks at Baddesley Basin marina (potential low impact on route feasibility)

At Baddesley Basin, the flight of locks flow in the opposite direction to the desired transfer of water resources. Therefore, it would be necessary to pump and construct a pipeline from downstream of Lock 7, which is located at coordinate 42[redacted], 29[redacted]. The pipe outlet would then be located upstream of Lock 6 (to the south-east of Holly Lane, B4116), which is located at coordinate 43[redacted], 29[redacted].

Author names redacted

Grid references redacted

TECHNICAL NOTE – Route 1

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 1 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

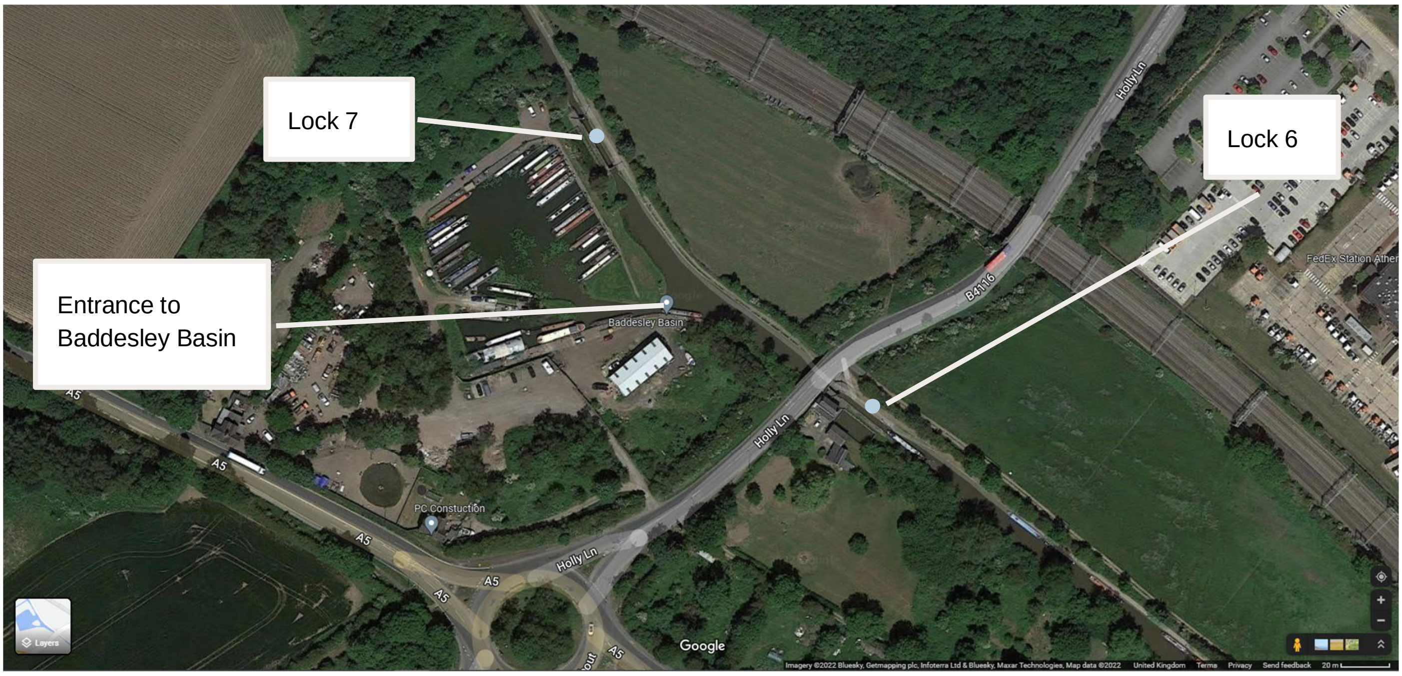

Figure 7: Location of Locks 7 and 6 on the Coventry Canal. Source @2022 Google

The closest vehicular access to the inlet would either be from the marina to the south-west or off Holly Lane (B4116) to the north-west of the canal. The most direct route for the pipeline would be to the north-east to avoid needing to divert around the outside of the marina.

It is therefore assumed that the pipeline would be routed through the field to the north-east side of the canal, from downstream Lock 7, across Holly Lane to downstream of Lock 6.

To facilitate access to the field, there is an existing overgrown dropped kerb and opening in the hedgerow off Holly Lane. To the south of Holly Lane (north-east of the canal), there is another field access which with some removal/reinstatement of the hedgerow could afford access to undertake the required construction works.

Issues associated with the location of the inlet/outlet and pumping station, plus route of the transfer pipeline, are anticipated to have the potential to introduce a low impact on the feasibility of the route.

Flight of locks at Atherstone, near station (potential high impact on route feasibility)

At Atherstone (near to the station), the flight of locks flow in the opposite direction to the desired transfer of water resources. Therefore, it would be necessary to pump and construct a pipeline from a location to the north of where Merevale road bridge crosses over the canal at coordinate 43[redacted], 29[redacted]. The pipe outlet would then be located upstream of Lock 1 (also known at Atherstone Top Lock), which is located at coordinate 43[redacted], 29[redacted].

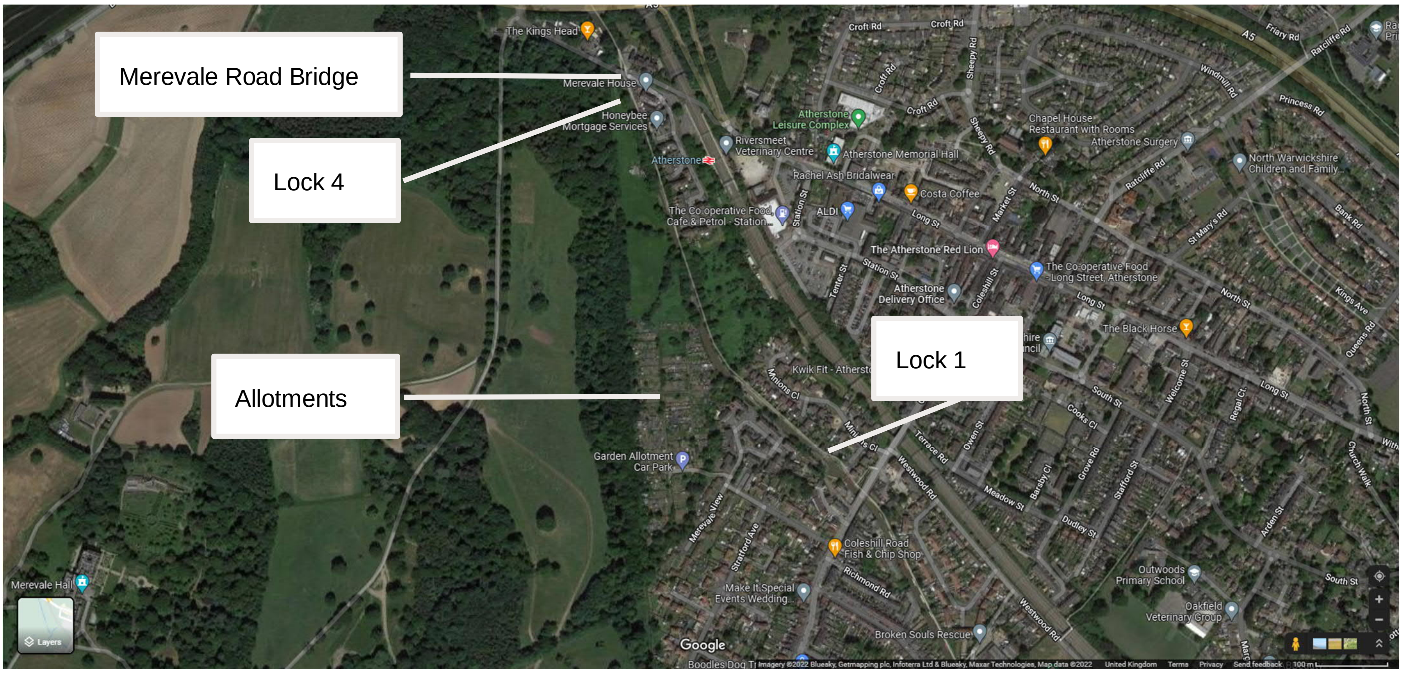

Figure 8: Location of Locks 7 and 6 on the Coventry Canal. Source @2022 Google

Two potential pipeline routes have been identified:

- **To the east of the canal:**

  The pipeline would need to cross Old Watling Street and run along Merevale Road. At the end of Merevale Road, it would cross through a fairly heavily vegetated area before running parallel with the railway, potentially utilising an existing access track (on what is expected is Network Rail land) up to the end of Minions Close. The pipeline would then follow Minions Close, where it would require the removal/reinstatement of a brick wall in a front garden at the end of the housing estate cul-de-sac, before discharging upstream of Atherton Locks. This option would require consultation and agreement with Network Rail to work in the vicinity of the railway.

- **To the west of the canal:**

  It may be possible to run the pipeline across the Kingshead carpark. Pipeline could then cross Merevale road, running through agricultural land (along the boundary) to the west of the lock and any bypass pond structures. Access to lay a pipeline could be gained via an existing field gate from Merevale Road (to the north-west). The pipeline would then need to cross through allotments, before running along Coleshill Road. This option would require potentially the consultation with a large number of individual stakeholders who hold agreements to garden the allotments plots. Additionally, as laid out in Acquisition of Land Act 1981, allotments are afforded some protection against compulsory acquisition as they are classified in s.19 as 'special kinds of land'[1].

Issues associated with the location of the inlet/outlet and pumping station, plus route of the transfer pipeline, are anticipated to have the potential to introduce a high detrimental impact on the feasibility of the route for both options.

Curdworth Tunnel (potential high impact on route feasibility)

Figure 9 Curdworth Tunnel

[1] See 'Guidance on Compulsory purchase process and The Crichel Down Rules', Department for Levelling up, Housing and Communities, July 2019 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026178/CPO_guidance_-_with_2019_update.pdf [accessed 09/03/2022]

Curdworth tunnel (circa 1789), although short at only 54m long, is narrow and is a Grade II listed structure (including the towpath). The width of the tunnel restricts the flow capacity at this point. At peak transfer flows the velocity through this section exceeds 0.34m/s and may be difficult for boats to pass. There is also the potential issue of scour and environmental impact (e.g. barrier to fish movements).

There is no obvious alternative route and may therefore require a bypass pumping station or tunnelled pipeline if high velocities are considered unacceptable.

Aqueduct 2, River Tame (potential high impact on route feasibility)

Figure 10 River Tame Aqueduct

The aqueduct, built in 1785-90, is a Grade II listed masonry structure. The aqueduct size restricts the flow capacity at this point. At peak transfer flows the velocity through this section exceeds 0.32m/s and the increase in water level is approximately 60mm. The restrictions on any amendments to the structure would make it extremely difficult to maintain safe freeboard and would affect boat passage against a strong flow. There is also the potential issue of scour and environmental impact (e.g. barrier to fish movements).

There is no obvious alternative route and may therefore require a bypass pumping station if reduced freeboard and high velocities are considered unacceptable.

Author names redacted

TECHNICAL NOTE – Route 1

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 1 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

SUMMARY

The review has identified nine locations where there are key issues and risks associated with Route 1 (Birmingham-Fazeley Canal to Coventry Canal). These primarily relate to issues associated with constrictions in the width of the canal and locations where it is necessary to transfer flow around flights of locks. Some of the issues identified have the potential to have a high detrimental impact on the feasibility of Route 1.

Appendix F.2

ROUTE 3

Author names redacted

TECHNICAL NOTE - Route 3

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 3 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

INTRODUCTION

There are three candidate routes that were presented at the end of the Gate 1 process, these were:

- Route 1 (Birmingham-Fazeley Canal to Coventry Canal and then Coventry Canal to Braunston Junction)
- Route 3 (Pipeline to Atherstone and then Coventry Canal to Braunston Junction); and
- Route 6 (Pipeline to Leamington Spa Trough on the GUC and then Oxford Canal to Braunston Junction)

The section from Braunston Junction to the abstraction point at Leighton Buzzard and treated water pipeline entering distribution at Chaul End WSR is common to all options and is therefore not a selection factor in this route selection paper (see separate selection report for decision process in making Leighton Buzzard and Chaul End the preferred abstraction and distribution points).

This review has been undertaken to identify key issues and risks associated with Route 3 (Pipeline to Atherstone and then Coventry Canal to Braunston Junction).

The length that has been examined as part of this technical note extends from the point where the transfer pipeline discharges into the canal at Atherstone Top Lock up to the point at which it merges with Coventry Canal/Grand Union Canal at Braunston Junction (also the point where Route 6 merges).

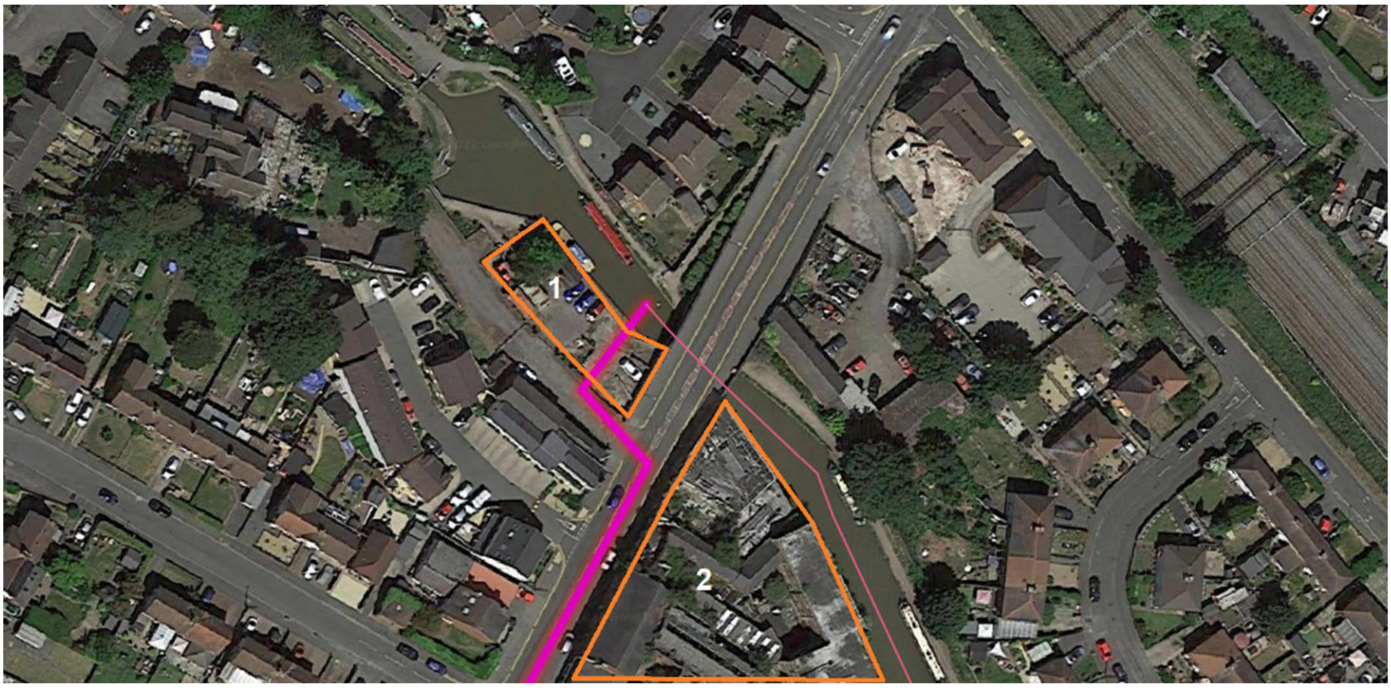

Figure 1 Discharge point to Atherstone Top Lock

Author names redacted

Grid references redacted

TECHNICAL NOTE - Route 3

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 3 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

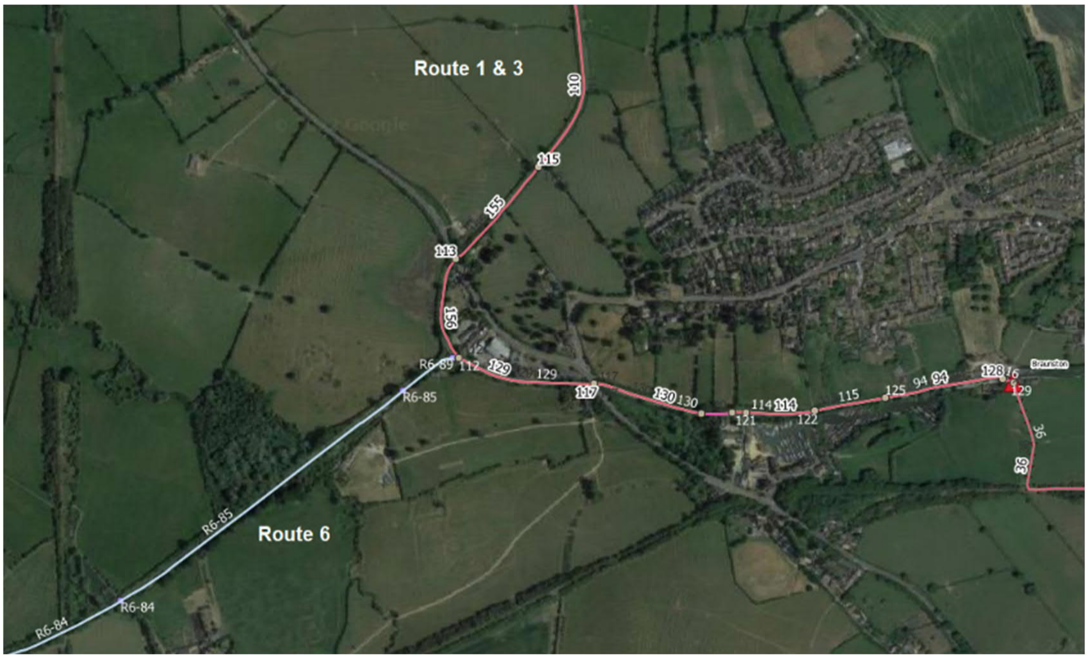

Figure 2 Braunston Junction, were all routes merge

KEY ISSUES AND RISKS IDENTIFIED

The following sections detail the key issues and risks identified, for works that might be required along the affected length of canal.

Pumped transfer discharge to Atherstone Top Lock (medium impact on route feasibility)

The construction of a discharge structure is required off Coleshill Road, Atherstone Top Lock, at coordinates 43[redacted], 29[redacted]. The following issues have been identified that will have a medium impact on the feasibility of the route

1. Congested route along the Coleshill Road to the site entrance
2. Limited space to connect to the canal (see area 1 in Figure 1)
3. Heritage area (see area 2 in Figure 1).

The original coal wharf for Atherstone was constructed around 1771 and retained a working presence until circa 2010 when A&R Rothen & Sons moved operations to Quarry Lane approximately 1.5km south . The main coal wharf has been filled in and buildings on the north side of the canal demolished for housing but the area around Britannia Works (historic hat factory) is zoned for redevelopment but retaining existing building frontages.

Constrictions within the canal route (potential medium detrimental impact on route feasibility)

QUARRY LANE

At Quarry Lane, approximately 1.5km south east of Atherstone Top Lock, the canal narrows to pass under two side by side bridges. One bridge is now a footbridge (formerly tramway line for Mancetter Quarry to the south) and the other is the original brick arch canal bridge. The estimated flow velocity through this narrow stretch is estimated to just exceed 0.3m/s at peak (115MLD) transfer. If survey data and hydraulic modelling confirms the extent of the constriction, a potential mitigation would be to widen the section and maintain the footpath access by providing a cantilever walkway.

Figure 3: Quarry Lane. Source @2022 Google

Author names redacted

TECHNICAL NOTE - Route 3

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 3 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

VERNONS LANE, NUNEATON

Figure 4 Vernons Lane, Nuneaton Source @2022 Google

At Vernons Lane, Nuneaton, the canal narrows to pass under the main road bridge. The estimated flow velocity through this narrow stretch is estimated to exceed 0.34m/s at peak (115MLD) transfer. If survey data and hydraulic modelling confirms the extent of the constriction a potential mitigation would be to widen the section and maintain the footpath access by providing a cantilever walkway.

Author names redacted

TECHNICAL NOTE - Route 3

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 3 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

STRETTON STOP

Figure 5 Streeton Stop Source @2022 Google

The area known as Stretton Stop dates in the 1830s. The "stop" itself is the narrow part of the canal by Rose Boatyard. It contained a pair of gates used to hold back (stop) boats to gauge the amount of cargo on board. Boats were charged a toll to use the canal based upon the tonnage carried. Each boat would be "gauged" in a special dock at Hillmorton (i.e. gradually loaded with weights and the weight required to lover the boat in the water to a fix point recorded). A copy of this record would have been kept at in the toll office at Stretton and used to calculate the cargo weight, and thus the toll due. The gates have now been removed but the recesses for them can still be seen.

The estimated flow velocity through this narrow stretch is estimated to exceed 0.34m/s at peak (115MLD) transfer. If survey data and hydraulic modelling confirms the extent of the constriction a potential mitigation would be to widen the section and maintain the footpath access by providing a cantilever walkway.

Author names redacted

TECHNICAL NOTE - Route 3

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 3 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

CLIFTON ARM JUNCTION BRIDGE (DISUSED)

Figure 6 Clifton Arm Junction, site of former bridge Source @2022 Google

At the junction with old Clifton Arm of the canal (now used for moorings but part of the original canal alignment but abandoned after the canal was straightened in 1834) there are the foundation remains of a bridge. Although the bridge is no longer there, the constriction is estimated to cause velocities to just exceed 0.3m/s at peak (115MLD) transfer. If survey data and hydraulic modelling confirms the extent of the constriction a potential mitigation would be to widen the section on the non-towpath side.

Access to Hawksbury pumping station (potential low impact on route feasibility)

Transfer flows will require pumping around the lock at Hawkesbury. As shown on **Figure 7**, there is no existing vehicular access for construction. However, there is potential to create access through private land off the B4109. Tree clearance would be required.

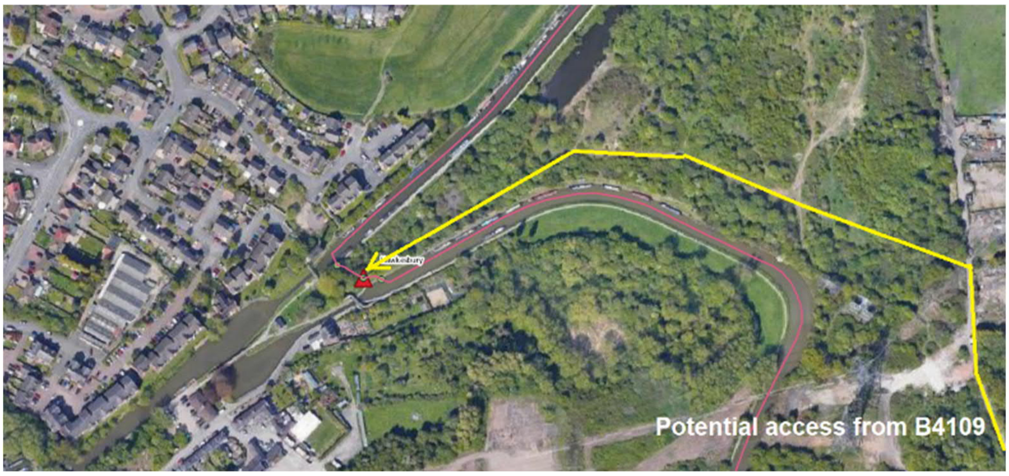

Figure 7: Access to Hawkesbury pumping station. Source @2022 Google

Access to Hillmorton pumping station (potential low impact on route feasibility)

Figure 8: Access to Hillmorton pumping station. Source @2022 Google

Access to the Hillmorton site is restricted by the mainline railway bridge (see **Figure 8**). This is the only access currently available. During construction, traffic management will be needed to maintain access for

TECHNICAL NOTE - Route 3

DATE:	09 March 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 3 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

residents and visitors. Mitigation for future access could be to introduce permanent traffic light control through the railway underpass.

SUMMARY

The review has identified several locations where there are key issues and risks associated with Route 3 These primarily relate to issues associated with constrictions in the width of the canal and locations where it is necessary to transfer flow around flights of locks. None of the issues identified have the potential to have a high detrimental impact on the feasibility of Route 3.

Appendix F.3

ROUTE 6

Author names redacted

TECHNICAL NOTE – Route 6

DATE:	20 April 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 6 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

INTRODUCTION

There are three candidate routes that were presented at the end of the Gate 1 process, these were:

- Route 1 (Birmingham-Fazeley Canal to Coventry Canal and then Coventry Canal to Braunston Junction)
- Route 3 (Pipe route to Atherstone and then Coventry Canal to Braunston Junction); and
- Route 6 (Pipe route to Leamington Spa Trough on the GUC and then Oxford Canal to Braunston Junction)

The section from Braunston Junction to the abstraction point at Leighton Buzzard and treated water pipeline entering distribution at Chaul End WSR is common to all options and is therefore not a selection factor in this route selection paper (see separate selection report for decision process in making Leighton Buzzard and Chaul End the preferred abstraction and distribution points).

This review has been undertaken to identify key issues and risks associated with Route 6 (Minworth to Braunston via Royal Leamington Spa and Oxford Canal).

The length that has been examined as part of this technical note extends from the point where the transfer pipeline discharges into the canal at the A445 Bridge, up to the point at which it merges with Coventry Canal/Grand Union Canal (i.e. the point where Route 3 joins).

Figure 1 Discharge point to Leamington Spa Trough

Grid references redacted

TECHNICAL NOTE – Route 6

DATE:	20 April 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 6 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

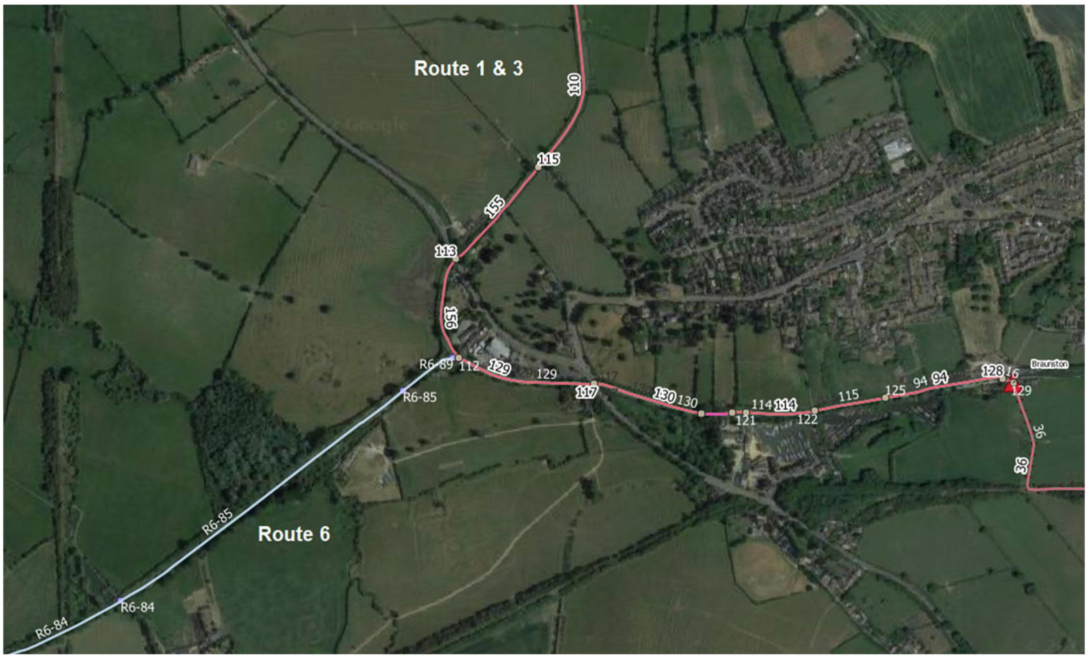

Figure 2 Braunston Junction, were all routes merge

KEY ISSUES AND RISKS IDENTIFIED

The following sections detail the key issues and risks identified, for works that might be required along the affected length of canal.

Pumped transfer discharge at A445 Bridge (high impact on route feasibility)

The construction of a discharge structure is required at the A445 Bridge, at coordinates 42[redacted], 26[redacted]. The following issues have been identified that will have a high impact on the feasibility of the route

1. Congested route along the A445 to the bridge crossing
2. Insufficient space to connect to the canal before crossing the bridge (see area 1 in Figure 1)
3. Insufficient clearance on the bridge deck to lay the transfer pipe in the highway (see area 2 in Figure 1 and Figure 4).
4. Congested access to the canal shared by major utilities (e.g. 132KV, 33KV and 11KV substations – see areas 3 & 4 in Figure 1) and large superstore.

Author names redacted

Property address redacted

TECHNICAL NOTE – Route 6

DATE:	20 April 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 6 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

Figure 3: A445 Bridge over canal to discharge point. Source @2022 Google

Figure 4 Entrance to discharge point

Author names redacted

TECHNICAL NOTE – Route 6

DATE:	20 April 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 6 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

Pumping Station locations, eleven sites required all in remote areas with limited access and limited existing services (potential high detrimental impact on route feasibility)

All of the pumping stations for Route 6 are in relatively remote rural locations and require significant enabling works for access, power and utilities and will result in a significant associated loss of trees. It is assumed that several of the sites monitoring and signals will only be possible via radio 3G, thereby threatening the reliability and resilience of this route option. The sites are summarised below:

Figure 5 Canal section from Royal Leamington Spa to Braunston Junction – showing pumping station locations

The canal, from the discharge point at Leamington Spa Trough, rises from approximately 50m Above Ordnance Datum (AOD) to 100m AOD at the Napton Junction of the Oxford Canal (i.e. discharge point of the Calcutt Lock pumping station – see Figure 5) before continuing onto Braunston Junction and joining the section of Grand Union canal common to all routes. The route is busiest at the east end, Calcutt Lock, with approximately twice the number of lock operations[1] as the Radford Bottom Lock. This is most likely due to the large marina and mooring areas at Calcutt Lock. It is also likely, but not confirmed, that the number of boat movements per lock operation is higher at Calcutt Lock.

Currently water supply available in the Birmingham canals (from Bradley borehole and Perry Well near Perry Bar) feed down the Grand Union Canal to Leamington, then back-pumped up the Calcutt-Braunston level where water can be further back-pumped up the Napton Flight to the South Oxford summit or up the Braunston Flight to the Braunston summit. From the Braunston summit water can be pumped up the Watford Flight to the Leicester Line summit or released down the Grand Union Canal in either direction.

For this water transfer to occur the Bowyer Street and Saltley Pumping Stations lift water from the Birmingham & Fazeley Canal (Minsworth pound at the Birmingham & Warwick Junction) up the Garrison and Camphill lock flights into the "10-mile Birmingham summit" of the Grand Union canal. From where it flows down Knowle Locks to Lapworth and along the North Stratford Canal. Water will then pass down the Hatton Flight to the Leamington Trough pound, where the proposed Route 6 pipeline will discharge.

[1] 2021 Annual Lockage Report, Canal & River Trust January 2022

Author names redacted

TECHNICAL NOTE – Route 6

DATE:	20 April 2022	**CONFIDENTIALITY:**	Confidential
SUBJECT:	G2 Route Selection - Route 6 Issues and Risks		
PROJECT:	Grand Union Canal	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

There is then a series of eleven pumps to lift water round 23 number locks to the top of Calcutt Flight.

The Canal and River Trust can run this system to maintain navigation in low flow conditions but for a number of reasons (e.g. the capacity of the pumps) achieving net transfer of water in all conditions is difficult. The ‘hydraulic’ capacity of the section to transfer water is restricted by short pounds with limited freeboard. A solution to this issue (involving longer rising mains bypassing multiple locks) was investigated but it was considered disproportionately expensive for the water resources gain.

The existing pumping stations have a typical capacity of 200l/s.

RADFORD BOTTOM LOCK

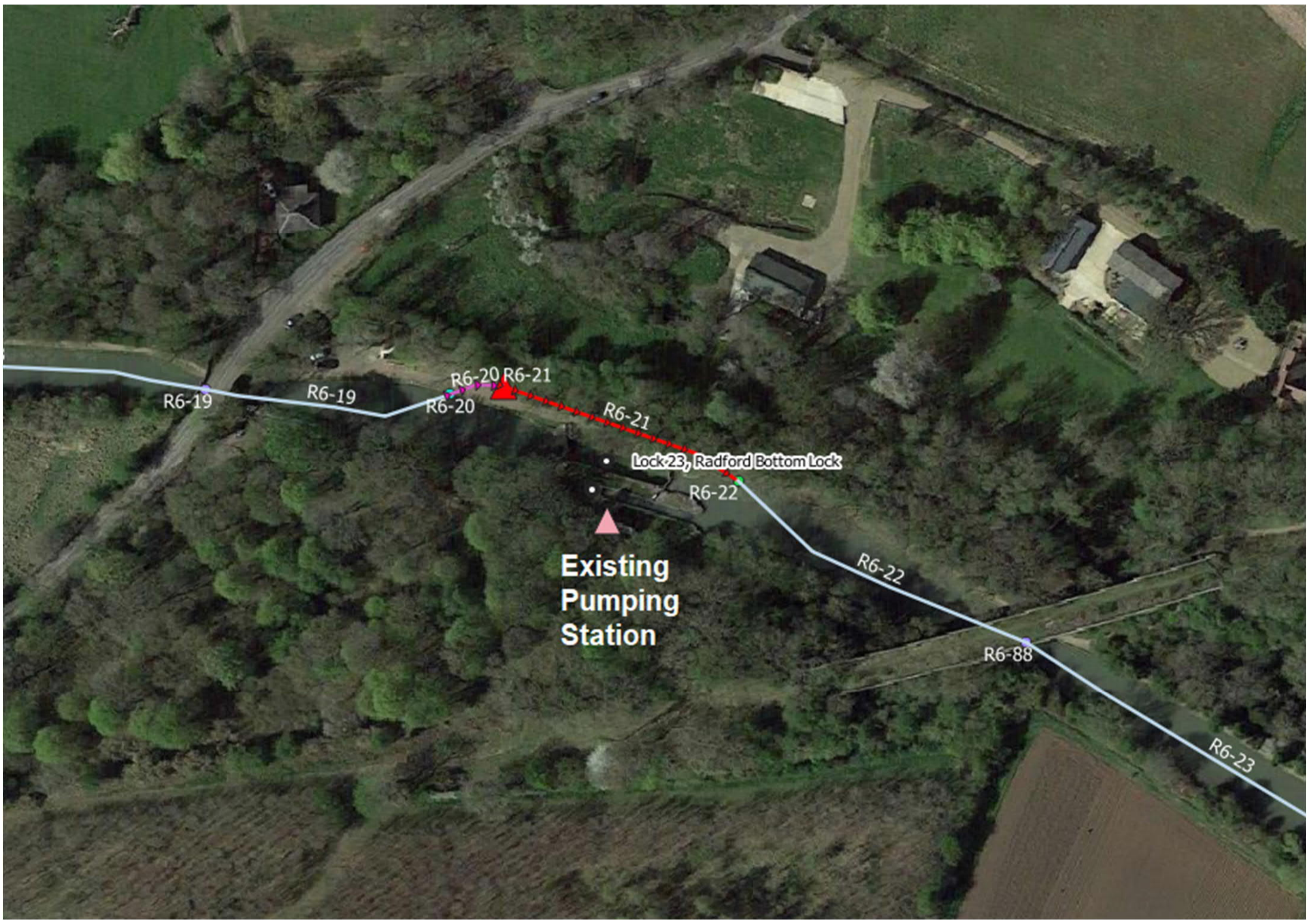

Figure 6 Proposed location for Pumping Station at Radford Lock

Located approximately 1km north east of Radford Semele village, adjacent the Offchurch Greenway (former Leamington to Ruby railway) part of the Sustrans National Cycleway Route 41. The original

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CHECKED:	[redacted]	**APPROVED:**	[redacted]

Radford Bottom Lock back pumping station built in 1942 and updated in 1997. A new pumping station will require tree removal and land purchase. A pole mounted power supply exists nearby to serve the existing pumping station but additional power would be required for the transfer pumps. Access is from Offchurch Lane.

LOCK 22

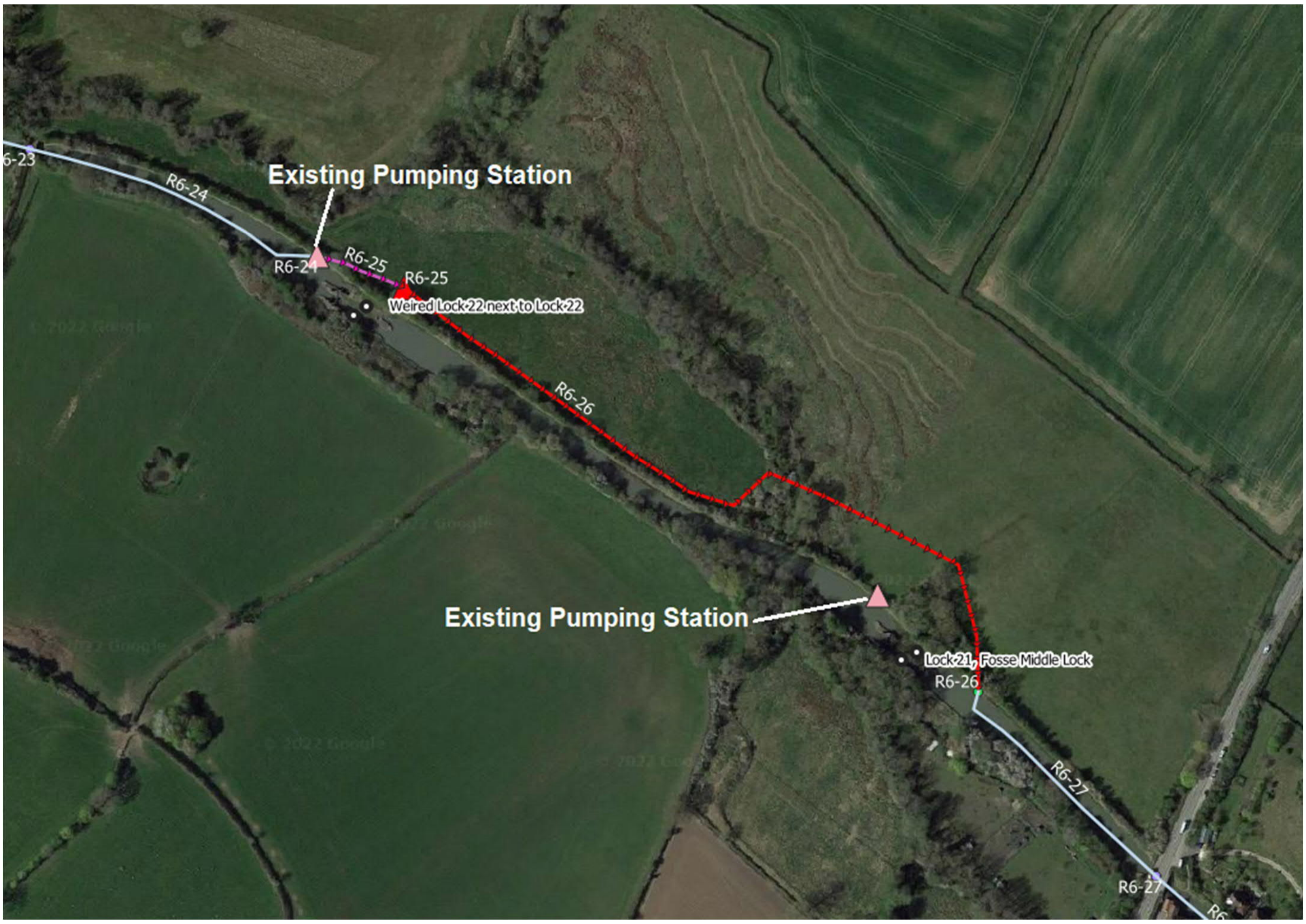

Figure 7 Proposed location for Pumping Station at Lock 22

There is no existing vehicle access to the pumping station site. A new 600m access off Fosse Way will be required including a bridge/culvert over a tributary of the River Leam. A new pumping station will require tree removal and land purchase. There is no obvious existing power supply, it is assumed that suitable connection can be made in Fosse Way. This site is also within the flood risk zone of the River Leam and its tributaries.

Author names redacted

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FOSSE TOP LOCK

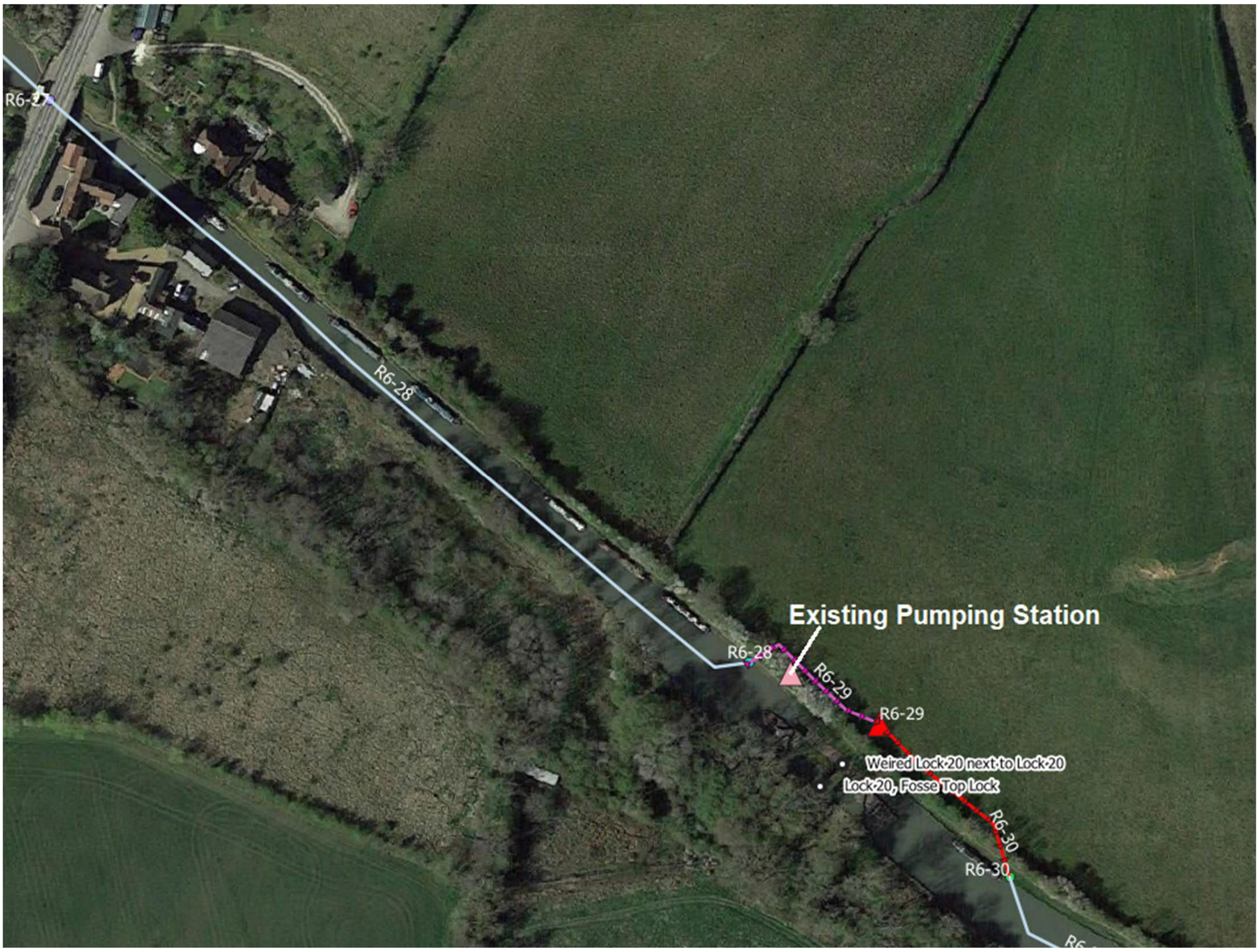

Figure 8 Proposed location for Pumping Station at Fosse Top Lock

There is no existing vehicle access to the pumping station site. A new 340m access off Fosse Way will be required. A new pumping station will require tree removal and land purchase. There is no obvious existing power supply, it is assumed that suitable connection can be made in Fosse Way. This site is also within the flood risk zone of the River Leam and its tributaries.

Author names redacted

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WOOD LOCK

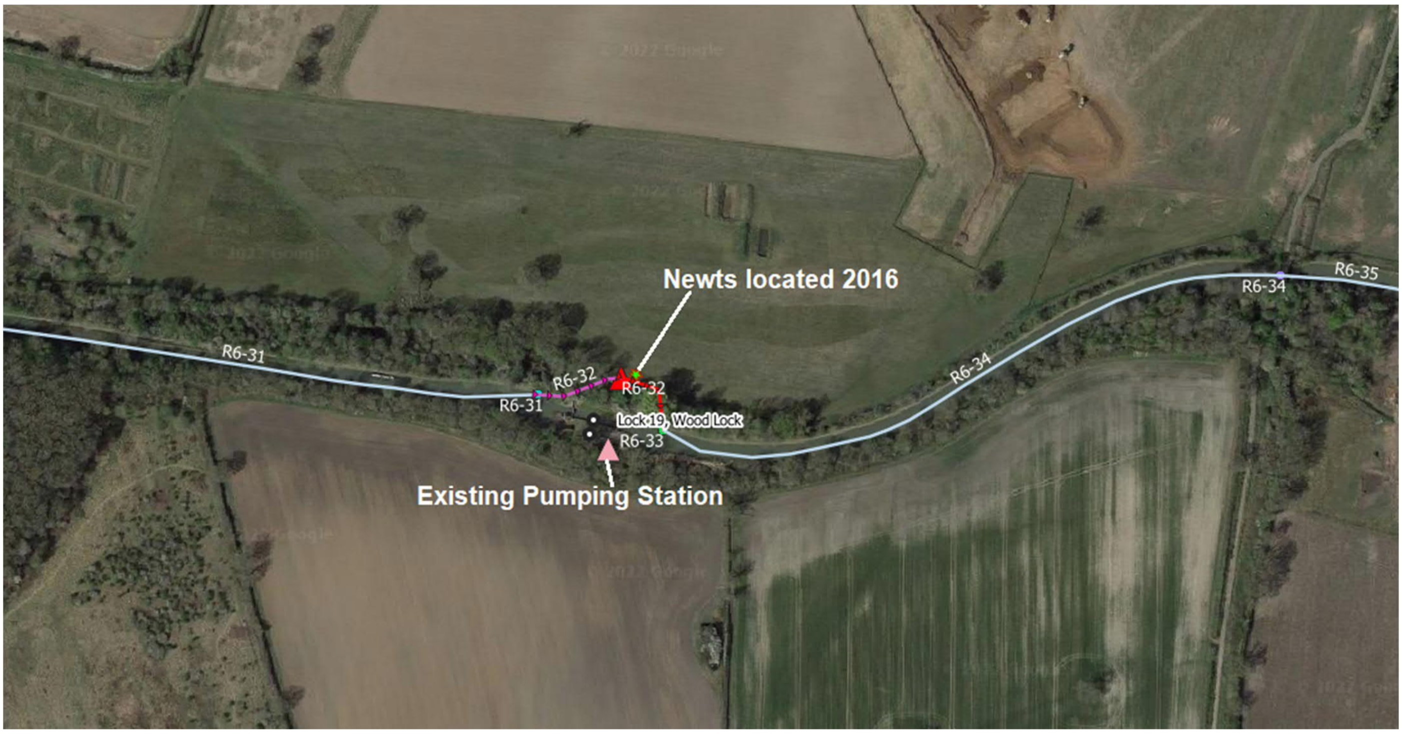

Figure 9 Proposed location for Pumping Station at Wood Lock

There is no existing vehicle access to the pumping station site. A new 780m access of Welsh Road will be required. This however assumes that an existing track can be reused after the completion of the HS2 line that passes 400m to the east. A longer 1540m route from Fosse Way would have to be constructed if the shorter route was not available. A new pumping station will require tree removal and land purchase. There is no obvious existing power supply, it is assumed that suitable connection can be made in Welsh Road.

There are also several ponds within 50m of the site that have previously been shown to have nesting newts. The level of impacts of the proposed work is likely to be judged as “high” because of the proximity (within 50m), potential to cause fragmentation of habitat (e.g. access road dissecting area).

This site is also within the flood risk zone of the River Leam and its tributaries.

Author names redacted

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WELSH ROAD LOCK

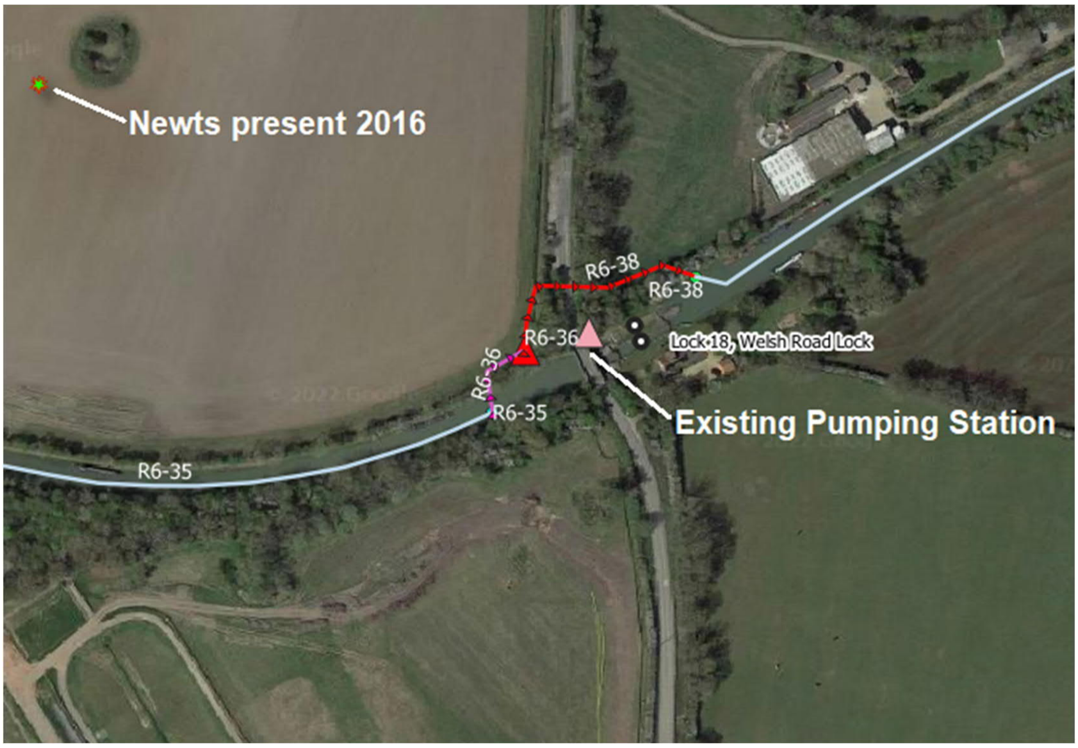

Figure 10 Proposed location for Pumping Station at Welsh Road Lock

There is no existing vehicle access to the pumping station site. A new 70m access of Welsh Road will be required. A new pumping station will require tree removal and land purchase. There is no obvious existing power supply, it is assumed that suitable connection can be made in Welsh Road.

There are also several ponds within 250m of the site that have previously been shown to have nesting newts. The level of impacts of the proposed work is likely to be judged as “medium to high” because of the proximity (within 250m), potential to cause fragmentation of habitat (e.g. access road dissecting area).

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BESCOTE LOCK

Figure 11 Proposed location for Pumping Station at Bascote Lock

There is no existing vehicle access to the pumping station site. A new 530m access of Welsh Road will be required. A new pumping station will require tree removal and land purchase. There is no obvious existing power supply, it is assumed that suitable connection can be made in Welsh Road.

Author names redacted

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BOTTOM STAIRCASE LOCK

Figure 12 Proposed location for Pumping Station at Staircase Lock

There is no existing vehicle access to the pumping station site. A new 1200m access of Stonebridge Lane will be required. This is however part of the National Cycle Route 41. An alternative route access is possible from Welsh Road (950m to the west) but this would require significantly more tree removal and a shared farm access agreement. A new pumping station will require tree removal and land purchase. There is no obvious existing power supply, it is assumed that suitable connection can be made in Welsh Road.

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ITCHINGTON BOTTOM LOCK

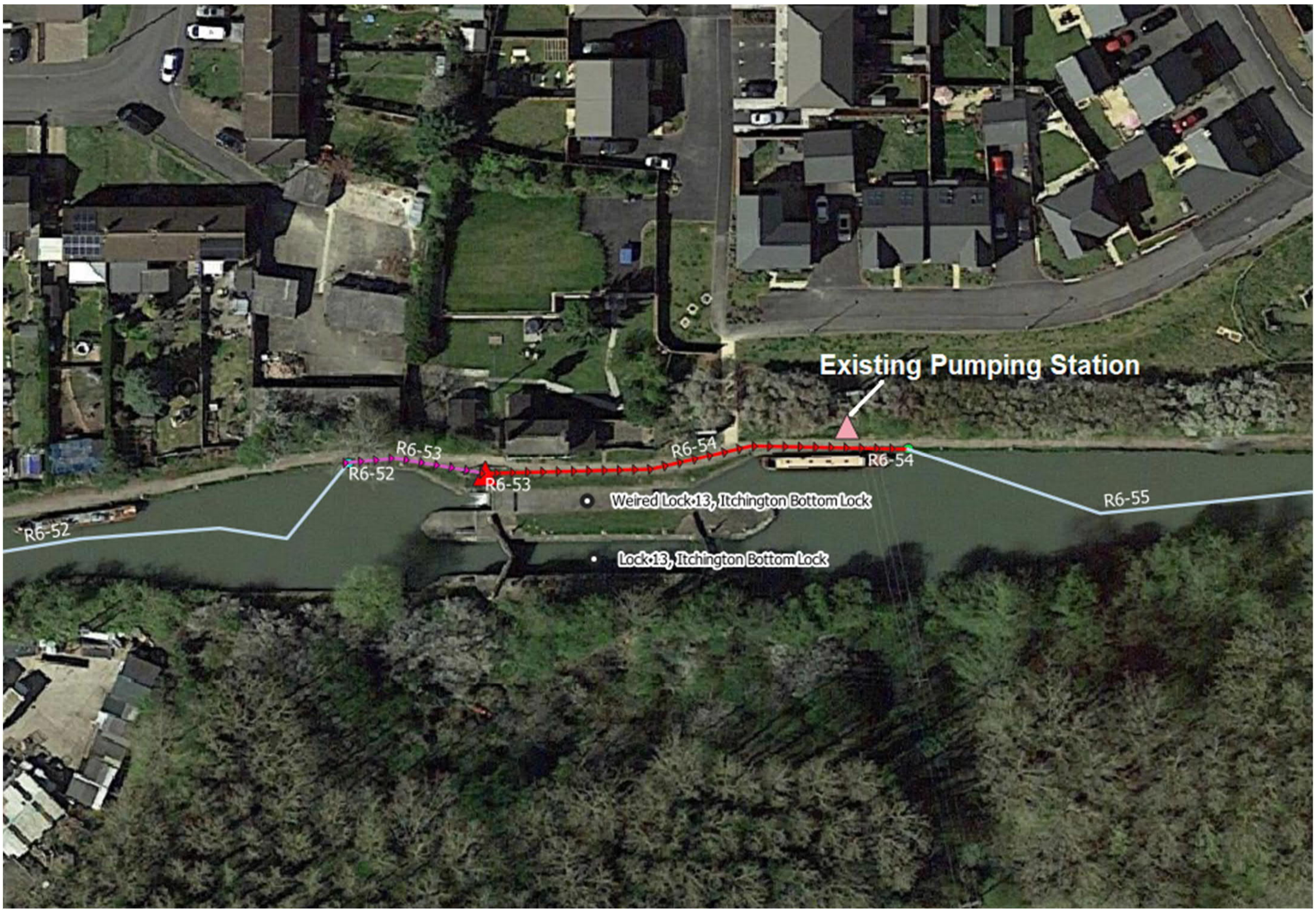

Figure 13 Proposed location for Pumping Station at Itchin Lock

There is no existing vehicle access to the pumping station site. Access can be taken directly off Keepers Meadows but this is a narrow housing estate road. The towpath is part of the National Cycle Route 41. A new pumping station will require tree removal and land purchase. There are overhead power lines across the canal into the housing estate therefore it is assumed power supply will be relatively straightforward.

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SHOP LOCK

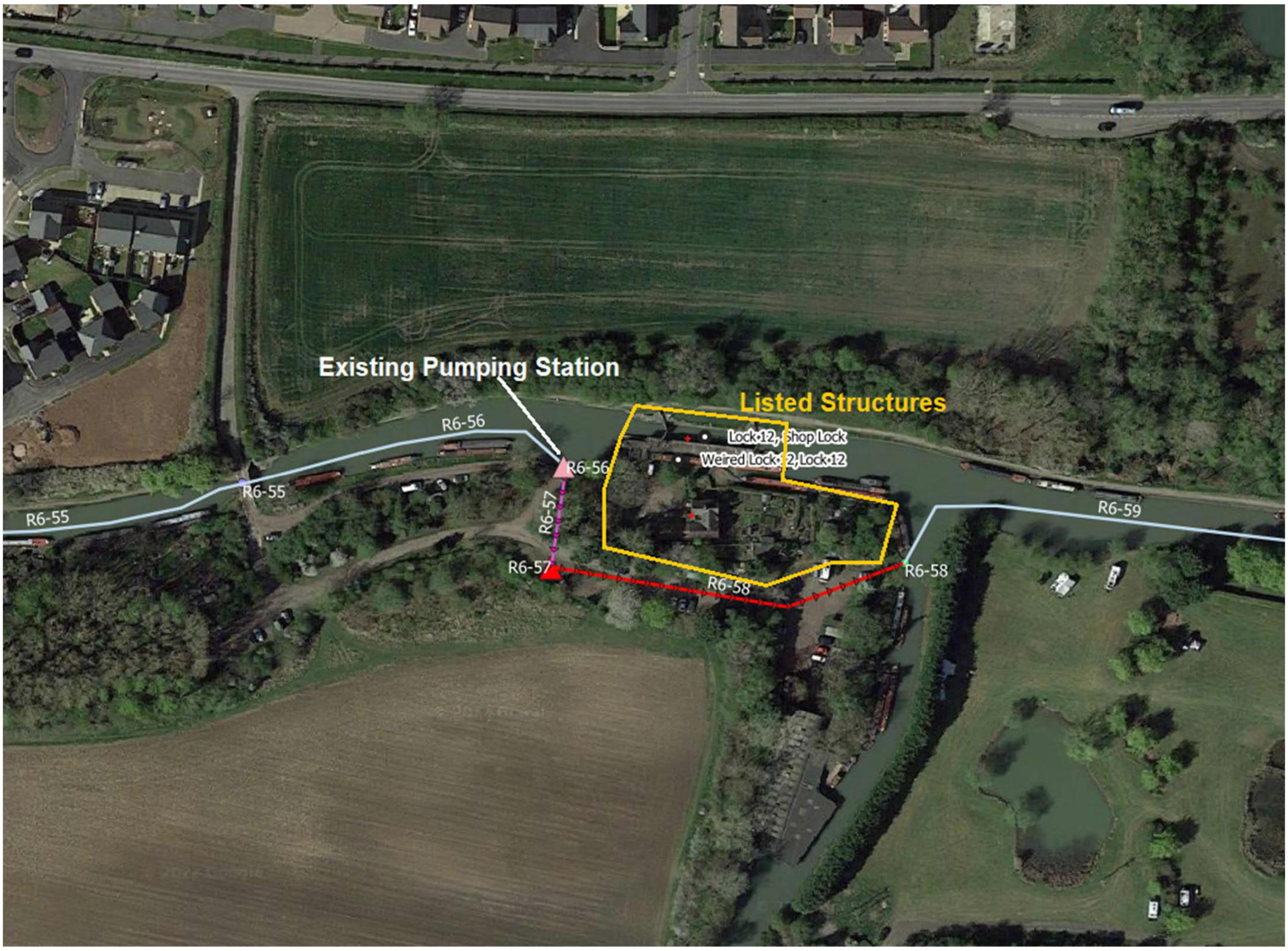

Figure 14 Proposed location for Pumping Station at Shop Lock

A new pumping station could be built adjacent to the existing. This however relies on a narrow access and weight limited bridge over the canal. A new pumping station will require tree removal and land purchase. An alternative would be to build the new pumping station on the northern bank of the canal and provide a new access off Stockton Road.

The lock and the buildings adjacent are designated Grade II listed.

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STOCKTON LOCKS

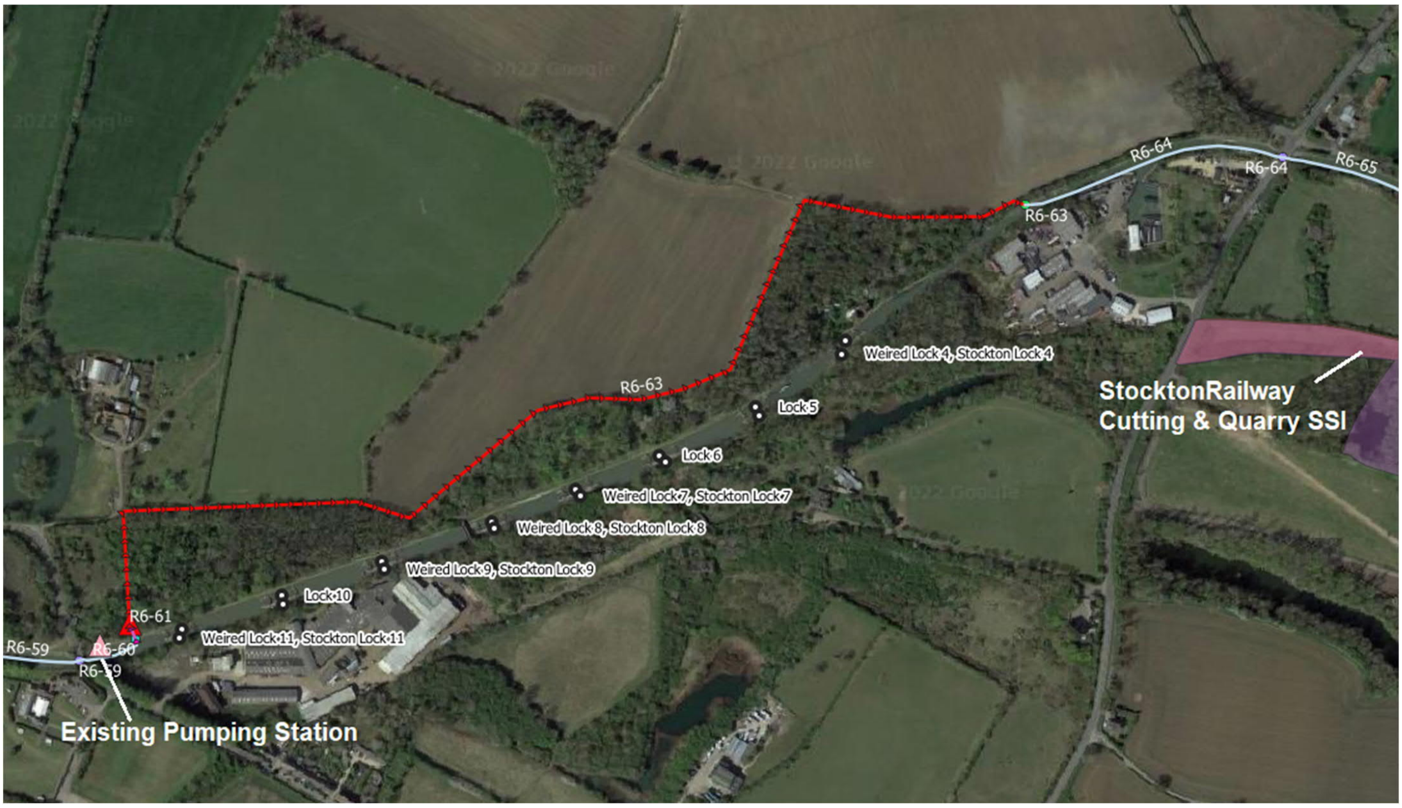

Figure 15 Proposed location for Pumping Station at Stockton Locks

There is no existing vehicle access to the pumping station site. Access can be taken off Stockton Road . The towpath is part of the National Cycle Route 41. A new pumping station will require tree removal and land purchase. It is assumed a power supply can be taken from Stockton Road.

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CALCUTT LOCK

Figure 16 Proposed location for Pumping Station at Calcutt Locks

The pumping station is within the Calcutt Marine boundary and will therefore require agreement and land purchase. Construction will also be within 300m of Calcutt Meadows SSSI. Suitability of any existing power supply will need confirming. The next nearest potential connection point is 1400m away on Tomlow Road

Condition of Existing Aqueducts (potential high detrimental impact on route feasibility)

There are five aqueducts along Route 6. Three of these have been highlighted by the Trust as having issues with leakage and spanning fast flowing rivers (i.e. potential scour risk) liable to flooding. The aqueducts identified are as follows:

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AQUEDUCT 7, AVON AQUEDUCT

Figure 17 Aqueduct 7, River Avon

The Avon Aqueduct spans the River Avon by means of a heavy three arch sandstone aqueduct, erected in 1799. The concrete parapet was added in 1909. Photographs from 2009 show the scale of the leaks that can occur (see inset within Avon Aqueduct image above) .

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CHECKED:	[redacted]	**APPROVED:**	[redacted]

AQUEDUCT 9, TRIBUTARY TO RIVER LEAM AQUEDUCT

Figure 18 Aqueduct 9

This aqueduct crosses Whitnash Brook and falls within a Local Nature Reserve. This area also falls within the Warwick District Council “Canalside Draft Development Plan Document” (DPD March 2020).

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CHECKED:	[redacted]	**APPROVED:**	[redacted]

AQUEDUCT 10, RIVER ITCHEN

Figure 19 Aqueduct 10, River Itchen

SUMMARY

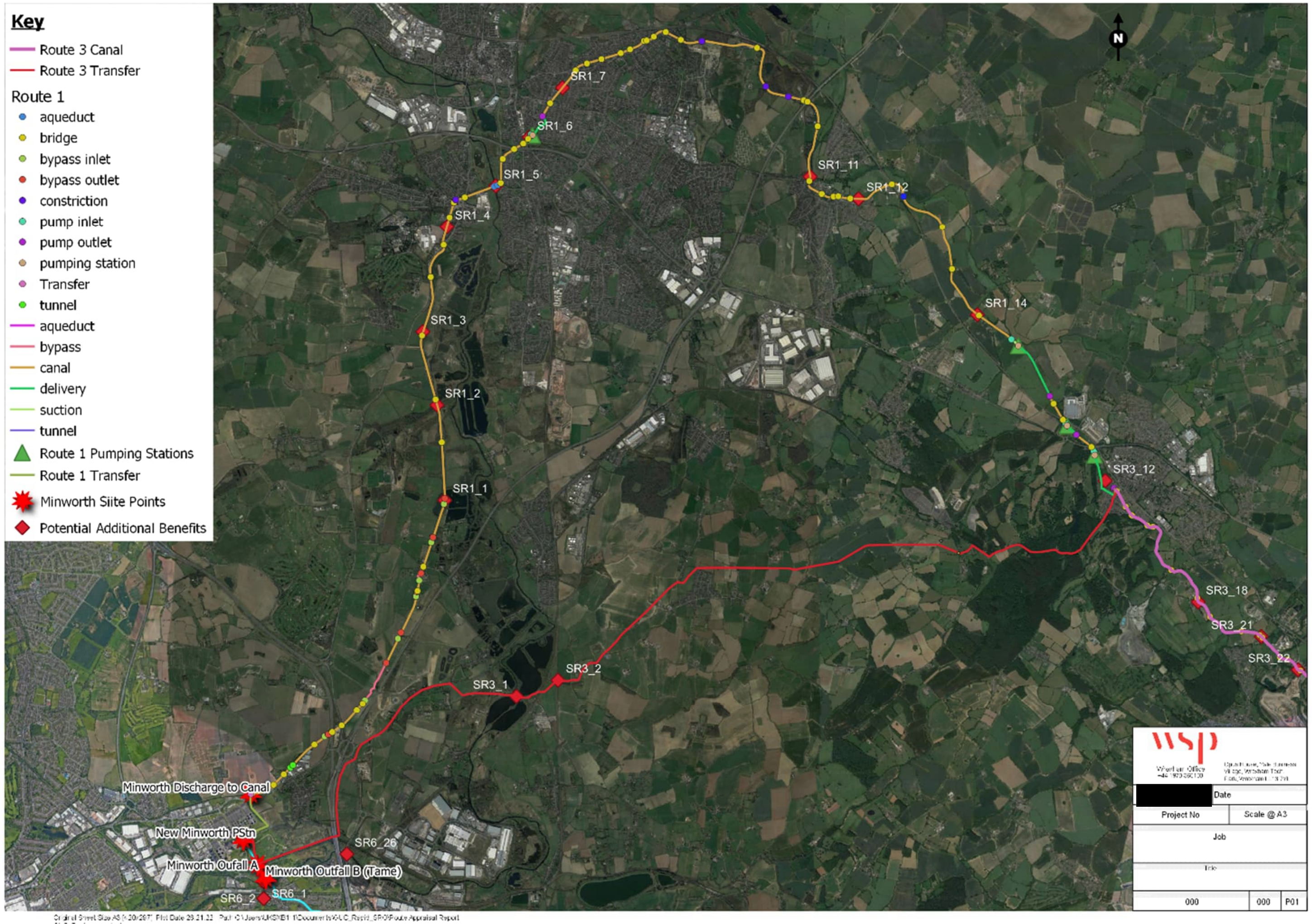
The review has identified key issues and risks associated with Route 6 (Leamington Spa Trough to Braunston Junction). These primarily relate to issues associated with construction of the pumping stations required to transfer flows up lock flights and the condition of existing canal assets. Some of the issues identified have the potential to have a high detrimental impact on the feasibility of Route 6.

Appendix G

POTENTIAL ADDITIONAL BENEFITS

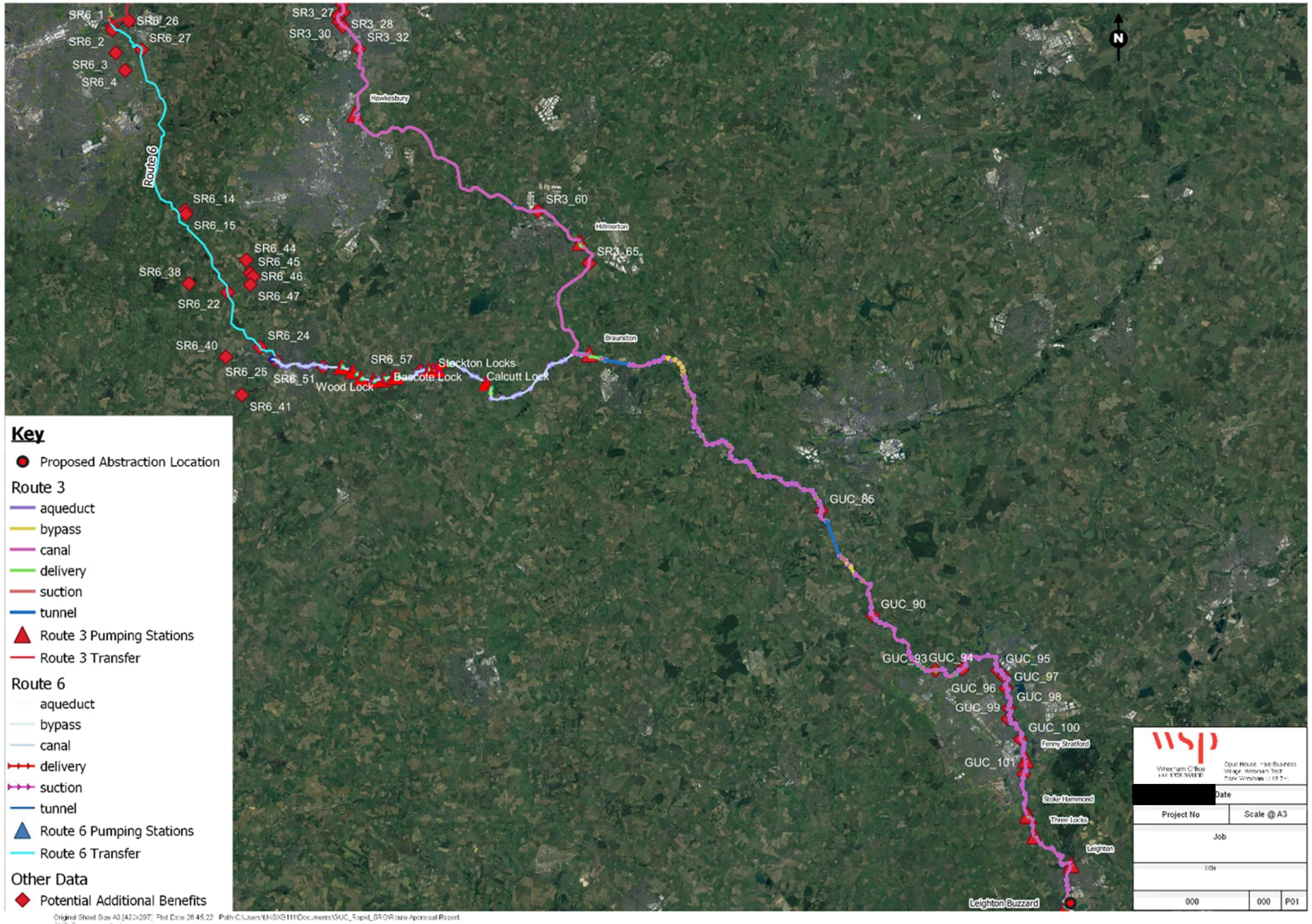
Author names redacted

Figure G-1 - Potential Benefits Identified between Minworth and Atherstone (Routes 1 & 3)



Author names redacted

Figure G-2 - Potential Benefits Identified between Warwick and Leighton Buzzard (Routes 3 & 6)



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