ANNEX B3.3.5

Environmental Appraisal Report

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

MOTT MACDONALD

Grand Union Canal Strategic Resource Option

Environmental Appraisal Report

August 2022

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Grand Union Canal Strategic Resource Option

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Issue and Revision Record

Author names redacted

Revision	Date	Originator	Checker	Approver	Description
P01	13/05/2022	[redacted]			First draft for PMB comment
P02	01/06//2022				Second draft for NAU comment
P03	20/06//2022				Draft for NAU comment
P04	14/07/2022				Draft to address NAU comments
P05	29/07/2022				Draft to incorporate fish, sediment, INNS and WFD updates.
P06	09/08/2022				Draft to further address NAU comments

Document reference: 100105044 | GUC-MMD-ZZZ-XX-RP-N-0009 | P06 |

Information class: Standard

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1 Introduction

1.1 Introduction

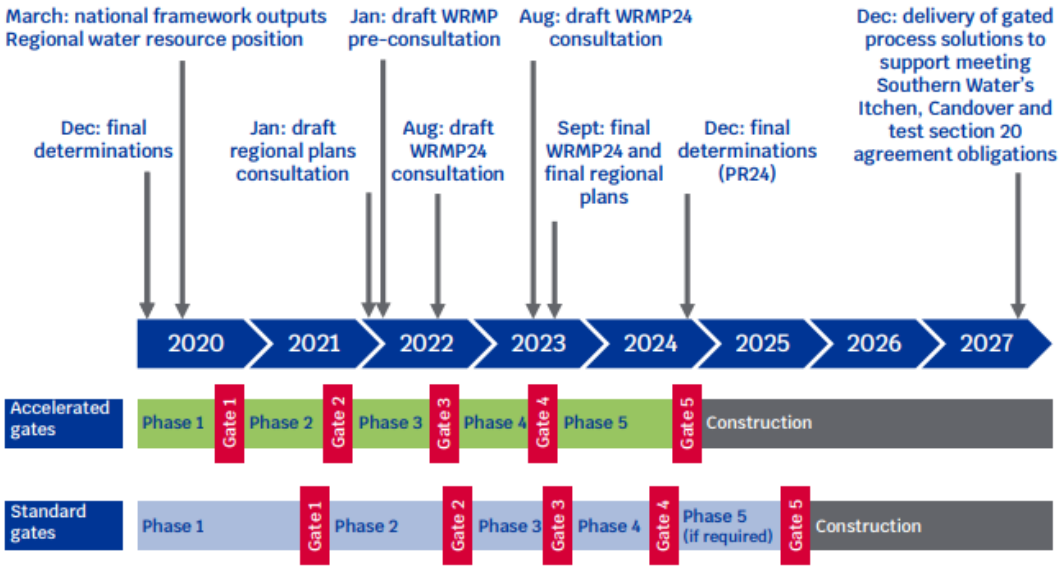
Ofwat, the economic regulator for the water and sewerage sectors in England and Wales, has identified the potential for water companies to jointly deliver strategic water resource schemes to secure long-term water supply resilience while protecting the environment.

To support the progression of these Strategic Resource Options (SROs), the Regulatory Alliance for Progressing Infrastructure Development (RAPID) has been established, comprised of representatives from Ofwat, the Environment Agency and the Drinking Water Inspectorate. RAPID has produced guidance for progressing each SRO which is aligned to a formal gated process to ensure that at each gate:

- Companies are progressing strategic water resource solutions that have been allocated funding at PR19 or have subsequently joined the programme.
- Costs incurred in doing so are efficient.
- Solutions merit continued investigation and development during the period 2020 to 2025.

The timelines for the assessment gates are shown in Figure 1.1 below; the Grand Union Canal (GUC) SRO is on the standard gate timeline and is currently at Gate 2.

Figure 1.1: Gated process for potential strategic regional water resource solutions[1]



[1] Source: Regulators' Alliance for Progressing Infrastructure Development, Forward programme 2021-22,March 2021, available online at https://www.ofwat.gov.uk/wp-content/uploads/2021/03/RAPID-Forward-programme-2021_22.pdf, accessed 07/03/2022.

1.2 Grand Union Canal SRO

The GUC SRO has been jointly developed in partnership between Severn Trent Water (STW), Affinity Water (AW) and the Canal and River Trust (the Trust). At the start of Gate 1 a long-list of sub-option routes were derived for the GUC SRO. The discharge options were then shortlisted to three route options by the start of Gate 2 based on the following criteria: environmental and societal impacts; operational flexibility and resilience; operational and embedded carbon; and cost. Of these, Option Route 3 was selected. Optioneering was also undertaken with regards to abstraction locations. A site at Leighton Buzzard was ultimately selected, further details on the optioneering process can be found in the Gate 2 submission.

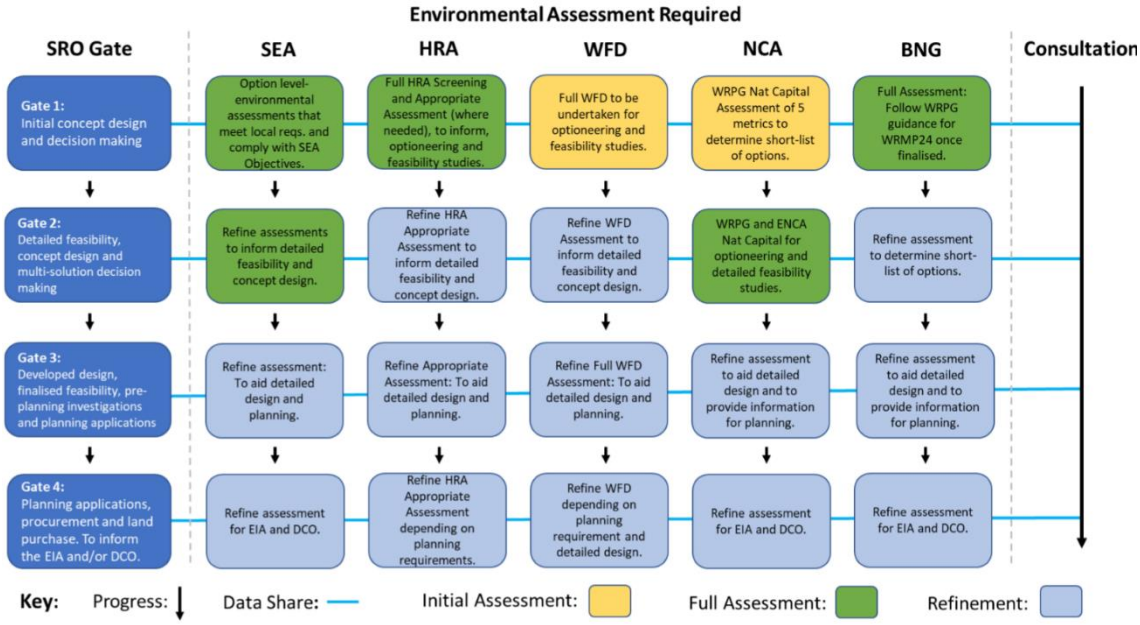
The single solution assessed at Gate 2 includes the pipeline from Minworth to Atherstone (Route 3), the canal transfer to Leighton Buzzard and the abstraction and treatment works at this location (hereafter referred to as 'the scheme') and will be assessed in the following Gate 2 Environmental assessments:

- Natural Capital and Biodiversity Net Gain (BNG) (Annex B3.3.2)
- Environmental Appraisal Report (EAR) (Annex B3.3.5)
- Fish survey report (Annex B3.2.3)
- Habitats and protected species desk study (Annex B3.2.6)
- Habitats Regulations Assessment (HRA) (Annex B3.3.3)
- Invasive and non-native species (INNS) survey report (Annex B3.2.4)
- Sediment report (Annex B3.2.5)
- Strategic Environmental Assessment (SEA) (Annex B3.3.1)
- Waterbody connections report (Annex B3.2.1)
- Water Framework Directive (WFD) Assessment (Annex B3.3.4)

This report forms the EAR. Figure 1.2 below shows the integration of the statutory assessment reports (i.e. SEA, HRA, WFD, NCA/BNG) RAPID gated process. This schematic is taken from the All Companies Working Group (ACWG) guidance that was released in Gate 1. While this is still largely relevant and followed, it has been somewhat superseded by the RAPID Gate 2 guidance[2], which the Gate 2 assessments have followed.

[2] Strategic regional water resource solutions guidance for gate two, Regulators' Alliance for Progressing Infrastructure Development, February 2022, available online at https://www.ofwat.gov.uk/wp-content/uploads/2022/02/Strategic-regional-water-resource-solutions-guidance-for-gate-two_Feb_2022.pdf, accessed 09/02/2022.

Figure 1.2: Environmental Assessment Integration with SRO Gates[3]



1.3 Scheme description

The scheme is shown below in Figure 1.3 and described in detail in Annex A1, Engineering CDR (WSP, 2022). It will comprise a transfer rising main from Minworth Wastewater Treatment Works (WwTW) 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 will pass through agricultural land until reaching the outskirts of Atherstone, a small market town within North Warwickshire. The rising main will discharge to the canal side at Coleshill Road, via a new discharge structure sized to avoid deleterious flow velocities and shears.

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

The Oxford Canal will then convey the water to the Grand Union Canal at Braunston. The majority of the flow along the Oxford Canal will be by gravity, however a pumping station will be required to bypass the locks at Hillmorton.

At Braunston a bypass pumping station will be 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 will be required south of Milton Keynes at Fenny Stratford, Stoke Hammond, Three Locks and Leighton. The Grand Union Canal section will also require eight gravity bypasses around “downflow” locks at the Wilton Marine Lock Flight, Stoke Bruerne Lock Flight and Cosgrove Lock.

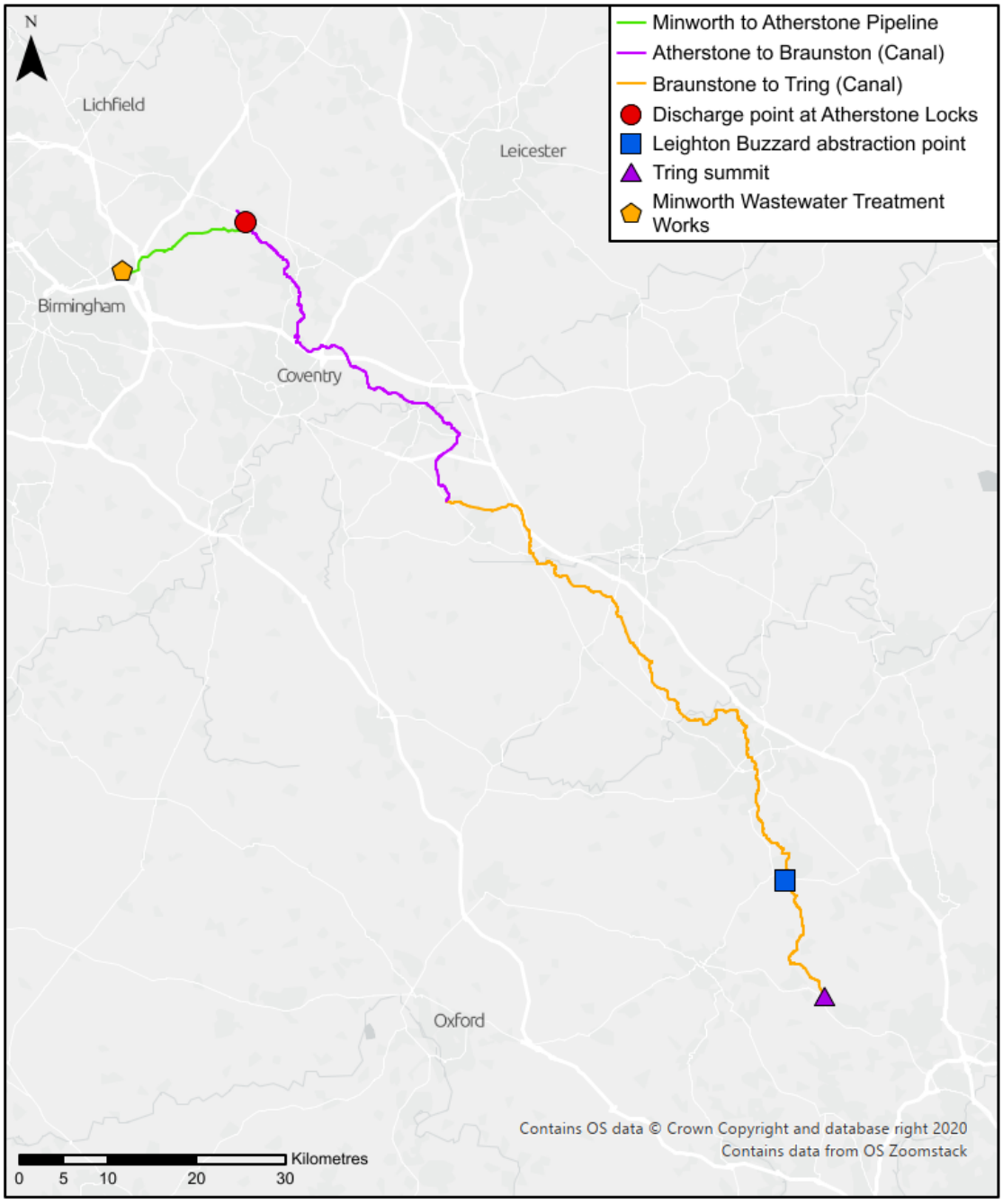
Flow will be abstracted from the Grand Union Canal just south of the A4146 bridge, after the River Ouzel. The site currently proposed at Gate 2 for the treatment works is on relatively flat land slightly raised from the river and canal, although further investigations will be carried out at Gate 2/3 to determine the precise location. Flow will therefore need to cross the River Ouzel within a new, short pipeline and be pumped into an operational raw water storage reservoir

[3] Source: All Companies Working Group, WRMP environmental assessment guidance and applicability with SROs, Mott MacDonald, October 2020

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).

During the option selection process, it was determined this option would have the least overall cost, lowest environmental impact and greatest opportunity for net gain and public benefit, as described in Annex A1, Engineering CDR (WSP, 2022). The slightly higher operational cost when compared to Route 1, due to longer transfer from Minworth to Atherstone, can be partially offset by energy recovery from the break tank to outfall.

Figure 1.3: The scheme



1.4 Purpose and structure of the report

The aim of this EAR is to meet the requirements of the RAPID Gate 2 guidance, to draw together the conclusions of all the Gate 2 assessment work into a single document for review. Where elements of the Gate 3 guidance lie within the scope of other workstreams, this document provides a signpost to where the assessment and information can be found. The supporting assessments, as listed above in section 1.2 can be found within Appendices A to F.

1.5 Assumptions and Limitations

The following assumptions have been used within the assessments:

- The design assumptions stated in the WSP Gate 2 Position Paper - Route Selection technical note[4] can be applied to the Gate 2 Environmental Assessments, including assumption that >50mm depth change requires towpath raising is valid.
- The assessment is based on based on 100% utilisation of the SRO to assess the scheme at maximum potential impact.
- Tring summit represents the SE limit of influence of the SRO.
- The volume of water passing NW (after discharging from pipeline) due to the locks opening at Atherstone is deemed to be of minimal change.
- The risk of fish and INNS travelling NW of Atherstone is not increased due to the scheme.
- The discharge quality from Minworth WwTW is acceptable to the EA, enabling water to be discharged to the GUC.
- There is limited data on what priority habitats are present along the affected route as well as area and condition of the habitat.
- The pipeline route between the treatment plant at Minworth and the outflow at Atherstone has not been confirmed yet.
- The pipeline between the abstraction at Leighton Buzzard and the Affinity treatment works has not been confirmed yet.
- The report references limited understanding of the hydrological connectivity of the GUC to Nene Valley Gravel Pits SPA and Ramsar.

The timing of walkover survey in November was not optimal and some vegetation may have died back.

[4] Gate 2 Position Paper - Route Selection, WSP Technical Note, 25 January 2022

2 Regulatory Assessments

2.1 Habitats Regulations Assessment

2.1.1 Methodology

There is a requirement under the Conservation of Habitats and Species Regulations 2017 to determine if a plan or project may have an adverse impact on a site designated under the same (or preceding regulations) prior to any consent or permission being determined. The process of undertaking this assessment is called an HRA. The assessment follows the Habitats Regulations 2017 to establish and maintain a network of sites protecting habitats which are both valuable in themselves as well as to the species they support. These sites are classified in Europe under Natura 2000, and in the UK consist of Special Protection Areas (SPAs) and Special Areas of Conservation (SACs), as well as proposed and candidate SPAs and SACs (pSPAs and cSACs). This network also extends to marine environments, with Ramsar sites also treated equally within this assessment framework.

The HRA process consists of four stages, with each stage being informed by the one preceding. These stages are: Stage 1 – Screening; Stage 2 – Appropriate Assessment; Stage 3 – Assessment of Alternative Solutions; and Stage 4 – Assessment where no alternative solutions exist and where adverse impacts remain. The methodology behind these stages is outlined in detail within the main HRA report[5] (Annex B3.3.3) included in Appendix A.

2.1.2 Stage 1 Screening Results

An HRA screening exercise was undertaken by Water Resources South East (WRSE) in February 2021 in line with methodology outlined in the WRSE Regional Plan Environmental Assessment Methodology Guidance, July 2020. It included the screening of the long-list of options considered for the scheme.

For the Upper Nene Valley SPA/Ramsar site, the justification for requirement of a Stage 2 HRA assessment is the identification of a hydrological connection from the GUC to the Habitats Site from the Wilton Brook/River Nene. The pathway has the potential to result in alterations to flow and water quality entering the Habitats Site.

For the Chiltern Beechwood SAC, although no hydrological connection has been identified, justification for the requirement of a Stage 2 assessment was the close proximity of the Tring intake, located in that assessment approximately 0.6km from the Habitats Site. However, the preferred option includes an intake at Leighton Buzzard approximately 10km away for this site. Therefore, effects are no longer anticipated from construction of the scheme. No further pathways are identified through which the site can be affected.

2.1.3 Stage 2 Appropriate Assessment Results

During the Stage 2 Appropriate Assessment process, each option identified at Stage 1 Screening was considered. It took into account a wide range of potential impacts on the site, as well as considering potential construction and operation impacts and any likely impact pathways.

Following this assessment, no significant adverse effects resulting from the implementation of the scheme are reasonably foreseeable on the features of interest of the following European

[5] Habitats Regulations Assessment, Mott MacDonald 2022, (Annex B3.3.3)

Sites, due to the lack of pathways between the scheme components and the following designated sites:

- Chiltern Beechwood SAC
- Upper Nene Valley Gravel Pits SPA/Ramsar

Overall, the plan is considered unlikely to have an adverse effect on integrity on the European Sites and therefore no further stages in the HRA process will be necessary for the scheme.

2.2 Water Framework Directive Assessment

2.2.1 Methodology

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (the WFD) requires all waterbodies (both surface and groundwater) to achieve good status or potential (retained in the UK legislation after the withdrawal from the EU). The Directive also requires that waterbodies experience no deterioration in status. Overall good status is a function of good ecological status (biological, physico-chemical and hydromorphological elements and specific pollutants) and good chemical status (Priority Substances and Priority Hazardous Substances). The ACWG has developed a consistent framework for undertaking WFD assessments for SROs, considering mitigation which would need to be put in place to protect waterbody status.

Two stages of assessment are completed under this approach – an initial Level 1 basic screening and a Level 2 detailed impact screening (Annex B3.3.4) included in Appendix B. These use a spreadsheet assessment tool which is automated based on option information for Level 1 and expert judgement for Level 2.

The Level 1 WFD screening assessment follows these steps:

- Identify affected waterbodies.
- Review SRO activities.
- Identify possible impacts.
- Apply ‘embedded’ mitigation measures.
- Calculate a screening score (using a six-point scale from -2 to 3) to ‘screen out’ waterbodies and scheme activities with no or very minor potential impacts from further assessment. If the maximum impact score is greater than 1 (minor localised impact) then the waterbody is taken forward into Level 2 screening.

Any options ‘screened in’ are then taken forwards into the Level 2 detailed impact screening.

The Level 2 WFD detailed impact screening assessment follows these steps:

- Waterbody scale detailed assessment of impacts to each WFD quality element for each activity proposed as part of the SRO preferred option.
- Assessment of data confidence level and design certainty – confidence levels are assigned for each assessment, based on the quality and availability of both physical data and design information about the option at the time of assessment (note, confidence/certainty expected to be medium at Gate 2 assessment and increase over time). Where the confidence levels are medium or low, the requirements for further data or design information to raise this confidence level for future Gates will be listed.
- Identification of further mitigation needs.
- Assessment of impacts after mitigation (scoring on a six-point scale).
- Identification of activities to improve certainty of assessment outcomes.

2.2.2 Level 1 screening assessment results

Multiple waterbodies identified at Gate 1 were assessed during the Gate 2 Level 1 screening assessment[6], with further design development work refining this list. This means that 26 WFD river and canal waterbodies were identified for Level 1 screening. A table within the assessment presents these findings, with the colour green showing a pass with no further assessment needed, and amber signifying where further Level 2 assessment is required.

Overall, the Gate 2 Level 1 WFD assessment indicated that seven out of 26 waterbodies could be screened out as not requiring further assessment.

2.2.3 Level 2 detailed impact screening assessment results

The assessment was based on the assumption that the water from Minworth WwTW could be treated to a standard to which discharge to the canal network would be acceptable. Using this assumption, the assessment identified that the screened-in Level 2 waterbodies could be split into two categories: waterbodies with a direct impact as a result of the scheme or as an indirect impact through waste weirs and overspills. The assessment noted 14 waterbodies where it is possible that the scheme could cause deterioration between status classes or compromise water body objectives, as shown below in Table 2.1. Reasons for possible failure include water quality changes and mobilisation of contaminated sediments, WFD mitigation measures assessment, High Status waterbodies (or the water quality elements of overall status being High) or fish communities that could be impacted.

Table 2.1: Waterbodies at risk of the scheme compromising WFD objectives

Waterbody ID	Waterbody name	Potential for waterbody objectives to be compromised
GB104028046460	Anker from River Sence to River Tame	The volume of flow moving towards any overspill connections in this waterbody will be limited but could still have a minor influence.
GB104028046430	Anker from Wem Brook to River Sence	Overspills will reflect a minor proportion of the flow within the river, but due to the number of connections this may be a higher risk than further down the route.
GB105033037900	Loughton Brook	The degree of influence of the scheme on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs, although all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.
GB70910513	North Oxford Canal	Some water quality parameters (physico-chemical quality elements) are at 'High' WFD status and therefore there could be a risk of deterioration, arising from transferred flow in greater volumes from the poorer areas of water quality in the Coventry Canal to the north.
GB105033038000	Ouse (Wolverton to Newport Pagnell)	The degree of influence of the scheme on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs, although all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.
GB105033030520	Ouzel (US Clipstone Brook)	The degree of influence of the scheme on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs, although all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.
GB105033037972	Ouzel (DS Caldecote Mill)	The degree of influence of the scheme on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs, although all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.

[6] Water Framework Directive Assessment, Mott MacDonald 2022, (Annex B3.3.4)

Waterbody ID	Waterbody name	Potential for waterbody objectives to be compromised
GB105033037971	Ouzel (US Caldecote Mill)	The degree of influence of the scheme on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs, although all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.
GB106039030410	Thame upstream of Aylesbury	Waterbody is located to the south of the transfer intake at Leighton Buzzard, so the volume of transfer water within the canal will be less but could still have a minor influence, although this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.
GB105033038180	Tove (DS Greens Norton)	The degree of influence of the scheme on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs, although all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.
GB105032045360	Welton Village Trib, Whilton branch of R. Nene	The degree of influence of the scheme on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs, although all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.
GB104028042430	Wem Brook from Source to River Anker	The degree of influence of the scheme on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs, although all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.
GB105033030490	Whistle Brook	The watercourse will receive overspill water above a certain level in the canal, although this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised.
GB109054044640	Withy Bk - source to conf R Sowe	The degree of influence of the scheme on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs, although all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be temporary/localised.

Table 2.2 below summarises the impacts, further analysis and anticipated mitigation related to WFD compliance.

Table 2.2: Impacts, further analysis and anticipated mitigation related to WFD compliance

Key potential impacts with WFD compliance risks	Further analysis requirements	Mitigation to reduce WFD risks
• Potential for deterioration in canal water quality at the point of discharge. Causing a significant deterioration (usually defined as a 10% deterioration, or 3% where the receiving water quality is already bad, or a class deterioration) is not permittable under the Water Framework Directive, as implemented in UK law. This may apply irrespective of canal waterbodies not having water quality WFD baseline classifications. • Preliminary WFD class deterioration tests undertaken in June 2022 (JBA) for impact at the 'point of discharge' indicate that approx. 50 determinands	• Maximum Discharge Values required to lead to load stand-still in receiving canal pound (Coventry and Ashby Canal) have been calculated and are being used to guide design of treatment process at Minworth. • Further water quality samples and analysis from the ongoing sampling programme. • Flow gauging as part of the hydrometric surveys. • Design treated effluent concentrations from the Minworth design team to negotiate discharge consent to the GUC. This should demonstrate no-deterioration at the point of discharge.	• Effluent treatment and environmental permits will be set such that a load standstill (or better) result is achieved in the receiving canal pounds. • Where feasible, treatment of the effluent at Minworth should be to a standard which can be demonstrated to cause no deterioration at all canal pounds and connected watercourses downstream.

Key potential impacts with WFD compliance risks	Further analysis requirements	Mitigation to reduce WFD risks
have a risk of at least a percentage deterioration.		
• Potential to move water from areas of relatively low quality (where impacts on the canal have already been mitigated by the load standstill approach) into areas of higher water quality, in particular transfer across canal summits. • Heavy metals such as cadmium, copper and zinc and PAHs are the highest risk based on initial assessments. Ammonia and nutrients, plus oxygen anticipated to be lower risk based on Environment Agency data. •	• Comparison of existing water quality along the canal and in the adjoining watercourses could identify the likelihood of this risk. Water quality modelling could then be used to quantify current-day and potential future transfers of lower water quality into areas of higher quality. • Determinands which represent a medium or high risk of leading to a downstream deterioration should be investigated using the water quality model.	• Where feasible, treatment at Minworth should be to a standard which can be demonstrated to cause no deterioration at all canal pounds and connected watercourses downstream. • Increasing the frequency of overflows from canal to connecting watercourses is undesirable because it would be a loss of transfer water. The hydraulic design should aim to not increase overflows to connected watercourses. This will reduce the risk of causing deterioration where linked watercourses have higher water quality than transfer flows. • The transfer scheme has potential to improve re-aeration and therefore dissolved oxygen levels in the canal. This should be modelled sufficiently to assess potential benefit.
• Accidental water quality incidents within Minworth supply or from other sources.	• Potential for real time water quality monitoring as part of operation.	• Real-time monitoring at Minworth and within the GUC. • A time-of-travel estimation system to forecast the rate of propagation through the canal system. • Procedures to stop the transfer to prevent further conveyance of contaminants. • Travel time in the pipeline from Minworth to Atherstone allows for isolation of flows in the case that Water quality monitors identify a failure.
• Increased sediment transfer, including sediment-bound contaminants or release into water column altering water chemistry. • Sediment sampling completed in spring 2022 indicated high levels of heavy metals and PAHs throughout the canal network, exceeding relevant sediment EQS levels.	• Topographic survey will collect hard and soft bed measurements at specified cross-sections of the canal, enabling the depth of sediments to be assessed. • Further targeted sediment sampling as recommended in the Sediment sampling and analysis report, to analyse the nature and chemistry of sediment samples along the canal. • Modelling / comparison of model outputs and velocity vs shear strength of sediments to be updated with refined hydraulic modelling.	• Where a significant increased risk of localised erosion is identified, some localised modifications to channels, scour protection measures or by-passes might be necessary. • Where highly contaminated sediments are identified and there is an increased risk that these become mobilised as a result of the transfer, dredging to remove contaminated sediments may be necessary.

Key potential impacts with WFD compliance risks	Further analysis requirements	Mitigation to reduce WFD risks
	• Potential to expand links from sediment to water quality monitoring and analysis, given identified potential links highlighted in initial sampling.	
• WTW backwash discharge into canal at Leighton Buzzard. • If significant concentrations of suspended sediment are predicted to be present in the backwash, these could deposit in the canal in some flow states, leading to a concentration of contaminated sediment. • There is a risk of a concentration of INNS (dependent on backwash design).	• The likely volumes of backwash discharges and their contaminant load should be calculated by the WTW design team. Initial mass balance calculation of volume and concentration shows it could be a risk. • INNS surveys and assessments are ongoing.	• WTW designers may need to consider a treatment train to improve the quality of the backwash water prior to discharge to the canal and biosecurity should be considered. •
• Fish entrainment at intakes.	• Assessment of appropriate structures to balance entrainment risk with maintenance and operation.	• Fish and eel screening structures would need to be included for all relevant structures.
• Localised hydromorphological impact of discharge from rising main pipeline into the Coventry Canal.	• Assessment of scour risk to be factored into discharge outfall design.	• The rising main will discharge into the canal near Coleshill Road from an existing access to the canal side, via a new discharge structure that will be sized to avoid deleterious flow velocities and shears.

It is identified that further WFD assessment would be required for detailed design development at Gate 3 and for future planning/consent applications, to improve the confidence and certainty of WFD risks outlined in the Gate 2 WFD Level 2 assessments (Annex B3.3.4).

2.3 Strategic Environmental Assessment

2.3.1 Methodology

The Strategic Environmental Assessment (SEA) (Annex B3.3.1) included in Appendix C is informed by the other environmental assessments undertaken for the scheme. The SEA breaks the assessment down into topics, identifying the SEA objectives for the scheme, and mitigation measures for these to be achieved. It also gives Red/Amber/Green (RAG) ratings for construction and operational effects, as well as residual construction and operational effects within the assessment table, which represents an update to the Gate 1 SEA. The SEA assessment looks at these pre-mitigation and residual construction and operational effects of the GUC option. Pre-mitigation effects are before any additional mitigation measures such as construction best practice, further surveys or additional landscaping proposals, but includes measures that are embedded (already part of) the design. Residual effects are the effects predicted after the identified additional mitigation measures have been implemented.

2.3.2 Results

The SEA identified the following potential effects:

- Biodiversity, flora and fauna – pipeline within 500m of Bentley Park Site of Special Scientific Interest (SSSI) (potential for disturbance during construction); several LNRs within 500m of canal; pipeline goes round the boundary of Gallops Hill Wood ancient woodland area and a small section of the Oxford Canal is adjacent to All Oaks Wood ancient woodland.
- Soil - Loss of grade 3 agricultural land, intersects Grade 1, 2 and 3 agricultural land; numerous authorised and historic landfill sites are also intersected or close by.
- Water - Parts of the scheme lie within flood zones 2 and 3; potential WFD compliance risks associated with the operation of the scheme; improving water availability and resilience across the region.
- Air – the scheme would intersect three air quality management areas and increases in air emissions are likely during construction).
- Climatic factors – there would be an increase in carbon emissions due to the scheme, but these would be reduced by utilising existing assets, and the scheme would increase water supply resilience.
- Landscape – Canal improvements will increase visual amenity and enhance character, although there will be visual effects during construction.
- Historic environment – there are numerous listed buildings and other heritage assets in close proximity to the scheme which could be impacted.
- Population and human health – there would be some disruption during construction.
- Material assets – the scheme would require resource use but this would be minimised by utilising existing assets. There would be traffic impacts as numerous small roads and the M42/M6 Toll and A446 are intersected.

An in-combination assessment was carried out, which included other SROs, Hybrid Bills, (Development Consent Orders) DCOs, and relevant Local Development Framework Polices within 10km (refer to Section 3.8.1 for an explanation of which projects were included). This identified potential in-combination construction effects with River Severn to River Thames transfer Joint solution, Daventry International Rail Freight Terminal and the Northampton Gateway Rail Freight Interchange and HS2, should the timings of these overlap with the construction of the scheme.

3 Environmental Appraisal

3.1 Purpose and scope of environmental appraisal

The purpose of this EAR is to meet the guidance set out within the RAPID Gate 2 guidance[7], which states that the Gate 2 environmental appraisal submission should address the following:

- An update of the Gate 1 work where relevant.
- The environmental appraisal work undertaken to date – likely to be at a strategic scale.
- Baseline and analysis – this might include results of monitoring, modelling, environmental surveys, etc.
- Options assessment, with sufficient detail to allow comparison of options within the solution and identify potential effects (positive and negative) and opportunities.
- Assessment of the effects of the solution, an evaluation of their significance and any cumulative or in-combination effects.
- Clear justification as to options within the solution discounted, those taken forward, and the preferred option selected. Where the preferred option is identified, potential environmental effects and opportunities should be discussed.
- The appraisal work should include consideration of resilience (e.g. climate change).
- A description of the connection to other assessments (e.g. biodiversity net gain, WFD, natural capital, carbon) and demonstrate how they have been considered within this initial appraisal work.
- Development of mitigation and enhancement opportunities.
- Any future monitoring requirements of the identified environmental effects and efficacy of any included mitigation measures.
- A plan to address uncertainties and data gaps.

In order to meet these requirements, a number of assessments were carried out for the scheme in addition to the regulatory assessments described in section 2. These other assessments are summarised below in sections 3.2 to 3.7.

3.2 Waterbody Connections

3.2.1 Methodology

The purpose of the Waterbody Connections report (Annex B3.2.1) included in Appendix D is to provide a consistent definition of water body connectivity for the environmental assessments, drawing together information from previous Gate 1 assessments and ongoing hydrological and water quality modelling workstreams.

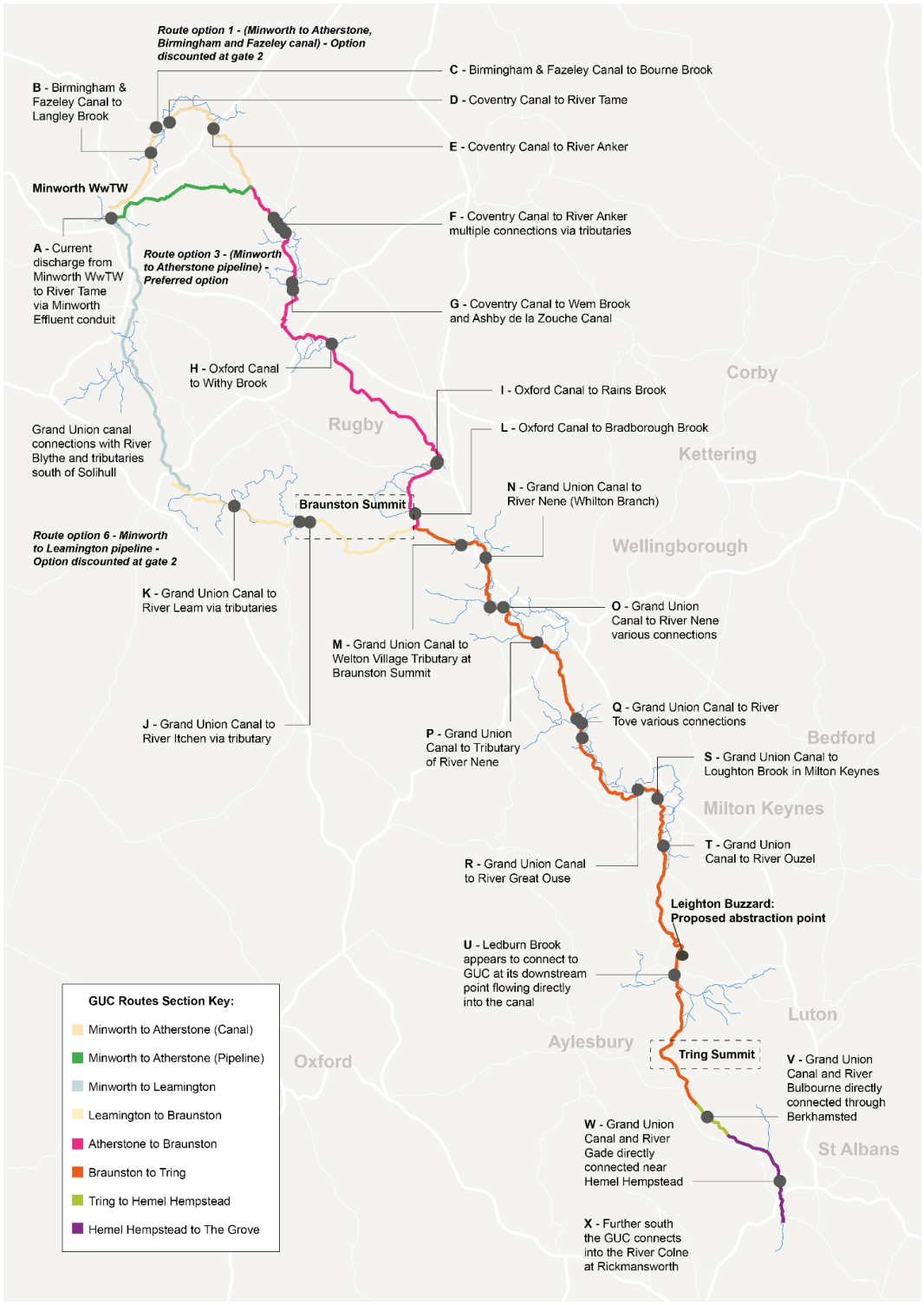
3.2.2 Results

The primary output is a map indicating existing points of connection between the canal network and natural watercourses, that provide a pathway for potential environmental effects (primarily changes to water quality) as a result of the transfer operating, as shown below in Figure 3.1. This conceptual map indicates the locations of identified watercourse connections throughout the transfer routes (direct, and via waste weirs/sluices to main rivers or tributaries) which can be

[7] Strategic regional water resource solutions guidance for gate two, Regulators' Alliance for Progressing Infrastructure Development 2022, available at: www.ofwat.gov.uk/wp-content/uploads/2022/02/Strategic-regional-water-resource-solutions-guidance-for-gate-two_RAPID.pdf

used to aid understanding of existing connectivity in the system to inform the ongoing environmental assessments. This process was undertaken in parallel with the optioneering process and as such, this map is not specific to the selected option, but rather shows all the connections in the scheme area to give a holistic view.

Figure 3.1: Conceptual map of watercourse connections along transfer route options



3.3 Fish survey report

3.3.1 Methodology

The Fish Survey Report (Annex B3.2.3) included in Appendix E outlines the relevant legislation relating to fisheries, national planning policy, survey methodology and all baseline data. It also includes the results for eDNA and electrofishing surveys, impact appraisals and mitigation measures.

The fish survey programme includes surveys at selected waterbody connections with the GUC (where connectivity is relevant for the purposes of these Gate 2 assessment, although it is noted that additional connections may be identified as relevant at later Gate stages) and on canals sections between Atherstone and the Leighton Buzzard abstraction point. Surveys include eDNA sampling in the canal and connected waterbodies and electrofishing surveys in the connected waterbodies.

eDNA methodology[8] for still waterbodies has been developed by the Environment Agency in collaboration with NatureMetrics. At each site, up to 1 litre[9] of sampled water was filtered through an encapsulated disk filter immediately upon collection using a syringe to monitor the volume of water sampled. A preservative solution was added to the filter units to be analysed at NatureMetrics specialist laboratory.

Electro-fishing is the primary survey methodology used to assess the WFD status of fish populations throughout England and Wales. All electro-fishing surveys were undertaken using WFD compliant fully quantitative methods. The survey used a direct current of electricity flowing between a submerged cathode and anode; stunned fish were easily and safely captured, details recorded and then returned unharmed to the same waterbody. Each 100m site was isolated using stop-nets set across the channel to prevent fish entering or exiting the fixed area, then a minimum of three passes or ‘runs’ was made moving in an upstream direction.

3.3.2 Results

3.3.2.1 eDNA

A total of seven strictly marine fish taxa were detected. These were assumed to be either wastewater contaminants, fishmeal used as angling bait or a result of contamination to samples; as such, they were discounted from the analysis. The most common detected taxa were *Cypriniformes* (found in 100% of the sites surveyed), followed by *Percidae* (76%) and Salmonidae (71%). There was an average species richness of 10.8 which ranged from 3 at River (Warwickshire) Avon to 22 at River Colne. The most commonly detected species were trout, roach and perch, followed by common bream and bullhead.

Similar levels of species diversity were also observed in the survey sites located within the canal system. An average of 12.2 different species were identified per site within the canal system, with Site 5 (GUC Northampton Arm Intersection) presenting the lowest fish biodiversity, and Site 8 the highest. Pike (*Esox lucius*), perch (*Percidae*) and roach (*Rutilus rutilus*) were the most frequent species, and the presence of fish such as common bream indicate that the canal has a fish community associated with a slow to stagnant flow of water and a silty substrate[10]. Silver

[8] Grand Union Canal Strategic Resource Option, Sampling Methodology Report, January 2022, document reference 100105044|100105044A|P03.

[9] Volumes of water filtered varied between sites according to the turbidity of the samples.

[10] Aarts, B. and Nienhuis, P.H. (2003) Fish zonations and guilds as the basis for assessment of ecological integrity of large rivers. *Hydrobiologia.* 500, 157-178.

bream (*Blicca bjoerkna*) were also identified within the canal system; in Britain this is a species restricted to slow-flowing lowland rivers and canals in the midlands and southeast of England[11].

The following protected species were detected in the sequencing: barbel (*Barbus barbus*), bullhead (*Cottus gobio),* Atlantic salmon (*Salmo salar*), brown/sea trout (*Salmo trutta)* and brook/river lamprey (species resolution not possible - *Lampetra planeri/fluviatilis*).

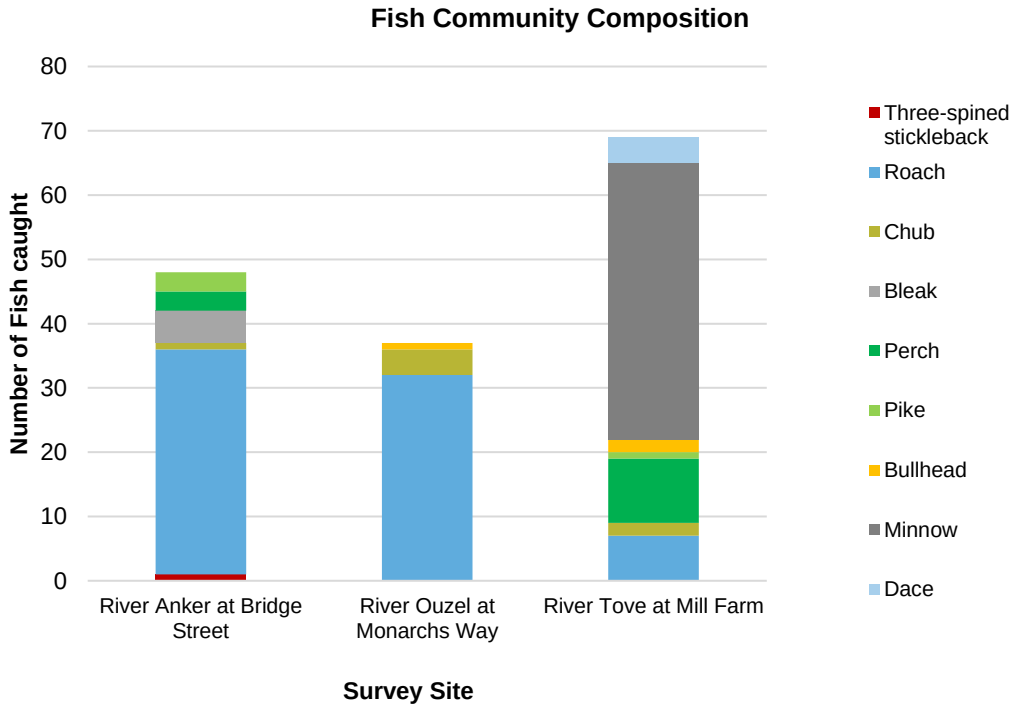
The eDNA data detected brown trout in the GUC, which, although not a typical species for this type of habitat, is found in some canal systems[12]. It may be that trout survive in some areas of the GUC although this could also be from close connections to rivers, fisheries, or other forms of contamination (such as wastewater or angling bait). Atlantic salmon was recorded at three sites (River Chess at Rickmansworth, Tringford Reservoir and at GUC near River Gade).

Five INNS[13] were also identified: carp (*Cyprinus carpio)*, zander (*Stizostedion lucioperca),* rainbow trout (*Oncorhynchus mykiss*), brook charr (*Salvelinus fontinalis*), and wels catfish (*Silurus glanis).*

3.3.2.2 Electrofishing

Electrofishing surveys were undertaken in rivers at or near connections to the GUC in areas of possible influence from the scheme design. Results from the surveys, carried out in July 2022, are shown below in Figure 3.2.

Figure 3.2: Fish abundance from electrofishing surveys, showing species community composition



[11] Maitland, P.S. and Campbell, R.N. (1992) *Freshwater Fishes*. Harper Collins Publishers.

[12] Canal and River Trust, 24 December 2020. *Brown trout.* [online] Available at < Brown trout | Types of fish | Canal & River Trust (canalrivertrust.org.uk)>. [Accessed 20 July 2022.]

[13] WFD UK TAG, 2019. *Classification of aquatic alien species according to their level of impact.* [pdf] WFD UK TAG. Available at: < UKTAG classification of alien species working paper v8.pdf (wfduk.org)> [Accessed 20 July 2022.]

3.3.2.3 Impact assessment

Potential impacts of the scheme on the fish community include changes to water quality such as an increase in turbidity and change in temperature, changes to habitat availability for fish, potential restriction of fish passage, risk of accidental pollution events, increase in overflow spills to connecting waterbodies, increased spread of invasive fish species and localised impacts on fish species at the intake structure.

Proposed mitigation strategies include such measures as:

- Appropriate design of discharge outlet and intake structures to protect habitat and fish communities in those areas.
- Protection of marginal habitat areas important for spawning and juvenile fish (NB: more information on habitat utilisation would benefit the assessment and mitigation of such impacts).
- Measures to protect or increase bed roughness in high-velocity constriction points.
- Appropriate allowance for fish passage.
- Prevention of pollution discharges through effluent standards and best-practice measures.
- Minimisation of spills from overflow weirs and waterbody connections.
- Screening on overflow weirs to prevent invasive species transmission.
- Increasing public awareness of INNS.

Further investigation during Gate 3 should aim to inform highlighted uncertainties, with emphasis on:

- Monitoring of water quality impacts.
- Assessment of key areas of silt and associated impacts.
- Modelling of flow velocity and associated water quality changes.
- Assessment of barriers to fish movement.
- Understanding of present habitats, likely habitat changes and the associated effects on fish communities including invasive species.
- Further understanding of the significance of waterbody connections and the impacts on fish populations through water and species transfer.

3.4 Habitats and protected species desk study

3.4.1 Methodology

A 3.4 Habitats and protected species desk study (Annex B3.2.6) included in Appendix F was carried out using publicly available data, to identify statutory and non-statutory designates sites, habitats of principal importance etc. The study areas for the desk study are as follows:

- Statutory sites including SAC, SPA, Ramsar sites, SSSI, National Nature Reserves (NNR) and Local Nature Reserves (LNR) were identified within 2km of the proposed pipeline route.
- Datasets on ancient woodland and habitats of principal importance have been collected for those sites with 500m of the route.

A first-pass habitat map to the UKHabs classification system[14] was produced to inform the desk study. This was carried out in GIS using OS Mastermap data to provide an initial habitat map of an area 500m either side the pipeline route and a number of individual locations along the various canals to be affected by the scheme. Due to the length of the canal network involved,

[14] Source: UKHabs website ukhab – UK Habitat Classification, accessed 09 March 2022

full surveys along the whole route were not feasible at this stage. Instead, a proportionate approach was taken where habitat mapping was carried out at a distribution of sites associated with the scheme to capture possible connections between the canal network and other major waterbodies. These sites were also surveyed for INNS. Those locations where habitat mapping has been undertaken are provided in Table 3.1 below.

Grid references for continued monitoring locations redacted

Table 3.1: Locations on the Canal Network for Habitat Mapping

Site		Connection/point
GUC @ Northampton arm intersection (GUC only)	Close to Gayton, near Northampton	[redacted]
River Tove & GUC	Downstream of Stoke Bruerne	
River Ouzel & GUC	Leighton Buzzard	
GUC @ Tring (GUC only)	Marsworth, north of Tring	
Tringford Reservoir	Tringford, north of Tring	
Startopsend Reservoir	Tringford, north of Tring	
Marsworth Reservoir	Tringford, north of Tring	

An assessment of the habitat map, and other freely available online resources has been undertaken to identify at a high level, the types of protected species and habitats that are likely to be present along and in the vicinity of the pipeline route and the selected canal locations.

3.4.2 Results

As the canals are engineered watercourses, their water levels are well regulated, with many of the waterbody connections controlled by sluices, gates etc. It is anticipated that the scheme design will maintain this so as the water level rises, the heights of the banks and control structures will also be increased, to ensure that water losses to the wider waterbody network between Minworth and Leighton Buzzard are minimised. However, there are existing connections between the canals and other waterbodies which could be affected by the predicted water level rise. It is anticipated that these would be very limited in scale, although detailed modelling would be required to quantify this.

In locations where it is likely to be necessary to increase the height of the canal banks engineering works will be required. Both of these factors combined mean that the riparian habitat is likely to be affected to varying degrees along much of the length of the affected canals.

In addition, the increase in water levels has the potential to affect other watercourses and waterbodies along the wider canal corridor. Where other canals, rivers, streams and ditches meet the affected canals, water levels in these are likely to be affected too, to the same degree as the increase in water level of the canal that they flow into. This effect will be felt upstream of these confluences for varying distances, depending on the topography of the surrounding land; however the scheme will aim to minimise overspills in order to keep as much of the transferred water as possible within the GUC, which will reduce effects to adjacent watercourses.

In the canals, and in the affected watercourses, increases in water level have the potential to affect the habitat for many protected species, including but not limited to otter (*Lutra lutra*), water vole (*Arvicola amphibius*) and great crested newt (*Triturus cristatus*). The pipeline route has the potential to affect valuable habitats, such as ancient woodland or works affecting structures or trees that could affect bat roosts.

Habitat surveys will be carried out at targeted locations, based on the locations of engineering interventions such as towpaths raising and weir adjustments, later in 2022. The result of these surveys will not be available for these Gate 2 assessments, but will be used inform the EIA Scoping to be undertaken in parallel with Gate 3.

3.5 Sediment report

3.5.1 Methodology

Existing numerical modelling undertaken by JBA has shown that the scheme will increase the flow speed and bed shear stress along the GUC (Section 6). Since the bed shear stress magnitude controls sediment mobilisation, transport and accretion, any changes to flow velocity brought about by the scheme may affect the dynamic behaviour of the canal bed sediments, and any increases in sediment resuspension and transport will affect water quality if the sediments are contaminated.

The sediment report (Annex 3.2.5) included in Appendix G describes the acquisition of bottom sediment samples from the GUC and its connections. It discusses results from laboratory analyses undertaken to establish the physical and chemical nature of the sediments. It also reports the acquisition and analysis of a few water samples used to investigate the local impacts of vessels using the canal.

Following a defined protocol to eliminate any cross-contamination between samples, sediment cores were obtained in June 2022 at 47 locations along the scheme and in seven connecting waterbodies. Water samples were also obtained at four places before and after the passage of a vessel on the canal. After preparation, the *in-situ* entrainment threshold of the sediment samples was measured using a cohesive strength meter (CSM). All samples were subject to particle size analysis (PSA) and chemical analysis to quantify concentrations of heavy metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and total petroleum hydrocarbons.

3.5.2 Results

The grain size characteristics of the canal bed sediments were relatively invariant, with average D_{10} and D_{50} values of 3.7µm and 51.4 µm (within clay size range). No trends emerge; the data show peak values superimposed on relatively stable along-canal values. The horizontal entrainment shear stress (τ_o) showed relatively small geographical variations in the measured value of τ_o with average and standard deviation values of 0.57N/m^2 and 0.84N/m^2, respectively.

In the absence of guidance, reference has been made to the literature[15] for the advice provided for coastal and estuarine sediments defining a threshold effect level (TEL) and a sediment quality objective (SQO). Except for total chromium (Cr), heavy metal concentrations exceed the TEL threshold at most sampling locations and, in most cases, exceed the SQO threshold. At the most contaminated sites, the concentrations of arsenic (As), cadmium (Cd), lead (Pb) and mercury (Hg) exceed TEL values by 9, 2, 5 and 2000, respectively. The highest concentrations of cadmium (Cd) and mercury (Hg) occur at sampling locations up to 50km south of the most northern sampling point (GUC1), greatly exceeding SQO thresholds and probably reflecting former industrial activities. The highest concentrations of copper (Cu), lead (Pb), nickel (Ni), and zinc (Zn) occur 50 to 120km south of sampling location GUC 1. Heavy metal concentrations in the connections are generally less than in the canal. However, in all cases, concentrations of arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), and mercury (Hg) exceed the TEL threshold.

Geographically, concentration values for most PAHs vary by no more than two or three times the minimum value. While fluorene values peak at around six times, the measured minimum value, acenaphthene, has: (a) the most significant variation with values around 600 mg/kg

[15] MacDonald, D. D., Carr, R. S., Calder, F. D., Long, E. R. & Ingersoll, C.G., 1996. Development and evaluation of sediment quality guidelines for Florida coastal waters. Ecotoxicology, 5(4), pp.253-278, Burton Jr, G. A., 2002. Sediment quality criteria in use around the world. Limnology, 3(2), pp.65-76.and Crane, M., 2003. Proposed development of sediment quality guidelines under the European Water Framework Directive: a critique. Toxicology Letters, 142(3), pp.195-206.

around GUC 1; (b) a decrease in values to less than 0.2mg/kg around 50 km south of GUC 1 (Daventry). However, the most striking feature of the measured PAH values is the magnitude of the concentrations, irrespective of the determinants considered. The measured PAH concentrations are three orders of magnitude greater than the TEL and SQO thresholds in all cases. PAH concentrations in the connection samples are also high and exceed the TEL and SQO thresholds.

The analysis provided detection of PCBs down to a minimum detection level; thus, concentration values are generally reported as being less than a stated value. PCB concentrations in marine sediments typically range between 1 to 100µg/kg. A significant spike in PCB concentration values was observed in the vicinity of Coventry.

Sediments in the water samples were very fine (D_{10} <10µm), and no trends in the particle size distribution were detectable before or after the vessel's passage. A direct relationship between vessel-induced disturbance to the bed sediments and the concentration of suspended sediments in the water column could not be established. All water samples showed low concentration values for all determinants, implying that layers of the canal sediment containing measurable concentrations of heavy metals, PAHs and PCBs had not been disturbed in an undefined period before obtaining the samples.

Typically, maximum (τ_{max}) and minimum (τ_{min}) bed shear stresses predicted by the JBA Gate 1 model values were 0.5N/m^2 to 2N/m^2, and no geographical trend in these data can be observed. The model indicated that at the GUC sediment sampling locations, bed shear stress would not increase significantly due to the increased flows associated with water transfer. At most sites, the sediment entrainment threshold exceeds the predicted maximum bed shear stress (τ_{max}) for the baseline and scheme cases. The only exceptions were at sample locations GUC 11, GUC 21 and GUC 46, where the entrainment threshold is marginally less than the predicted maximum bed shear stress.

3.6 Natural Capital and Biodiversity Net Gain

3.6.1 Methodology

Natural Capital refers to the elements of the natural world that provide benefits to society, including aspects such as woodland, grassland, freshwater, marine, urban greenspace and wetland habitats. The benefits provided to humans by the natural environment vary from regulating services such as natural flood management to cultural services such as recreational value.

A Natural Capital assessment (NCA) (Annex B3.3.2) included in Appendix H has been undertaken on the scheme in accordance with the Water Resources Planning Guideline[16] (WRPG) and Enabling a Natural Capital Approach[17] (ENCA) requirements. The aim of the Gate 2 process was to update the Gate 1 NCA in line with ENCA updated guidance from August 2021. The impacts considered during this process include:

- Carbon sequestration
- Natural hazard management
- Water purification - qualitative assessment
- Biodiversity and habitats – BNG assessment

[16] 2021, Available online at Water resources planning guideline - GOV.UK (www.gov.uk)..

[17] 2020. The Green Book Central Government Guidance on Appraisal And Evaluation. [online] London: HM Treasury. Available at: <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938046/The_Green_Book_2020.pdf> [Accessed 16 March 2022].

- Air pollutant removal
- Recreation and amenity value
- Food production

BNG refers specifically to the combination of habitats present within a site and their ability to support biodiversity. Each habitat is given a distinct score that relates to its area, condition, distinctiveness and connectivity. The change in habitat due to the construction and operation of the SRO options informs the overall BNG score and whether they are likely to contribute to a net gain in biodiversity.

The Gate 2 process aims to develop these assessments in line with the new BNG 3.0 metric[18] as outlined in the Environment Act 2021. The process uses the Priority Habitat Inventory, and SSSI, SAC, SPA and Ramsar designations to identify areas with a high biodiversity importance. Units have been assigned to the pre-construction land use according to the habitats present in the scheme boundary. Post construction land use, including any mitigation described in the scheme description, has been used to calculate the post construction score.

3.6.2 Results

The NCA concluded that the scheme will cause the temporary loss of natural capital stocks. The scheme could also cause the permanent loss of ancient woodland and traditional orchards, that once lost cannot be replaced, and therefore, during Gate 3 the design could look towards re-iterating the design to avoid impacting these areas.

The BNG assessment concluded that the scheme is likely to result in a loss of BNG habitat units due to the temporary loss of natural capital assets during construction. However, there are opportunities to provide BNG enhancements as the scheme crosses several priority habitats and Network Enhancement Zones and is therefore suitable for the planting of new high value habitats, including the following:

- Creation of higher value habitat within grassland, arable and pasture natural capital assets onsite to achieve an increase in Biodiversity Units (BU) and work towards a 10% uplift in BNG.
- Habitat creation work within the adjacent priority habitats.
- Increase the quality/quantity of freshwater assets, including lakes, ponds located in designated SSSIs, pending detailed assessment of local conditions and available space.
- Scheme to identify suitable areas offsite for the creation, enhancement and/or restoration in order to develop off-site net gains, working towards achieving a 10% uplift in BNG.
- Identify areas of local peatland restoration
- Possibly create man-made floating wetland islands, enabling plants and microbes to form and attract wildlife both above and below the water's surface and create biochemical and physical processes to improve things such as water quality.
- Seeding of grassland within footprints of the above ground infrastructure, where possible.

Mitigation and enhancement opportunities for the scheme are suggested within Section 4 of this report, based on the Grand Union Canal Strategic Transfer – Wider Benefit Summary Technical Note[19] which can work in tandem to reduce the loss of BNG and introducing net gain. It identified opportunities for habitat creation possibilities both on-site and off-site.

Opportunities identified within the Technical Note included:

[18] Biodiversity Metric 3.0, Natural England (2021), available online at http://nepubprod.appspot.com/publication/6049804846366720

[19] Grand Union Canal Strategic Transfer - Wider Benefit Summary, WSP (25th March 2022)

- River Tove Lock Flight - opportunities to take advantage of the construction works proposed to improve the interaction between the river and canal and introduce additional wetland habitats that both enhance the environment and provide operational benefit to the scheme (e.g. around managing surge flows and weir discharges).
- Leighton Buzzard Treatment Site - how the works can fit into the existing environment and provide both priority habitat and mitigation of carbon costs.
- Hillmorton Locks - opportunities to both enhance the environment and improve the functioning of the site for boat users.

These should be developed further during Gate 3, as well as exploring wider partnerships with landowners, conservation groups and other organisations to help deliver opportunities for biodiversity enhancement.

3.7 Invasive Non-Native Risk Assessment

3.7.1 Methodology

The transfer of water from one location to another may increase the risk of spreading INNS. The introduction of INNS to a waterbody can have a significant detrimental effect on ecosystem structure and functioning, as well as jeopardising compliance with environmental legislation. The potential threats from INNS means that a risk assessment is imperative in ensuring WFD objectives are met, and safety and supply of both drinking water and wastewater in the environment are maintained.

The INNS risk assessment (Annex B3.2.4) included in Appendix I presents an assessment of the potential increase in INNS risk arising from the scheme. The following objectives have been considered as part of the assessment:

To establish if the scheme will introduce a hydrological connection between previously isolated catchments.

To identify INNS within an appropriate study area to understand current INNS distribution.

To outline legislative context of INNS risk assessment.

To use the SRO aquatic INNS Risk Assessment Tool (SAI-RAT) developed by APEM Ltd on behalf of the Environment Agency to quantify INNS risk associated with the scheme based in the conceptual design information currently available.

The report considers the methodology for both desk-based study and field study, outlining the survey methods for various INNS. It also provides an overview of the risk assessment tool used within surveys.

3.7.2 Results

For the desk study, open source macroinvertebrate, macrophyte and fish data for the period 1965 to 2020 were obtained for the study area from the Environment Agency Ecology and Fish Data Explorer App[20] and the National Biodiversity Network (NBN) Atlas online records[21]. The data from this was screened against Schedule 9 of the Wildlife and Countryside Act 1981 and WFD-UKTAG guidance to identify INNS present in the study area.

A total of 33 invasive aquatic species were identified during the desk-based study of the Environment Agency and NBN Atlas records for the study area. Five invasive fish species were identified, including the High Impact common carp (*Cyprinus carpio*). Thirteen invasive

[20] Environment Agency Ecology and Fish Data Explorer App. Available online at: https://environment.data.gov.uk/ecology/explorer/

[21] NBN Atlas Records. Available online at: https://nbnatlas.org/

macroinvertebrates species were recorded, including four High Impact species. Fifteen invasive plant species were recorded, with eleven of those being High Impact.

To conduct the physical field study, surveys were undertaken on a wide distribution of sites associated with the scheme to capture possible connections between the canal network and other major waterbodies. At each site, the survey comprised of:

- Collection of two eDNA samples, one to detect fish and one to detect aquatic invertebrates.
- Manual search for non-native aquatic invertebrates.
- Visual search for non-native plants.

Four INNS fish species were recorded within the study area using eDNA metabarcoding. Of those, common carp were the most widely spread, detected in samples from twelve of the fifteen sites surveyed. Rainbow trout (*Oncorhynchus mykiss*) were detected in two sites, Wels catfish (*Silurus glanis)* and zander (*Sander lucioperca*) in one sample, and species from the *Cyprinidae* family in samples from eleven survey sites. Many of the species of the *Cyprinidae* family are invasive to the UK.

Seven invertebrate and three aquatic plant species were identified by physical observation across the fifteen sites surveyed, as follows:

Invertebrate INNS field survey positive results:

- Bloody red mysid *Hemimysis anomala*
- Caspian mud shrimp *Chelicorophium curvispinum*
- Demon shrimp *Dikerogammarus haemobaphes*
- Jenkin's spire snail *Potamopyrgus antipodarum*
- Bladder snail *Physella sp*.
- Northern River / Florida crangonyctid *Crangonyx pseudogracilis / floridanus*
- Signal crayfish *Pacifastacus leniusculus*
- Zebra mussel *Dreissena polymorpha*
- Quagga mussel *Dreissena rostriformis*

Plant INNS field survey positive results:

- Floating pennywort *Hydrocotyle ranunculoides*
- Himalayan balsam *Impatiens glandulifera*
- Nuttall's waterweed *Elodea nuttallii*

These field surveys did not identify any new INNS to the study area. All the INNS identified by either eDNA analysis or by physical observation had previously been recorded within the study area by the Environment Agency and/or NBN Atlas.

The results of the SRO aquatic INNS Risk Assessment Tool (SAI-RAT) are summarised below in Table 3.2. It should be noted that INNS are widespread within the canal network with the movement of boats and people, and these scores do not take into account any engineering interventions that may be required as mitigation to prevent the spread of INNS.

Table 3.2: INNS risk assessment scores for RWT components

Transfer route section	Risk score	Risk score category
Minworth WwTW to Atherstone via a pipeline	30.25	Low

Atherstone to Leighton Buzzard via the Coventry Canal, Oxford Canal and the GUC	52.13	Medium

The Atherstone to Leighton Buzzard canal transfer generated a risk score of 52.13, which falls into the Medium risk category.

The Minworth WwTW to Atherstone pipeline transfer generated a risk score of 30.25, which falls into the Low risk category. Pipeline pathways incur a lower score in the risk assessment tool than canal pathways. Additionally, pipelines do not present the same opportunity as canals for INNS spread via navigation and recreation pathways. These results suggest that the pipeline section of the route presents the lower risk with respect to INNS transfer.

Following the INNS risk assessment, the following conclusions were drawn:

- The scheme will introduce a new hydrological connection between previously isolated catchments with the connection from Minworth.
- The proposed transfer route and hydrologically connected waterbodies within an approximately 1km radius already host a range of aquatic INNS, including a number of High Impact species.
- Although the addition of treated water from a WwTW will not introduce new INNS to the canal network, which is already connected and has boat traffic passing through it, the resulting increase in flows may facilitate the downstream spread of INNS already present in the receiving waterbody.
- It is critical that the potential risk associated with increased flows through connections are further investigated/understood to enable suitable mitigation to be incorporated into the scheme design.
- The proposed pipeline section of the scheme presents a lower risk than the open canal section due to the lack of ability of INNS to pass through treatment processes at Minworth.
- Regular monitoring of the canal network and connected waterbodies would offer the best chance of identifying new invasions at an early stage so that further actions can be implemented.

For a more detailed description of the INNS risk due to the scheme and a discussion of potential mitigation measures, reference should be made to the INNS Risk Assessment Report (Annex B3.2.4).

3.8 In-combination effects

3.8.1 Methodology

An initial in-combination effects assessment has been undertaken as part of the Gate 2 SEA and HRA (Annex B3.3.3 and Appendix A). It is understood that if the scheme is selected as an option in the WRSE Regional Plan and Affinity WRMP24 it will be subject to further in-combination effects assessment with the other selected options, neighbouring water companies plans and neighbouring regional plans. Until the WRSE Best Value Regional Plan has been developed and agreed, it is not known when the scheme would be implemented, and therefore, which other developments it could act in-combination with.

Assumptions were therefore made about other plans, programmes and projects that could act in-combination with the scheme and the following were considered within this in-combination effects assessments. For the purpose of this assessment, it was assumed that the scheme would be implemented at the same time as other developments considered:

- **Other SROs** - Abingdon reservoir, London effluent reuse, South Lincolnshire reservoir, Fawley desalination, River Itchen effluent reuse, Vyrnwy reservoir, Minworth effluent reuse source, United Utilities sources, West Country south sources (and associated transfers), Severn Trent Water sources, West Country north sources (and associated transfers), River Severn to River Thames transfer Joint solution, Thames Water – Southern Water transfer.
- **DCO Schemes** (Within 10km buffer, based on HRA ZoI, information taken from National Infrastructure Planning website[22]) - M42 Junction 6 Improvement, Daventry International Rail Freight Terminal, Northampton Gateway Rail Freight Interchange.
- **Hybrid Bills** – High Speed Two (HS2).
- **Local Development Frameworks** – North Warwickshire Local Plan, Birmingham Development Plan, Solihull Local Development Plan, Aylesbury Value Local Plan, Central Bedfordshire Local Plan, Dacorum Local Plan.

The in-combination assessment will be further developed at Gate 3 and for the EIA, when there should be greater certainty about the timing of the scheme and how it will overlap with other projects.

3.8.2 Results

There is potential for in-combination construction effects with Minworth effluent reuse source and River Severn to River Thames transfer joint solution if the schemes are implemented together. These effects could include construction traffic, noise, dust and visual intrusion. It is unlikely that there will be any in-combination effects with the other SROs identified.

Regarding DCO schemes, there may be potential for in-combination effects with the M42 Junction 6 improvement scheme and GUC construction traffic to the pipeline crossing the M42/M6 toll at Junction 9. This could result in an increase in construction traffic and subsequent delays. In-combination effects with the Daventry International Rail Freight Terminal and Northampton Gateway Rail Freight Interchange are also possible relating to increases in construction traffic.

The HS2 route (hybrid Bill) intersects the proposed Minworth to Atherstone pipeline near Minworth around the M42 junction 9. Whitacre Heath SSSI is approximately 1.4km from the HS2 route and 2km from the GUC Minworth to Atherstone Pipeline route at this point. In-combination construction effects could cause disturbance for SSSIs and for local residents from construction noise, traffic, dust and visual intrusion. No operation effects are anticipated.

In terms of Local Development Frameworks (LDF), Atherstone and most of the proposed pipeline route falls under the North Warwickshire Local Plan (September 2021)[23]. The proposed pipeline route is within green belt land but no in-combination effects with other LDF policies were identified. Similarly, this is the case for Minworth treatment works and the Leighton Buzzard abstraction no LDF in-combination effects were identified. Overall, the GUC option is unlikely to have in-combination effects with the other LDFs as it is not within or close to any planned housing and employment allocation sites or other policies/designations and is largely existing canal.

During the HRA assessment, no pathways were identified that could result in significant effects alone, and there is no potential for cumulative effects from other plans or projects proposed in the ZoI of the scheme. No further assessment is required.

[22] National Infrastructure Planning (planninginspectorate.gov.uk), date accessed 3rd March 2022.

[23] North Warwickshire Borough Council (September 2021) Adopted Local Plan 2021. Available online at: https://www.northwarks.gov.uk/downloads/download/2682/adopted_local_plan_2021, accessed 11/03/2022

4 Additional RAPID Gate 2 requirements

4.1 Introduction

The RAPID Gate 2 guidance[24] includes a number of requirements for other assessments, which are included within a separately contracted workstream. For the avoidance of duplication, this EAR provides signposting to these assessments only and their conclusions will not be duplicated here.

4.2 Resilience

The major positive resilience effects are identified in respect to climatic factors, as this scheme supports the provision of additional water resource to Affinity Water. The scheme will assist the reliable transfer of water, therefore reducing the vulnerability and improving resilience to drought risks associated with climate change. This enhances Affinity Water's resilience to drought events, but also to operational issues such as pollution or major outages, given this will be a new strategic import to the region.

4.3 Wider solution benefits

The scheme is extremely well placed to offer a range of wider benefits due to the fact it is an existing asset, with existing users. The Gate 2 Concept Design Report (CDR) describes a few of these case studies in detail. There is a question to be asked as to how far the scheme can go, and how many interventions can be delivered. At this stage of the RAPID process, the question of 'ownership' is still being discussed and the conclusion of this will enable greater certainty on what 'wider benefits' can be delivered.

Despite the uncertainty regarding ownership and delivery at this stage, it is recognised that a minimum of 10% net gain is required to be included as part of the planning process. It is the ability to go beyond this which is technically feasible at this stage but requires further conversations, once ownership and delivery partners have been confirmed.

The 'wider benefits' within the CDR look at improved public access to the canal, creating new wetlands and habitats, as well as mitigating existing (pre-transfer) INNS concerns which have been flagged to the project team through stakeholder engagement during Gates 1 and 2.

4.4 Carbon

Embodied and operational carbon emissions for the lifespan of the SRO schemes are considered through the carbon assessment. Further details on the carbon assessment can be found within the Grand Union Canal SRO CDR (WSP, 2022), where the scheme design is reported in detail. This enables specific items to be targeted within the narrative. If, for example, one particular component of the design is carbon intensive, this will be identified in the CDR and recommendations can be put forward for how to mitigate this activity.

4.5 Consultation

Engagement with key stakeholders including the Environment Agency, NAU and Natural England have taken the form of online workshops to agree the scope of field-based monitoring,

[24] Strategic regional water resource solutions guidance for gate two, Regulators' Alliance for Progressing Infrastructure Development, February 2022, available online at https://www.ofwat.gov.uk/wp-content/uploads/2022/02/Strategic-regional-water-resource-solutions-guidance-for-gate-two_Feb_2022.pdf, accessed 09/02/2022.

to update on progress to date and to disseminate findings and conclusions. It was important for the teams to work collaboratively so that the correct data could be collected in an efficient manner.

The project team has also been working with stakeholder groups and canal user groups to understand the requirements and expectations of those who already use the canal asset. This involves angling groups, boating groups, local businesses etc. The goal has been to understand their concerns and arguably more importantly, where delivery of the SRO could help to achieve positive outcomes.

All stakeholder work is detailed in the Gate 2 submission paper, as well as in a dedicated annex to the Gate 2 submission.

5 Scoping checklist

This scoping checklist identifies the appropriate study areas for topics, based on the results of the Gate 2 assessments and the sources of baseline information used to date. It will need to be reviewed in light of the outcomes of the Gate 3 assessments. A full statutory EIA screening and scoping exercise will also be required at Gate 3. This Scoping Checklist provides an indication of the topics that may require assessment, based on the outcomes of the Gate 2 assessments and professional judgement. Given the early stage of the scheme design, this Scoping Checklist has been produced on a precautionary basis and topics may therefore be scoped out at a later stage when the design has developed. Uncertainties left after the Gate 2 assessments are also provided, along with a Red/Amber/Green (RAG) rating for these, to enable a prioritisation of the additional work required at Gate 3.

Table 5.1: Scoping checklist

Topic	Construction	Operation	Gate 2 uncertainties to be resolved at Gate 3	Additional surveys required at Gate 3
Air Quality	Scoped in	Scoped out	None identified.	None identified.
Cultural Heritage	Scoped in	Scoped in	Pipeline route and construction footprint will determine impacts to heritage assets.	None identified. Historic environment assessment as part of EIA may identify requirements for archaeological investigations or site surveys of heritage features.
Landscape	Scoped in	Scoped in	Pipeline route and construction footprint will determine landscape and visual impacts.	Site surveys will be required for the Landscape and Visual Impact Assessment as part of the EIA.
Biodiversity	Scoped in	Scoped in	Pipeline route, water levels changes, and construction footprint will determine impacts to terrestrial ecology. Impacts to aquatic ecology will be determined by flow and water quality changes, with impacts to adjacent, connected watercourses possible if overspills increase as a result of augmented flows. There is an increased risk of INNS dispersal due to the scheme. The Gate 3 assessments will need to demonstrate no Likely Significant Effects on Natura 2000 sites (i.e. SAC, SPA and Ramsar sites). An assessment of potential effects on other designated sites (including local sites) will also be required. Scheme should look to develop the design of the Leighton Buzzard abstraction site to enable a more reliable and in-depth BNG and NC assessment to be undertaken. The scheme should consider opportunities to create and improve habitats, offsite if required.	Walkover surveys of the pipeline route and overall scheme area, to determine requirements for targeted protected and priority species surveys. Electrofishing and eDNA surveys. Further field surveys in the summer to capture full range of INNS present along the transfer route and within hydraulically connected waterbodies. BNG baseline surveys.
Geology and Soils	Scoped in	Scoped out	Pipeline route and construction footprint will determine impacts to geology and soils.	None identified. Contaminated land risk assessment as part of EIA may

Topic	Construction	Operation	Gate 2 uncertainties to be resolved at Gate 3	Additional surveys required at Gate 3
				identify requirements for land quality testing.
Material Assets and Waste	Scoped in	Scoped in	Pipeline route and construction footprint will determine materials requirements and likely waste produced.	None identified.
Noise and Vibration	Scoped in	Scoped in	Pipeline route and construction footprint will determine impacts to sensitive noise receptors, although construction noise impacts can be mitigated.	Baseline noise surveys may be required to inform the EIA.
Population and Human Health	Scoped in	Scoped in	Pipeline route and construction footprint will determine impacts to population and human health.	None identified.
Water Environment	Scoped in	Scoped in	Changes to flow and water quality (from both discharge quality and mobilised sediments) will determine impacts on the water environment. The construction footprint and engineering requirements (bank raising, changes to existing weirs and structures, and new outfalls and inlets) will determine impacts to hydromorphology.	Additional sediment sampling with an additional testing locations, if required following analysis of Gate 2 sample. Ongoing water quality sampling.
Climate and Carbon	Scoped in	Scoped in	Construction footprint and methodology will determine carbon emissions and climate impacts.	None identified.
Major Accidents and Disasters	Scoped in	Scoped in	None identified.	None identified.
Combined and cumulative	Scoped in	Scoped in	Timing of scheme will affect which plans, programmes and projects could lead to cumulative effects.	None identified.

6 Conclusion

6.1 Environmental Feasibility Statement

Table 6.1 below shows the risks and mitigation measures identified by the Gate 2 assessments.

Table 6.1: Risks and mitigation measures identified by the Gate 2 assessments

Risk	Potential mitigation measure
Potential impacts on designated sites from pipeline.	Refinement of the pipeline route to avoid designated sites and their supporting habitat and sensitive habitats such as ancient woodland, with creation of habitat to compensate for any losses. Areas of offsite compensation may be required.
Loss of Grade 3 agricultural land at Leighton Buzzard abstraction.	Reinstate farmland and post-construction landscape design to achieve a 10% BNG increase.
Impacts to heritage assets.	Refinement of the pipeline route to avoid impacts to heritage assets. Historic environment assessment as part of EIA may identify requirements for archaeological investigations or site surveys of heritage features and an archaeological watching brief may be required during construction to avoid impacts to buried archaeological features.
Temporary impacts during construction, including pollution or disruption to services.	Best construction practices and pollution prevention and control measures. Best construction practices such as use of plant silencers. Use of directional drilling for pipeline to minimise disturbance to existing infrastructure. Design to consider measures to reduce embodied carbon. Investigate use of renewable energy for construction and operation.
Impacts on adjacent watercourses, should augmented flows lead to increased overspills to connected watercourses.	Engineering design to reduce overspill to adjacent watercourses.
Potential for impacts on terrestrial habitat of water voles and otters due to pipeline, which may require route refinement.	Protected species surveys (all relevant sites where work to structures or canal banks is occurring, at an appropriate time of year and appropriate time in planning of works) and licensing, with appropriate mitigation measures as required by the licenses.
Likely BNG decrease, unless habitat is created as part of the scheme.	Post-construction landscape design to achieve a 10% BNG increase and minimise visual impacts from the scheme. Permanent screening and restoration to original landscape character where possible, once construction is complete.

Risk	Potential mitigation measure
Temporary loss of woodland and permanent loss of farmland, which are both NC assets.	Reinstate farmland and woodland and post-construction landscape design to achieve a 10% BNG increase. However, it is acknowledged that there will be a delay in the replacement habitat reaching the same level of maturity and value as any mature woodland.
Increased volumes and flows lead to increased risk of INNS transfer and dispersal.	Engineering solutions to minimise the spread of INNS, including incorporation of biosecurity measures into the transfer design and operational protocol.

6.2 Regulatory barriers

The Gate 2 assessments have not identified any regulatory barriers to the scheme progression, although it should be noted that a full review of the LDF policies of the Local Authorities within which the scheme lies has not been carried out. It is understood that the potential consenting regime for the scheme is being investigated as part of a separate workstream, which should include an LDF policy review, as well as a review of National Policy Statements[25] and the National Planning Policy Framework[26].

6.3 Recommendations for Gate 3

Further surveys required at Gate 3 are provided in Table 5.1 above and comprise:

- Ecology walkover surveys of the pipeline route.
- eFishing and eDNA surveys.
- Further field surveys in the summer to capture full range of INNS present along the transfer route and within hydraulically connected waterbodies.
- Additional sediment sampling, in conjunction with additional water quality sampling.

The above data will be incorporated into the updated regulatory assessments as shown in Figure 1.2, namely the refined SEA, HRA, WFD and NC/BNG assessments. In addition, further sediment sampling, INNS surveys and habitats surveys will be reported as updates to the Gate 2 reports.

The draft RAPID guidance for Gate 3[27] states that an EIA is now a requirement of Gate 3 and the ongoing work for the scheme will therefore incorporate a full statutory EIA at the next stage, which will be sufficiently developed to support an application for consent (assumed at this stage to be a DCO). All pre-application activities will be carried out in accordance with the requirements of the 2008 Planning Act and a draft DCO application and Environmental Statement will be available for review at the end of Gate 3.

[25] Draft National Policy Statement for Water Resources Infrastructure, Department for Environment Food and Rural Affairs (2018), available online at https://consult.defra.gov.uk/water/draft-national-policy-statement/supporting_documents/draftnpswaterresourcesinfrastructure.pdf

[26] National Planning Policy Framework, Ministry of Housing, Communities and Local Government (2021), available online at https://www.gov.uk/government/publications/national-planning-policy-framework--2.

[27] DRAFT Gate Three Guidance, RAPID (2022)

Annexes

The annexes to this report are published separately:

GUC Annex B3.2.1 Watercourse Connections Report

GUC Annex B3.2.2 Fish Assessment Report

GUC Annex B3.2.4 Invasive and Non-Native Species Risk Assessment

GUC Annex B3.2.5 Sediment Sampling and Analysis

GUC Annex B3.2.6 Habitats and Protected Species

GUC Annex B3.3.1 Strategic Environmental Assessment

GUC Annex B3.3.2 Natural Capital & Biodiversity Net Gain

GUC Annex B3.3.3 Habitats Regulation Assessment

GUC Annex B3.3.4 Water Framework Directive

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