ANNEX B3.3.4

Water Framework Directive

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

Water Framework Directive Assessment

July 2022

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Glossary

Acronym	Definition
ACWG	All Company Working Group
AWB	Artificial Waterbody
CDR	Concept Design Report
CPET	Chironomid Pupae Excavation Technique
DNRA	Does Not Require Assessment [wrt WFD classification]
EA	Environment Agency
EAR	Environmental Assessment Report
EU	European Union
EQS	Environmental Quality Standard
GEP	Good Ecological Potential
GES	Good Ecological Status
GUC	Grand Union Canal
HMWB	Heavily Modified Waterbody
INNS	Invasive Non Native Species
Ml/d	Megalitres per day
PMB	Programme Management Board (GUC)
POM	Programme of Measures [WFD measures required to improve waterbody status]
PS	Pumping station
RAPID	Regulators' Alliance for Progressing Infrastructure Development
RBMP	River Basin Management Plan
RNAG	Reason for Not Achieving Good [WFD status]
SRO	Strategic Resource Option
WFD	Water Framework Directive
WSR	Water supply reservoir
WSW	Water Supply Works
WwTW	Water Treatment Works

1 Introduction

1.1 Overview

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

1.2 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

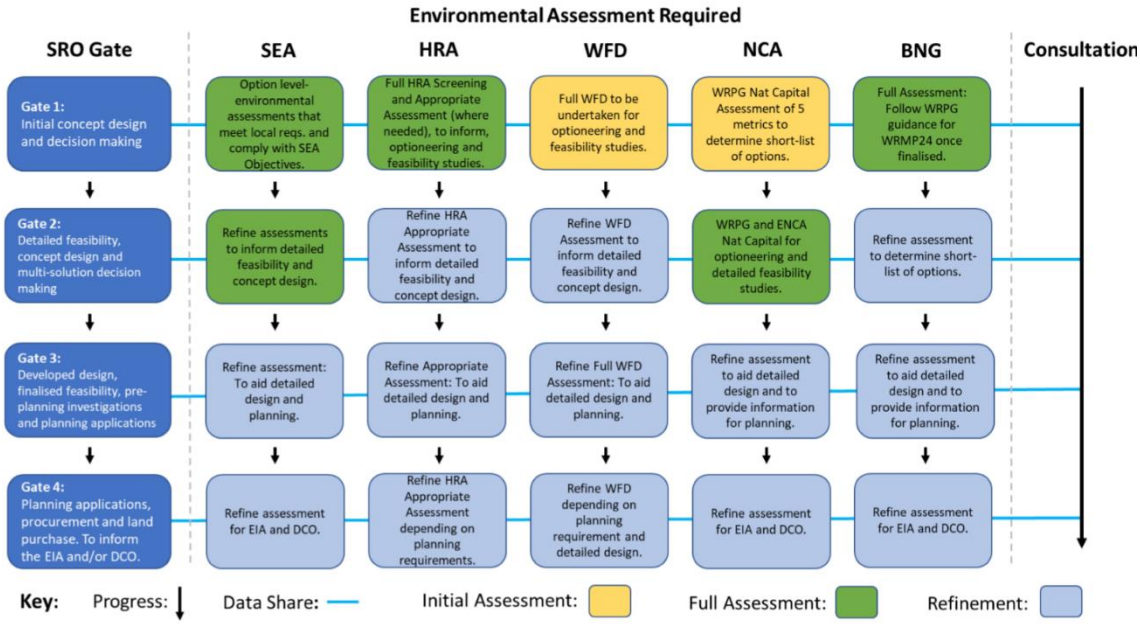
abstraction locations. A site at Leighton Buzzard was ultimately selected, further details on the optioneering process can be found in the Gate 2 submission.

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 (NC) and Biodiversity Net Gain (BNG) (Annex B3.3.2)
- Environmental Appraisal Report (EAR) (Annex B3.3.5)
- Fish survey report (Annex B3.2.2)
- 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 Assessment (WFD) (Annex B3.3.4)

This report forms the WFD update for Gate 2**.** Figure 1.2 below shows the integration the statutory assessment reports (i.e., SEA, HRA, WFD, NCA/BNG) with the 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[1], which the Gate 2 assessments have followed.

Figure 1.2 Environmental Assessment Integration with SRO Gates



[1] 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.

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.

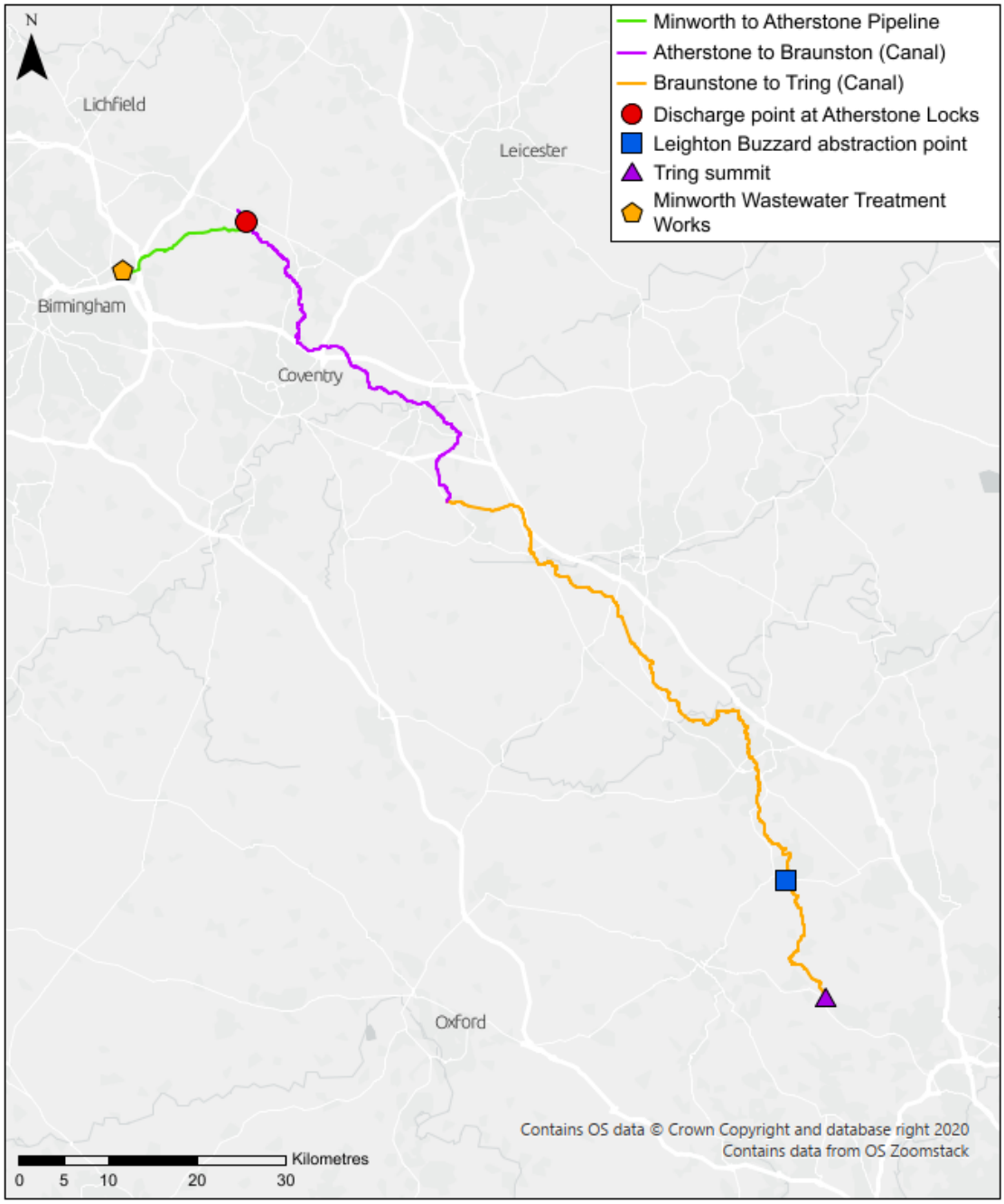
The Oxford Canal will then convey the water to the Grand Union Canal at Braunston. The majority of the flow along the Oxford Canal will be by gravity, however a pumping station will be required to bypass the locks at Hillmorton.

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 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. 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 Assumptions and Limitations of the Scheme

The following assumptions have been used within the environmental 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 a 'worst-case' 100% utilisation of the SRO.
- Tring 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 discharge quality from Minworth WwTW is acceptable to the EA, enabling water to be discharged to the GUC.

As the project continues through the stages of design development, a precautionary approach has been exercised because of residual uncertainty. The limitations and assumptions in Table 1.1 have been applied to the WFD assessment at Gate 2 to apply a consistent proportionate approach for the level of design development and supporting technical data and analysis.

Table 1.1: Limitations and assumptions applied to Gate 2 WFD assessment

Topic	Description of assumption
WFD baseline classification data	The ACWG approach uses WFD 2015 baseline data, as the current officially reported baseline for the 2015-2021 Cycle 2 RBMP[2]. The RBMPs are in the process of being updated, and it is anticipated that 2019 WFD baseline data will become the 'new' baseline for Cycle 3. To make sure of consistency with the legal baseline, the 2015 data has been used at Gate 2, but it is acknowledged that this is likely to need to be updated once the final RBMPs are published (potentially for Gate 3). Changes in baseline data between 2015-2019 have been reviewed and are presented in Appendix A.
Abstraction location and design	Abstraction from the transfer route will be located on the Grand Union Canal at Leighton Buzzard to be piped to a new WTW. The provisional location of the abstraction intake has been identified, however detailed design is outstanding. Screens/intakes themselves as physical structures would only affect a relatively small length of watercourse. Abstraction activity has been assessed to have a limited/localised WFD impact, because it is assumed that the water balance would not be changed (i.e. additional volume of water supplied from Minworth will subsequently be abstracted).
Study area	The geographical extent of the WFD assessment has been limited to waterbodies between the start point of the transfer and the abstraction point at Leighton Buzzard to Tring Summit. There is potential for some effects continuing downstream of the abstraction point, although it is assumed these would become increasingly limited to 'negligible' with distance.
Pipelines	Assessment assumes pipelines will be underground (directionally drilled or pipe-jacked beneath any watercourses) and therefore will not cross watercourses above ground or cause direct impacts.
Canal towpath modifications	Modifications to canal towpaths along the transfer route are being integrated into the design using a mixture of simple towpath raising and structural raising, as detailed in the Gate 2 Position Paper – Route Selection[3] . Structural modifications to canals are considered unlikely to pose a risk of deterioration to WFD status given their artificial nature, but would need to consider future objectives and environmentally sensitive designs/mitigation when design information becomes available and added to the assessment at Gate 3.
Failsafes	Assessment assumes fail safes / stop of transfer will be in place in the case of a significant failure of Minworth treatment. It is possible that real-time monitoring could be incorporated into the operation of the transfer. The length of pipeline from Minworth to Atherstone also allows for a reasonable time period to prevent discharge in the case of an emergency pollution incident. The risks or a pollution incident have therefore not been explicitly included in the WFD assessment.
Canal-river flood connectivity	Assessment assumes that some existing mixing of rivers and canals would naturally occur during floods (over and above canal infrastructure connections such as waste weirs), and does not attempt to address such impacts.
Canal feeders	Canal feeder watercourses are included in ongoing hydrological / water resource modelling work. These are not anticipated to be affected by the transfer operation so have not been included within the WFD assessment.
Treatment levels at Minworth	Assumption that the current Minworth discharge water quality would fail to meet Good status for at least some WFD water quality parameters in receiving canals based on current situation evidence from ongoing environmental water quality assessment work. While there is a clear requirement to upgrade wastewater treatment at Minworth, at this stage the WFD assessment retains a risk of changes to physico-chemical conditions until further evidence is provided by treatment process design and water quality dispersion modelling.

[2] https://www.gov.uk/government/collections/river-basin-management-plans-2015

[3] Gate 2 Position Paper – Route Selection – WSP draft Technical Note, Jan 2022

Topic	Description of assumption
Transfer operation	The transfer is anticipated to convey up to 100Ml/d of mixed treated effluent and canal water. Transfer operational details (volume, timing / frequency) are ongoing by the engineering workstream at this stage, and the assessment has assumed the maximum transfer operation.
Canal overspills	Increasing the frequency of overflows from the canal to connecting watercourse as a result of the transfer is undesirable because it would be a loss of transfer water. It is assumed that the hydraulic design will aim to not increase overflows to connected watercourses, and it may actually decrease spills. This would reduce the risk of causing a deterioration where linked watercourses have higher water quality than the transfer flows. Further topographic survey, modelling and design information is required to confirm changes at specific locations.
Groundwater	Groundwater bodies are unlikely to be significantly affected by the proposed works, and have not been included in this Gate 2 WFD assessment. Further information about the likely effects on groundwater/canal-groundwater interactions is included in the GUC Gate 1 Model Report[4].
Pumping stations	Impacts of lock bypass pumping stations along the transfer route are not considered to be a WFD compliance risk and have not been assessed explicitly, acknowledging these will alter localised flow velocities in the canal.
Sediments	Surveys of sediments and sediment quality within the canal and the potential risks due to increased erosion as a result of the transfer have been undertaken in 2022. The sampling strategy was devised to capture as far as practicable the geographical variability in sediment properties al allowed key trends to be identified that may influence WFD outcomes.
Effects of Minworth SRO	The requirement to upgrade wastewater treatment at Minworth is set out in the Minworth SRO Concept Design Report (CDR) (March 2021). Work on refining the additional processes is ongoing and a new CDR is being produced to support the Gate 2 submission, considering further data collected throughout the programme and key stakeholder considerations. Reduced treated effluent discharge from Minworth to the River Tame due to diverting flow to the transfer pipeline could impact on river flow and dilution in the Tame. This potential impact has not been assessed in the GUC WFD assessment; the WFD methodology is being applied as part of the Minworth SRO to consider the impact to the River Tame.

[4] Grand Union Canal Gate 1 Model (JBA, Mar 2021)

2 Methodology

2.1 Approach to WFD assessment for SROs

The WFD requires all waterbodies (both surface and groundwater) to achieve 'good status'. The Directive also requires that waterbodies experience no deterioration in status. 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 All Company Working Group (ACWG) has developed a consistent framework for undertaking WFD assessments for SROs to demonstrate that options would not cause deterioration in status of any WFD waterbodies. The assessment considers mitigation that would need to be put in place to protect waterbody status. The assessment also considers WFD future objectives.

Two stages of assessment are completed under the ACWG WFD approach[5], an initial Level 1 basic screening and a Level 2 detailed impact screening. These are conducted/reported using a spreadsheet assessment tool which is automated based on option information for Level 1 and expert judgment for Level 2, with reference to baseline WFD classification and measures data as outlined in the RBMP.

2.1.1 Level 1 – basic screening

Level 1 WFD assessment follows these steps:

- Identify affected waterbodies.
- Review SRO activities.
- Identify possible impacts.
- Apply 'embedded' mitigation measures. Examples of embedded/assumed mitigation are included in the ACWG Level 1 screening spreadsheet and typically include construction stage mitigation and avoidance 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.

Where waterbodies and option impacts were 'screened in', they are taken forward to Level 2 assessment.

2.1.2 Level 2 – detailed impact screening

The second level of WFD assessment follows the 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

[5] *All Company Working Group, WFD: Consistent framework for undertaking no deterioration assessments, Nov 2020*

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.

Explanations of levels of confidence are given in Table 2.1: and descriptions of the WFD risks/outcomes are given in Table 2.2.

Table 2.1: Explanation of WFD confidence levels, based on ACWG methodology

Confidence Level	Description	Acceptable at Gate stage
Low	Limited data and evidence available, based mainly or completely on expert judgement with many assumptions. Preliminary design information only, detailed information on location/routes, construction methods etc not yet available.	1
Medium	Some data and evidence available, based partially on expert judgement with some assumptions. Design progressed but some assumptions made on construction methods etc.	2
High	Lots of good data and evidence available, minimal assumptions. Design advanced minimal assumptions needed.	3 & 4

Table 2.2: Description of WFD risk levels/outcomes, based on ACWG methodology

Deterioration between status classes	Compromises waterbody objectives	Assists attainment of waterbody objectives
Yes = activities have a clear potential to cause deterioration of WFD status	**Yes** = activities clearly conflict with delivery of future improvements in WFD status	**No** = activities unlikely to contribute to achieving 'Good' status or potential
Possible = activities could cause deterioration of WFD status but unclear extent/level of effect	**Possible** = activities conflict with future improvements in WFD status but unclear extent/level of effect	**Possible** = activities could contribute to achieving 'Good' status or potential but unclear extent/level of effect
No = activities unlikely to pose any risk of deterioration in status	**No** = activities unlikely to pose any risk of deterioration in status	**Yes** = activities could directly contribute to achieving 'Good' status or potential
Uncertain = insufficient information or evidence to assess		

Source: *ACWG, WFD: Consistent framework for undertaking no deterioration assessments, Nov 2020*

2.2 Information used for WFD assessment

The Gate 2 stage Level 2 WFD assessments have been completed on the basis of the current stage of design development of the engineering requirements, hydrological/hydraulic and environmental water quality work packages, and available information on aquatic ecology and presence of Invasive Non-Native Species (INNS). Key sources of information include:

- Watercourse Connections, Gate 2 (Mott MacDonald, Jun 2022) – Annex B3.2.1
- Grand Union Canal SRO Water Quality Modelling, Gate 2 Phase 1 (JBA, Draft report, Jan 2022) – Annex A2.4
- Grand Union Canal SRO Water Point of Discharge Quality Impact Assessment (JBA, Draft report, Jun 2022)
- Grand Union Canal Strategic Resource Option, Water Quality Monitoring Gate 2 Report (Atkins, July 2022) – Annex B1.3
- Grand Union Canal Strategic Transfer – Ecological Monitoring: Phase 2 Report (APEM, Draft report, Feb 2022) – Annex B2.1

- Grand Union Canal Gate 2 Environmental Assessment – Fish Assessment (Mott MacDonald, Draft report, July 2022) – Annex B3.2.2
- Grand Union Canal Gate 2 Environmental Assessment – Invasive and Non-Native Species Risk Assessment (Mott MacDonald, Draft report, Jun 2022) – Annex B3.2.3
- Grand Union Canal Strategic Resource Option – Sediment sampling and analysis report (Mott MacDonald, Draft report, July 2022) – Annex B3.2.5
- Grand Union Canal, Gate 2 Position Paper – Route Selection (WSP, Draft technical note, Jan 2022)
- Grand Union Canal Strategic Resource Option, Gate 1 Water Framework Directive Assessment: Level 2 Assessment (Mott MacDonald, May 2021)
- Grand Union Canal Gate 1 Model (JBA, Mar 2021)
- GIS layers of canal sluices and weirs (provided by Canal and River Trust in Nov 2021)

More details on the supporting technical assessments that have fed into understanding of WFD compliance risks are provided in Section 3. The approach taken in the Gate 2 assessments reflects limited certainty/detail in design information including ongoing topographic and hydrographic surveys, modelling and assessment work. Section 1.4 sets out the limitations and assumptions, and Section 6.2 sets out the next steps and requirements for updating the Level 2 WFD assessment at future Gates to reduce uncertainty.

2.3 Recommendations for WFD for Gate 3 and beyond

Where WFD risks have been identified, recommendations will be made for increasing the confidence in the assessment. This is expected with the greater level of detail available during later stages of design development for subsequent gateways. In combination assessments, where reliant SRO option delivery is interdependent, would also be required.

Recommendations for further work are summarised in Section 6.2.

3 Supporting technical assessments

This section identifies supporting technical assessments for the scheme that have influenced the Gate 2 WFD Assessment. Ongoing workstreams, baseline data collection and analysis during Gate 2 included, but were not limited to; route and design development, hydraulic, hydrometric and hydrological survey and modelling, water quality monitoring and modelling, sediment sampling and analysis, and ecological monitoring.

3.1 Gate 1 WFD assessment

Mott MacDonald carried out a Level 1 and Level 2 WFD Assessment for Gate 1 in early 2021[6], which assessed the risk of deterioration or impeding achieving 'good status' to a WFD waterbody based on the various route and abstraction options that were outlined in the optioneering phase.

The findings indicated that there were potential WFD compliance risks associated with operation of the transfer for all options and that potential water quality effects could conflict with achieving WFD status objectives. This assessment has been fully updated geographically and with the further baseline and design information developed in the last 12 months.

3.2 Engineering design and route selection

WSP produced a Gate 2 Route Selection Paper[7] in early 2022 following the SRO project board selection of Route 3. The paper summarises some of the current engineering and operational assumptions, that have in turn been applied to the WFD assessment (see Table 1.1).

3.3 Watercourse connections

Mott MacDonald carried out a watercourse connections assessment in early 2022[8], which supports the Gate 2 WFD assessment by completing a detailed review of the existing connections between canal and river waterbodies, building a clearer picture of the source, pathways, receptors, and risks associated with the transfer. This was based on GIS asset data provided by The Trust corroborated by checks with topographic survey being completed by JBA as part of the hydrology and hydraulic modelling workstream. The connections informed the Level 1 waterbody screening for the WFD assessment.

3.4 Ecological baseline data

An Ecological Monitoring workstream has been ongoing through Gate 1 and 2, with an update report produced by APEM in early 2022[9]. Mott MacDonald completed more detailed INNS and fish surveys and assessments during Gate 2. The monitoring and surveys were developed from previous gap analysis studies and in consultation with EA and NE. The surveys included macrophyte and habitat transects in some of the chalk stream waterbodies that were potentially affected by route options at Gate 1; these waterbodies are no longer affected (see Section 4.1).

[6] Grand Union Canal Strategic Resource Option, Water Framework Directive Assessment: Level 2 Assessment (Mott MacDonald, May 2021) – Annex B3.3.4

[7] Grand Union Canal, Gate 2 Position Paper – Route Selection (WSP, Draft technical note, Jan 2022)

[8] Watercourse Connections, Gate 2 (Mott MacDonald, Jun 2022) – Annex B3.2.1

[9] Grand Union Canal Strategic Transfer – Ecological Monitoring: Phase 2 Report (APEM, Draft report, Feb 2022) – Annex B2.1

The main outcomes of other surveys and assessments relevant to WFD compliance are summarised below.

3.4.1 Chironomid surveys

The monitoring undertaken by APEM includes Chironomid Pupae Excavation Technique (CPET) which is a standard method for determining ecological and water quality, particularly in the canal network where limited invertebrate or water quality data exists for formal WFD classification. The data collected in 2020 and 2021 helped establish the risks of water quality change along the canal. Overall, chironomid communities were indicative of relatively poor water quality throughout the canal network particularly in northern sections, with improvements in southern areas of the Oxford Canal and GUC.

3.4.2 INNS surveys and risk assessment

INNS surveys (macroinvertebrate, macrophyte and fish eDNA) have been ongoing by APEM and Mott MacDonald. A combination of monitoring for the scheme and historical records indicates many INNS species are prevalent in the canal system and adjacent rivers under existing environmental conditions. Changes in water quality or flow conditions may encourage expansion, or further transfer, throughout the canal network or to connecting river water bodies, and the overall risk posed to contravening INNS legislation has been provisionally assessed as Moderate[10].

3.4.3 Fish

Mott MacDonald undertook further work and surveys related to the baseline for fish in the canal and in key connected watercourses and reported the results in and July 2022[11]. eDNA and subsequent electrofishing surveys were completed in spring-summer 2022. The results of the surveys and review of longer-term EA fish data show that fish communities of the canal are coarse fish, typical of slow flow or stagnant water, with a number of non-native species present. The connecting rivers recorded mostly coarse fish associated with moderate flows. A number of protected fish species were recorded in the canal system; lamprey, barbel, bullhead and trout, whilst connecting waterbodies also support spined loach and eel. Potential impacts of the scheme on the fish community are varied, although the majority could be addressed with further assessment and design of mitigation. A fish impact assessment has been completed at Gate 2.

3.5 Water quality monitoring and analysis/modelling

Potential sources and pathways for water quality changes by mixed treated effluent and canal water, creating potential to move water from areas of relatively low quality into areas of higher water quality are one of the highest environmental risks posed by the transfer. Ongoing water quality workstreams include water quality monitoring at Minworth WwTW and at eight sites within the canal network, for which Atkins produced a Gate 2 report in July 2022[12]. This was the most recent water quality monitoring report available at the time of writing, further data will be incorporated at a later stage. Using the outputs from the monitoring together with available long term monitoring data, water quality is being integrated into the hydrology and hydraulic

[10] Grand Union Canal Gate 2 Environmental Assessment – Invasive and Non-Native Species Risk Assessment. (Mott MacDonald, Draft, Jun 2022) - Annex B3.2.3. Note, INNS relevance to WFD compliance is for transfer risk to WFD 'High Status' river waterbodies that do not currently contain High-Impact INNS. There are no 'High Status' waterbodies within the study area.

[11] Grand Union Canal Gate 2 Environmental Assessment – Fish Assessment. (Mott MacDonald, Draft report, July 2022) - Annex B3.2.2

[12] Grand Union Canal Strategic Resource Option, Water Quality Monitoring Gate 2 Report (Atkins, July 2022) – Annex B1.3

modelling workstream (JBA) in order to provide a joined-up assessment. The modelling is ongoing but preliminary assessments[13] have been completed to identify key risks for WFD compliance, and these have been used to inform which physico-chemical and chemical quality elements are potentially at risk for WFD compliance. Key findings are summarised here:

- The most common Environmental Quality Standard (EQS) exceedances were polycyclic aromatic hydrocarbons (PAHs). Benzo(a)pyrene is the key PAH marker used in WFD classification and is a priority hazardous substance, being persistent in the environment and having toxic effects on aquatic biota.
- Biochemical oxygen demand (BOD) levels resulted in exceedances across all sampled sites. BOD (5-day) quantifies the oxygen demand exerted by biochemical processes, typically associated with the presence and microbial decomposition of organic material. Higher biochemical oxygen demand values are commonly associated with lower dissolved oxygen levels in the water column.
- Soluble Reactive Phosphorus (SRP) exceeded site specific EQS at most sampled sites.
- Perfluorooctane sulfonate (PFOS) concentrations were high at all sites – this type of substance is found to be quite ubiquitous across the water environment and results in failure of WFD chemical status in the 2019 baseline datasets used by the EA to determine the Cycle 3 RBMP baseline.
- A number of substances do not currently exceed EQS in the canal, but may, if final effluent from Minworth WwTW were discharged into the GUC without additional treatment. This may result in a future WFD compliance risk, as the new discharge would prevent the water quality of the receiving body from achieving Good Status in the future.
- WFD class deterioration tests undertaken for impact at the 'point of discharge' (JBA, draft report, June 2022) indicate that 100 determinands would not result in a class deterioration following the proposed discharge; 16 determinands currently fail EQS in the canal at Atherstone, and would continue to do so with the discharge, and new class deterioration is predicted for two determinands, cypermethrin and permethrin (insecticides, toxic to fish and aquatic invertebrates).
- Percentage deteriorations have also been assessed; this indicates that approximately a third of determinands show a potential deterioration of >10%, or >3% if the EQS in the canal is already exceeded.

3.6 Sediment quality and mobility

Baseline sampling of sediment quality and physical parameters throughout canal pounds and key connected watercourses was completed in spring 2022 and the locations, results and analysis are reported in detail in the Sediment Report[14]. The results are useful in a number of ways to support the WFD compliance assessment and key findings are summarised here:

- Numerical modelling undertaken by JBA (ongoing) showed that the scheme could increase flow speed and bed shear stress along the canal when the transfer is in operation. Since this controls sediment mobilisation, transport and accretion, changes to flow velocity may affect dynamic behaviour of the canal bed sediments. Increases in sediment resuspension and transport could affect water quality if the sediments are contaminated.
- The sediment sampling showed that the first few centimetres below the bed surface layer were highly unconsolidated in several cases, and these are likely to be more mobile. Organic

[13] Grand Union Canal SRO Water Quality Modelling, Gate 2 Phase 1 (JBA, Draft report, Jan 2022) – Annex A2.4; Grand Union Canal SRO Water Point of Discharge Quality Impact Assessment (JBA, Draft report, Jun 2022) – Annex A2.4

[14] Grand Union Canal Strategic Resource Option – Sediment sampling and analysis report (Mott MacDonald, Draft report, July 2022) – Annex B3.2.5

vs inorganic proportions were not determined, however the unconsolidated upper layer suggests a higher proportion of organic material present. This may correlate with the BOD exceedances observed in the Atkins water quality data.

- Clay and silt-size particles were evident in both bed and water samples. Overall, 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 in the clay size range.
- In common with the canal bed sediments, clay and silt size sediments dominate the bed sediment samples from the connections, however there are more coarse particles and wider range in parameters, as expected given the more varied controls on sediment in natural watercourses.
- The sediment quality tests indicated high levels of heavy metals and PAHs throughout the canal network, exceeding relevant sediment EQS levels. Two main overall 'zones' of canal sediment contamination appear to be present; in the north of the canal (Coventry and Oxford Canals, from Atherstone to Daventry), Cadmium and Mercury have the highest concentrations and data display an almost linear decrease moving southwards. In contrast, in the GUC mid-south sections, levels of Copper, Lead, Nickel and Zinc are higher.
- In connected watercourses, concentrations of all heavy metals are much lower, but often above thresholds (slightly elevated levels in areas sampled between Northampton and Milton Keynes).
- Corresponding water samples showed a low concentration values for all determinants; though limited in number compared to the sediment sample sites, the measurements imply that deeper 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.

In terms of sediment mobility, the results from the JBA Gateway 1 model indicate that at the GUC sediment sampling locations, bed shear stress will not increase significantly due to the increased flows associated with water transfer.

4 Level 1 WFD findings

4.1 Changes since Gate 1

Since the WFD Assessment completed for Gate 1 in 2021, the GUC SRO board has selected a preferred route and abstraction location and further design development work has continued. This allowed the list of waterbodies requiring WFD assessment to be refined for Gate 2. Maps illustrating the general location of waterbodies in relation to the scheme are included in Appendix B.

Through the identification of watercourse connections[15], a number of additional waterbodies have been added to the assessment, whilst others have been removed due to the refined geographical extent and likely zone of influence of the scheme. Key WFD waterbodies which were previously considered as being of importance at the southern end of the route (red or amber risks in Gate 1 assessment) but no longer considered likely to be affected by the transfer are:

- GB106039029890 - Bulbourne
- GB106039029860 - Gade (from confluence with Bulbourne to Chess)
- GB10603902990 - Gade (Upper stretch Great Gaddesden to confluence with Bulbourne / GUC)
- GB70610182 - Grand Union Canal, Tring summit
- GB70610184 - Grand Union Canal, Tring summit to Berkhamstead
- GB70610185 - Grand Union Canal, Berkhamstead to Maple Lodge (Rivers Bulbourne, Gade and Colne)

Waterbodies located along the other two previously considered route options have also been removed from the WFD assessment. These include:

- GB104028046901 - Langley Bk - source to conf R Tame
- GB109054044402 - Avon (Wark) conf R Leam to Tramway Br, Stratford
- GB104028042420 - Cole from Hatchford-Kingshurst Brook to R Blythe
- GB104028042490 - Hatchford-Kingshurst Brook from Source to R Cole
- GB104028042571 - Blythe from Temple Balsall Brook to Patrick Bridge
- GB104028042572 - Blythe from Patrick Bridge to R Tame
- GB109054044470 – Finham Bk – source to conf Canley Bk
- GB109054043840 - Avon (Warks) - conf R Sowe to conf R Leam
- GB70410515 – Birmingham and Fazeley Canal upper section

4.2 Level 1 WFD Assessment Summary

Table 4.1 presents a key to explain colour-coding for whether waterbodies were screened in or out of further assessment. Table 4.2 provides a summary of the Level 1 WFD assessment for the scheme across the 26 WFD river and canal waterbodies that were identified. Within the Level 1 WFD assessment, the transfer of water via canal has an impact score of '2'. Consequently, based on the nature of the transfer utilising the canal network, the majority of waterbodies have scored at least '2'. This led to the majority of waterbodies being identified as requiring Level 2 WFD assessment. Where a transfer pipeline will cross the catchment (Minworth to Atherstone, and from Leighton Buzzard WTW to Chaul End), and will not directly

[15] Watercourse Connections, Gate 2 (Mott MacDonald, draft, Feb 2022) – Annex B3.2.1

interact with watercourses, these have an impact score of '1' in the Level 1 assessment, and those seven waterbodies are not screened in for further assessment.

The Level 2 WFD Assessment is presented in Section 5 of this report.

Table 4.1: Level 1 WFD screening colour coding summary

Green – Passes Level 1 WFD, no further assessment
Amber – Level 1 WFD score >1, screened in for Level 2

Table 4.2: WFD Level 1 assessment summary (waterbody screening)

WFD waterbody	Screening outcome	Comment
GB104028046460 - Anker from River Sence to River Tame		Waterbody catchment crossed by pipeline from Minworth to Atherstone. Waterbody boundary is close to the canal pipeline discharge location at Atherstone.
GB104028046430 - Anker from Wem Brook to River Sence		Waterbody catchment crossed by pipeline from Minworth to Atherstone. Waterbody connected to canal by overspill along transfer route.
GB70410212 - Coventry and Ashby Canals		Main transfer route, location of discharge of the pipeline from Minworth WwTW.
GB104028042630 - Dog Lane Brook from Source to R Tame		Waterbody catchment crossed by pipeline from Minworth to Atherstone. Negligible effects anticipated for below ground pipeline.
GB70510193 - Grand Union Canal, Braunston summit		Main transfer route.
GB70510251 - Grand Union Canal, Milton Keynes to Braunston summit		Main transfer route.
GB70510192 - Grand Union Canal, Milton Keynes trough pound		Main transfer route.
GB70510191 - Grand Union Canal, Tring summit to Milton Keynes		Main transfer route. Intake to Leighton Buzzard WTW and likely discharge of WTW backwash.
GB105033037900 – Loughton Brook		Waterbody connected to canal by overspill along transfer route.
GB70910513 – North Oxford Canal		Main transfer route.
GB105033038000 – Ouse (Wolverton to Newport Pagnell)		Waterbody connected to canal by overspill along transfer route.
GB105033030520 Ouzel (US Clipstone Brook)		Waterbody connected to canal by overspill along transfer route.
GB105033037972 (Ouzel DS Caldercote Mill		Waterbody connected to canal by overspill along transfer route.
GB105033037971 – Ouzel US Caldercote Mill		Waterbody connected to canal by overspill along transfer route.
GB104028046841 – Tame – R Rea R Blythe		Waterbody catchment crossed by pipeline from Minworth to Atherstone. Negligible impacts anticipated for below ground pipeline. On-going investigations by the Minworth SRO regarding potential reduced flow in the River Tame.

WFD waterbody	Screening outcome	Comment
GB104028046440 – Tame from R Blythe to River Anker		Waterbody catchment crossed by pipeline from Minworth to Atherstone. Negligible impacts anticipated for below ground pipeline.
GB106039030410 – Thame upstream of Aylesbury		Connected waterbody located south of the transfer intake, so volume of transfer water within the canal will be less but could still have a minor influence.
GB105033038180 – Tove (DS Greens Norton)		Waterbody connected to canal by overspill along transfer route.
GB105032045360 – Welton Village Trib, Whilton branch of R. Nene		Waterbody connected to canal by overspill along transfer route
GB104028042430 – Wem Brook from Source to River Anker		Waterbody connected to canal by overspill along transfer route.
GB105033030490 – Whistle Brook		Connected waterbody located south of the transfer intake, so volume of transfer water within the canal will be less but could still have a minor influence.
GB109054044640 Withy Bk – source to conf R Sowe		Waterbody connected to canal by overspill along transfer route.
GB105033030500 – Eaton Bray Brook		Waterbody catchment crossed by pipeline from Leighton Buzzard WTW to Chaul End reservoir. Negligible impacts anticipated for below ground pipeline.
GB106039029920 - Ver		Waterbody catchment crossed by pipeline from Leighton Buzzard WTW to Chaul End reservoir. Negligible impacts anticipated for below ground pipeline.
GB106038033391 – Lee (from Luton to Luton Hoo Lakes)		Waterbody catchment crossed by pipeline from Leighton Buzzard WTW to Chaul End reservoir. Negligible impacts anticipated for below ground pipeline.
GB106039029820 – Upper Colne and Ellen Brook		Waterbody catchment crossed by pipeline from Leighton Buzzard WTW to Chaul End reservoir. Negligible impacts anticipated for below ground pipeline.
Total no. of river and canal waterbodies screened out at Level 1 WFD assessment	7	
Total no. of river and canal waterbodies requiring Level 2 WFD assessment	19	

5 Level 2 WFD assessments

5.1 Summary of results / outcomes

Section 5.2 provides the outcomes of the Gate 2, Level 2 WFD compliance results.

The assessment has identified that the screened-in Level 2 waterbodies, can be split into two categories: waterbodies that have a direct impact, as a result of the scheme i.e., as a transfer receptor via the canal network or via a new pipeline or as an indirect impact through waste weirs and overspills. There is potential that changes caused by the transfer will cause deterioration of waterbodies, although it is acknowledged that a permit level for key substances or parameters would need to be agreed and that work within the Environmental Water Quality workstream and subsequent process design work will progress this.

For consistency in the WFD risk assessment at Gate 2, the following have been used in differentiating between 'amber', 'yellow' and 'green' risks (see Table 2.2):

- INNS risk in relation to WFD compliance has generally been identified as low. For INNS to present a WFD compliance risk, there would need to be evidence of a high impact INNS having potential to transfer to a WFD high status waterbody. The risk is low for WFD compliance as there are currently no high status waterbodies within the scheme. An assessment of INNS risk is reported in Annex B3.2.4 – the overall risk is identified as Moderate.
- For canal WFD waterbodies, the current baseline WFD status is based on highly limited data, without classifications for individual quality elements such as fish, or individual physico-chemical elements. This means the risk of a fundamental 'deterioration' in classification status compared to current RBMP reported baseline status is theoretical, and has therefore been assessed as negligible. This requires further consultation with the EA to confirm it is a reasonable interpretation, in particular if classification methods change for forthcoming RBMP Cycle 3.
- It is assumed that canal-watercourse connections would either be maintained as current, or potentially reduced to maintain water within the canal for transfer. Overspills from the canal during transfer operation could create a temporary effect, but are unlikely to cause significant deterioration over a sufficient duration to permanently impact on biological quality elements in connected watercourses over and above the existing situation.
- At this stage, the WFD assessment retains the risk of changes to physico-chemical and chemical conditions for canal and connected watercourses, until further evidence is provided by treatment process design and water quality dispersion modelling. Parameters identified as having a moderate or high risk of WFD deterioration (full class or percentage) from initial analysis (Atkins, 2022 and JBA, 2022) have been flagged as Amber, while other parameters have been allocated a yellow rating. For some parameters, transfer water from Minworth WwTW may prove to be of better water quality than the existing baseline in the canal and therefore result in an improvement; for example, potential improvements in oxygenation within the canal due to aeration from faster flows have been identified.

5.2 WFD Level 2 assessment outcomes

Table 5.1 provides the outcomes of the Gate 2, Level 2 WFD compliance results. Further details on impacts, ongoing analysis and relevant anticipated mitigation are provided in Table 5.2.

Table 5.1: WFD Level 2 assessment

Waterbody ID	Waterbody Name	Confidence in WFD data	Confidence in option design	Requirements to improve confidence	Deterioration between status classes	Compromises water body objectives	Further comments
GB104028046460	Anker from River Sence to River Tame	Moderate	Moderate	Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	This stretch of the River Anker is located to the north of the transfer pipeline discharge to the Coventry Canal at Atherstone. It is connected to the canal via overspill weirs and sluices. Because the transfer flow in the canal will pass south, flow moving north will be limited to when locks function, and the volume of flow moving towards any overspill connections in this waterbody will be limited but could still have a minor influence. Overspills will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment, and updated design information. The pipeline from Minworth will pass through the waterbody catchment but this is not anticipated to have any effect.
GB104028046430	Anker from Wem Brook to River Sence	Moderate	Moderate	Design information - specifically any changes to the level and operation of CC-026-013, CC-025-006 and CC-024-008 at Mancetter and CC-022-003/005, CC-021-001, CC-020-005 and CC-019-005 near Nuneaton, which control overspill from canal into the watercourse. Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	The pipeline section of transfer from Minworth will discharge into the Coventry Canal pound at Atherstone, which is highly connected to this waterbody via a series of overspills between Atherstone and Nuneaton. The degree of influence of the transfer on this river waterbody will be influenced by any changes to overspills and the frequency with which any connection occurs. Essentially one of three scenarios will happen: 1 – waste weir stays as-is and flow input will increase because the water level in the transfer will overtop it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. 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. It should be noted the existing canal water quality is quite poor and that for some parameters the additional discharge from Minworth could improve the canal water quality and in doing so indirectly reduce any impacts the canal currently has on river water quality. This is to be confirmed via future outputs of water quality modelling and assessment, and updated design information. Long term EA water quality monitoring sites are located at River Anker - Mancetter Bridge Witherley and River Anker - Weddington.
GB70410212	Coventry and Ashby Canals	Low	Moderate	Collection of further baseline data within the canal including sediments. Initial sediment sampling completed in 2022 indicates high levels of heavy metals and PAHs. Outputs of ongoing water quality and hydraulic modelling. Design information - specifically around requirements for towpath raising and changes to any overspills to connected rivers (e.g. River Anker).	No	No	Canal waterbody, which is classified currently for WFD only on Mitigation Measures Assessment. This means that deterioration in WFD is highly unlikely. However, the basis for classification could change in the future. Flow volume: Additional water will be transferred throughout the network as a result of the scheme as this could affect the delivery of AWB mitigation measures if measures are set for the waterbody. Outputs from ongoing hydraulic modelling will provide a quantification of the effect. Channel footprint: The current design states that the towpath will need to be increased by >100mm for c.3.8km and by >50mm for c.5.7km within this waterbody respectively. Hydromorphology: Canal waterbody only has baseline WFD classification for Mitigation Measures Assessment, the sensitivity to changes is uncertain. However, given the existing poor water quality and artificial nature of the canal, this is unlikely to represent a risk of deterioration. Water quality: This waterbody is being sampled as part of the ongoing water quality monitoring programme. Monitoring data suggests that for many parameters, in particular heavy metals, water quality in the canal is poorer than the quality of the Minworth transfer source. However for other determinands, treatment at Minworth would be required to avoid increasing concentrations in the canal.

Waterbody ID	Waterbody Name	Confidence in WFD data	Confidence in option design	Requirements to improve confidence	Deterioration between status classes	Compromises water body objectives	Further comments
							INNS: The risk of the spread of INNS throughout the network is likely to increase as a result of the scheme. This watercourse is contaminated with Zebra mussel (*Dreissena polymorpha*) and Orange Balsam (*Impatiens capensis*) and is at risk of being contaminated by the spread of Signal crayfish (*Pacifastacus leniusculus*) identified at Minworth from the upstream waterbody.
GB70510193	Grand Union Canal, Braunston summit	Low	Moderate	Collection of further baseline data within the canal. Outputs of ongoing water quality and hydraulic modelling. Design information - specifically around requirements for towpath raising and changes to any overspills to connected rivers.	No	No	Canal waterbody, which is classified currently for WFD only on Mitigation Measures Assessment. This means that deterioration in WFD is highly unlikely. However, the basis for classification could change in the future.
GB70510251	Grand Union Canal, Milton Keynes to Braunston summit	Low	Moderate	Collection of further baseline data within the canal. Outputs of ongoing water quality and hydraulic modelling. Design information - specifically around requirements for towpath raising and changes to any overspills to connected rivers (e.g. River Tove).	No	No	Canal waterbody, which is classified currently for WFD only on Mitigation Measures Assessment. This means that deterioration in WFD is highly unlikely. However, the basis for classification could change in the future. The water quality within this section of the canal based on the WQ monitoring undertaken for the scheme is better for the majority of parameters than the canal sections further north. Therefore, water quality could be impacted negatively by the scheme, even if this is not identified as a WFD risk based on the baseline classification.
GB70510192	Grand Union Canal, Milton Keynes trough pound	Low	Moderate	Collection of further baseline data within the canal. Outputs of ongoing water quality and hydraulic modelling. Design information - specifically around requirements for towpath raising and changes to any overspills to connected rivers (eg River Ouse, Loughton Brook).	No	No	Canal waterbody, which is classified currently for WFD only on Mitigation Measures Assessment. This means that deterioration in WFD is highly unlikely. However, the basis for classification could change in the future. The water quality within this section of the canal based on the WQ monitoring undertaken for the scheme is better for the majority of parameters than the canal sections further north. Therefore, water quality could be impacted negatively by the transfer, even if this is not identified as a WFD risk based on the baseline classification.
GB70510191	Grand Union Canal, Tring summit to Milton Keynes	Low	Low	Collection of further baseline data within the canal. Outputs of ongoing water quality and hydraulic modelling. Design information - specifically around requirements for towpath raising and changes to any overspills to connected rivers (e.g. River Ouzel). Design information - specifically for the intake to new WTW and for any discharge from it (location and expected quality).	No	No	Canal waterbody, which is classified currently for WFD only on Mitigation Measures Assessment. This means that deterioration in WFD status is highly unlikely. However, the basis for classification could change in the future. The water quality within this section of the canal based on the WQ monitoring undertaken for the scheme is better for the majority of parameters than the canal sections further north. Therefore, water quality could be impacted negatively by the transfer, even if this is not identified as a WFD risk based on the baseline classification. A new intake point would be required to the new WTW at Leighton Buzzard. The intake is unlikely to impact the canal but would need screening to prevent fish entrainment. Backwash discharge from the new WTW is anticipated to be discharged to the canal, which could influence water quality, primarily within the adjacent pound.
GB105033037900	Loughton Brook	Moderate	Moderate	Design information - specifically any changes to the level and operation of V6 Fixed Weir GU-118-005 which controls overspill from canal into the watercourse. Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	Water body is connected to GUC within the 'Grand Union Canal, Milton Keynes Trough Pond' WFD canal waterbody in Milton Keynes, at Grafton Street. This means the watercourse will receive overspill water above a certain level in the canal. 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. Essentially one of three scenarios will happen: 1 – waste weir stays as-is and flow input will increase because the water level in the transfer will overtop it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. In all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment, and updated design information.

Waterbody ID	Waterbody Name	Confidence in WFD data	Confidence in option design	Requirements to improve confidence	Deterioration between status classes	Compromises water body objectives	Further comments
							There is no long-term EA monitoring data on the brook.
GB70910513	North Oxford Canal	Low	Moderate	Collection of further baseline data within the canal. Outputs of ongoing water quality and hydraulic modelling. Design information - specifically around requirements for towpath raising and changes to any overspills to connected rivers (eg Withy Brook).	Possible	Possible	Canal waterbody classified currently on both Mitigation Measures Assessment and some basic water quality parameters. Some water quality parameters 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)	Moderate	Moderate	Design information - specifically any changes to the level and operation of Target Turn Weir and Sluice at Milton Keynes GU-120-001 which controls overspill from canal into the watercourse. Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	Water body is connected to GUC within the 'Grand Union Canal, Milton Keynes Trough Pond' WFD canal waterbody, north of Milton Keynes, at Target Turn Sluice. This means the watercourse will receive overspill water above a certain level in the canal. 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. Essentially one of three scenarios will happen: 1 – waste weir stays as-is and flow input will increase because the water level in the transfer will overtop it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. In all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment, and updated design information. Long term EA water quality monitoring sites are located at Newport Pagnell, upstream of the GUC connection.
GB105033030520	Ouzel (US Clipstone Brook)	Moderate	Moderate	Design information - specifically any changes to the level and operation of Leighton Flood Weir GU-145-011 and Fixed Weir Twelve Arches GU-144-006 which control overspill from canal into the watercourse. Design and construction information about the intake structure as in the current design this sits on a narrow area between the canal and River Ouzel, to confirm any impact on riverbanks or bed. If any, this is anticipated to be a localised effect. Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	Waterbody is connected to GUC within the 'Grand Union Canal, Tring Summit to Milton Keynes' WFD canal waterbody, through Leighton Buzzard via a number of overspill weirs. This means the watercourse will receive overspill water above a certain level in the canal. 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. Essentially one of three scenarios will happen: 1 – waste weir stays as-is and flow input will increase because the water level in the transfer will over top it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. In all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment, and updated design information. River Ouzel is noted to have a good baseline fish community based on EA data generally dominated by cyprinid species. Long term EA water quality monitoring sites are located on tributaries upstream of this waterbody as well as downstream within the Ouzel US Caldecote Mill waterbody.
GB105033037972	Ouzel DS Caldecote Mill	Moderate	Moderate	Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	Waterbody is connected to GUC within the 'Grand Union Canal, Milton Keynes Trough Pond' WFD canal waterbody, through Milton Keynes. It is not directly connected within this waterbody but is via the River Ouzel US Caldecote Mill. This means the watercourse will receive overspill water above a certain level in the canal.

Waterbody ID	Waterbody Name	Confidence in WFD data	Confidence in option design	Requirements to improve confidence	Deterioration between status classes	Compromises water body objectives	Further comments
							The degree of influence of the transfer on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs. Essentially one of three scenarios will happen: 1 – waste weir stays as-is and flow input will increase because the water level in the transfer will over top it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. In all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment, and updated design information. River Ouzel is noted to have a good baseline fish community based on EA data generally dominated by cyprinid species. Long term EA water quality monitoring sites on the Ouzel are located along the Ouzel up and downstream of GUC connections.
GB105033037971	Ouzel US Caldecote Mill	Moderate	Moderate	Design information - specifically any changes to the level and operation of Fixed Weir Kimbles GU-132-002, Fixed Weir Stoke Hammond GU-137-002, and Weir Below Three Locks GU-139-003 which control overspill from canal into the watercourse. Outputs of ongoing water quality and hydraulic modelling. Electrofishing surveys to supplement EA monitoring data.	Possible	Possible	Waterbody is connected to GUC within the Grand Union Canal, Tring Summit to Milton Keynes WFD canal waterbody, to the south of Milton Keynes between Leighton Buzzard and Bletchley at a number of overspill weirs. This means the watercourse will receive overspill water above a certain level in the canal. 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. Essentially one of three scenarios will happen: 1 – waste weir stays as-is and flow input will increase because the water level in the transfer will over top it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. In all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment and updated design information. River Ouzel is noted to have a good baseline fish community based on EA data generally dominated by cyprinid species. Long term EA water quality monitoring sites on the Ouzel are located along the Ouzel up and downstream of GUC connections including at Orchard Mill and Grange Mill.
GB106039030410	Thame upstream of Aylesbury	Moderate	Moderate	Outputs of ongoing water quality and hydraulic modelling.	No	Possible	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. Waterbody is connected to GUC within the Grand Union Canal, Tring Summit to Milton Keynes WFD canal waterbody to the east of Aylesbury. This means the watercourse will receive overspill water above a certain level in the canal. This will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment and updated design information.
GB105033038180	Tove (DS Greens Norton)	Low	Low	Design information - specifically any changes to the level and operation of Fixed Weir 11 at Grafton Regis GU-108-002 which controls overspill from canal into the watercourse. Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	Waterbody is connected to GUC within the Grand Union Canal, Milton Keynes to Braunston Summit WFD canal waterbody, at Grafton Regis. This means the watercourse will receive overspill water above a certain level in the canal. 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. Essentially one of three scenarios will happen:

Waterbody ID	Waterbody Name	Confidence in WFD data	Confidence in option design	Requirements to improve confidence	Deterioration between status classes	Compromises water body objectives	Further comments
				Electrofishing surveys to supplement EA monitoring data.			1 – waste weir stays as it is and flow input will increase because the water level in the transfer will overtop it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. In all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment, and updated design information. The River Tove is noted to have a good baseline fish community based on EA data. The rivers are generally dominated by cyprinid species, with bullhead also present. The presence of bullhead suggests relatively clean water and gravel substrate, as well as good flow velocity. Some species may therefore be sensitive to water quality changes. Long term EA water quality monitoring sites on the Tove are located at Bozenham Mill and Cosgrove Park, up and downstream of the GUC interaction respectively.
GB105032045360	Welton Village Trib, Whilton branch of R. Nene	Moderate	Moderate	Design information - specifically any changes to the level and operation of the Braunston Flood Paddle ref GU-075-003 which controls overspill from canal into the watercourse. Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	Waterbody is connected to Oxford Canal/GUC within the 'Braunston Summit' WFD canal waterbody, at Braunston Summit Flood Paddle. This means the watercourse will receive overspill water above a certain level in the canal. 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. Essentially one of three scenarios will happen: 1 – waste weir stays as-is and flow input will increase because the water level in the transfer will overtop it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. In all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment, and updated design information. No long-term EA WQ or aquatic ecology data.
GB104028042430	Wem Brook from Source to River Anker	Moderate	Moderate	Design information - specifically any changes to the level and operation of CC-016-003 and CC-014-004 near Bedworth, which control overspill from canal into the watercourse. Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	Water body is connected to Coventry and Ashby Canal/North Oxford canal and to Ashby de La Zouche Canal. This means the watercourse will receive overspill water above a certain level in the canal. The degree of influence of the transfer on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs. Essentially one of three scenarios will happen: 1 – waste weir stays as-is and flow input will increase because the water level in the transfer will over top it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. In all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment, and updated design information. Long term EA monitoring data for water quality at locations Wem Brook - Pingle Fields and Wem Brook - Gipsy Lane, to the south of Nuneaton. Water quality influenced by Bulkington STW (also EA monitoring points here).

Waterbody ID	Waterbody Name	Confidence in WFD data	Confidence in option design	Requirements to improve confidence	Deterioration between status classes	Compromises water body objectives	Further comments
GB105033030490	Whistle Brook	Moderate	Moderate	Design information - specifically any changes to the level and operation of the Fixed Weirs Seabrook North GU-154-005 and South GU-154-009 which controls overspill from canal into the watercourse. Outputs of ongoing water quality and hydraulic modelling.	No	Possible	Whistle Brook 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. Waterbody is connected to GUC within the 'Grand Union Canal, Tring Summit to Milton Keynes' WFD canal waterbody, between Cheddington and Pitstone. This means the watercourse will receive overspill water above a certain level in the canal. This will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment and updated design information.
GB109054044640	Withy Bk - source to conf R Sowe	Moderate	Moderate	Design information - specifically any changes to the level and operation of Sluice 2 - Nettle Hill OX-008-005 which appears to overspill from canal into the watercourse. Outputs of ongoing water quality and hydraulic modelling.	Possible	Possible	Water body is connected to North Oxford Canal to the east of Coventry. This means the watercourse will receive overspill water above a certain level in the canal. The degree of influence of the transfer on this river waterbody will therefore be influenced entirely by any changes to this overspill and the frequency with which any connection occurs. Essentially one of three scenarios will happen: 1 – waste weir stays as-is and flow input will increase because the water level in the transfer will over top it more frequently. 2 – waste weir will be raised to the new towpath level with flow input staying the same 3 – waste weir removed and so there will be less flow going into the river. In all situations this will reflect a very minor proportion of the flow within the river, so the effect is anticipated to be so temporary/localised that it is probably not measurable and will not represent a deterioration or compliance risk. This is to be confirmed via future outputs of water quality modelling and assessment and updated design information. EA water quality data is monitored at Withy Brook - High Bridge which is downstream of the canal connection.

Table 5.2: 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 have a risk of at least a percentage deterioration.	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.
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 lower risk based on EA 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 as a 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 WQ 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 WQ monitors identify a failure.
Increased sediment transfer, including sediment-bound contaminants or release into water column altering water chemistry.	Topographic survey will collect hard and soft bed measurements at specified cross-sections of the canal,	Where a significant increased risk of localised erosion is identified, some localised modifications to channels, scour protection

Key potential impacts with WFD compliance risks	Further analysis requirements	Mitigation to reduce WFD risks
Sediment sampling completed in spring 2022 indicated high levels of heavy metals and PAHs throughout the canal network, exceeding relevant sediment EQS levels.	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. Potential to expand links from sediment to water quality monitoring and analysis, given identified potential links highlighted in initial sampling.	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.
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.

6 Conclusions

6.1 Summary

The Gate 2 Level 1 WFD assessment indicated that seven out of 26 waterbodies could be screened out as not requiring further assessment. A Gate 2 Level 2 WFD assessment has been completed for the remaining 19 waterbodies that were screened in and considered to have a direct impact on WFD supporting conditions as part of the scheme. The findings indicate that there are potential WFD compliance risks associated with the operation of the scheme, though the majority of these are anticipated to be minimised through design either of water quality treatment or structures and operational parameters that reduce risks to an acceptable level.

A key change since completion of the Gate 1 assessment is the confirmation of a preferred route and abstraction location, which has influenced the spatial scale of the assessment (Section 4.1).

6.2 Further assessment

Further WFD assessment would be required for further work on the design 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. It is likely that the majority of WFD assessment data requirements will be met by existing ongoing work packages around design and water quality now that the key risks are well understood. In addition to the further investigations outlined in Table 5.2, specific actions are recommended below. Water quality is likely to remain the biggest challenge for WFD compliance.

Areas for further assessment include:

- Ongoing consultation with the EA on key WFD risks. This should include expectations for 'within class' deterioration allowances in relation to permitting levels and WFD compliance;
- Collation and review of Artificial and Heavily Modified Waterbody (A/HMWB) measures information from the Environment Agency for inclusion into the assessment of potential impediment to achieving Good Ecological Potential (GEP) – in particular information relating to measures that will be included in Cycle 3 RBMPs;
- As noted in Table 1.1, Cycle 3 RBMPs are due to be published in 2022 (currently at consultation stage), which may bring about changes in the official WFD baseline status and objectives. Where necessary, changes will need to be accounted for in updates to the WFD assessments to include the formal Cycle 3 baseline data;
- Ongoing hydrological, water quality, ecology and sediment baseline and modelling data, in particular the outcomes of continuing hydraulic and water quality monitoring and modelling, and integration of further sediment baseline data to further quantify WFD risks (including 'within class' deterioration);
- Further information on the design and operation of the scheme to allow a more explicit assessment of physical changes;
- Assessment of inter-reliant multiple SRO options (as the option is reliant on the Minworth SRO being delivered);
- Further information on the design and operation of the scheme to allow a more explicit assessment of physical changes;
- Update to Level 2 WFD assessments at Gate 3 to incorporate additional information. The format for this assessment and reporting should be discussed and agreed with the EA.

A. WFD baseline data changes

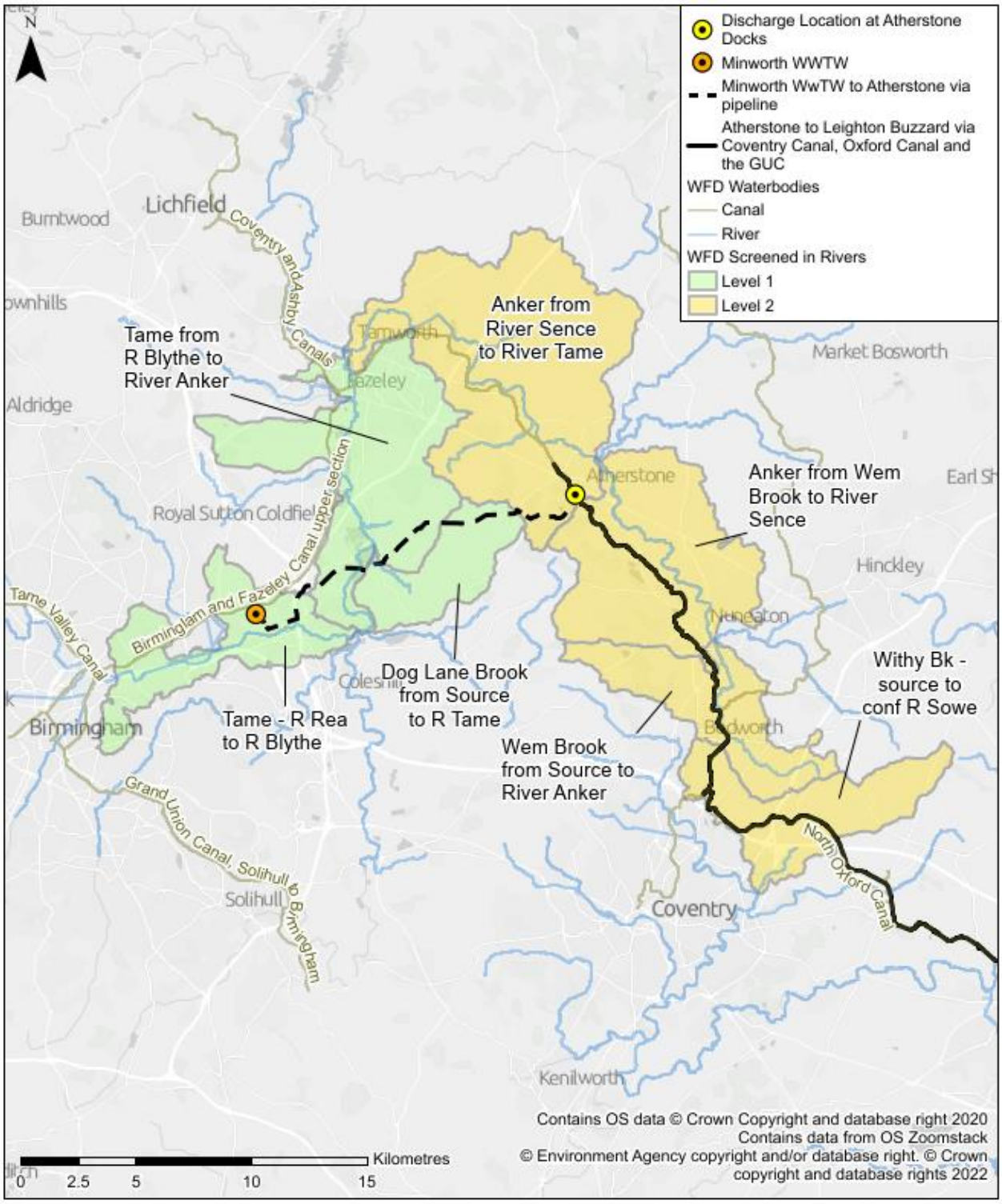
Table A.1: Changes in WFD baseline status, 2015-2019

WFD waterbody	Changes in WFD baseline status, 2015-2019
Anker from River Sence to River Tame	Fish High-Good Inverts Mod-Good Chemical Good-Fail (Mercury, PBDE)
Anker from Wem Brook to River Sence	Fish Good-High Ammonia High-Mod Specific pollutants High-Mod (Arsenic/Mang/Zinc) Chemical Good-Fail (various)
Coventry and Ashby Canals	Chemical DNRA*-Fail (Mercury, PBDE)
Grand Union Canal, Braunston summit	MMA Good-Mod Chemical DNRA-Fail (Mercury, PBDE)
Grand Union Canal, Milton Keynes to Braunston summit	MMA Good-Mod Chemical DNRA-Fail (Mercury, PBDE)
Grand Union Canal, Milton Keynes trough pound	Chemical DNRA-Fail (Mercury, PBDE)
Grand Union Canal, Tring summit to Milton Keynes	Chemical DNRA-Fail (Mercury, PBDE)
Loughton Brook	Chemical Good-Fail (Benzo(g-h-i)perylene, PBDE)
North Oxford Canal	No change
Ouse (Wolverton to Newport Pagnell)	Chemical Good-Fail (PFOS, PBDE)
Ouzel (US Clipstone Brook)	Inverts Mod-Good Phosphate Mod-Poor Chemical Good-Fail (PFOS, PBDE)
Ouzel DS Caldecote Mill	Chemical Good-Fail (PFOS, PBDE)
Ouzel US Caldecote Mill	Phosphate Mod-Poor Chemical Good-Fail (PFOS, PBDE)
Thame upstream of Aylesbury	Chemical Good-Fail (Benzo(g-h-i)perylene, Mercury, PFOS, PBDE)
Tove (DS Greens Norton)	Chemical Good-Fail (PFOS, PBDE)
Welton Village Trib, Whilton branch of R. Nene	Inverts Good-Mod Chemical Good-Fail (Mercury, PFOS, PBDE)
Wem Brook from Source to River Anker	Fish Poor-Mod Amm Mod-Bad DO Mod-Poor Chemical Good-Fail (Mercury, PFOS, PBDE)
Whistle Brook	Inverts Mod-Good MMA Good-Mod Chemical Good-Fail (PBDE)
Withy Bk - source to conf R Sowe	Inverts High-Good Amm Good-High Chemical Good-Fail (Mercury, PFOS, PBDE)

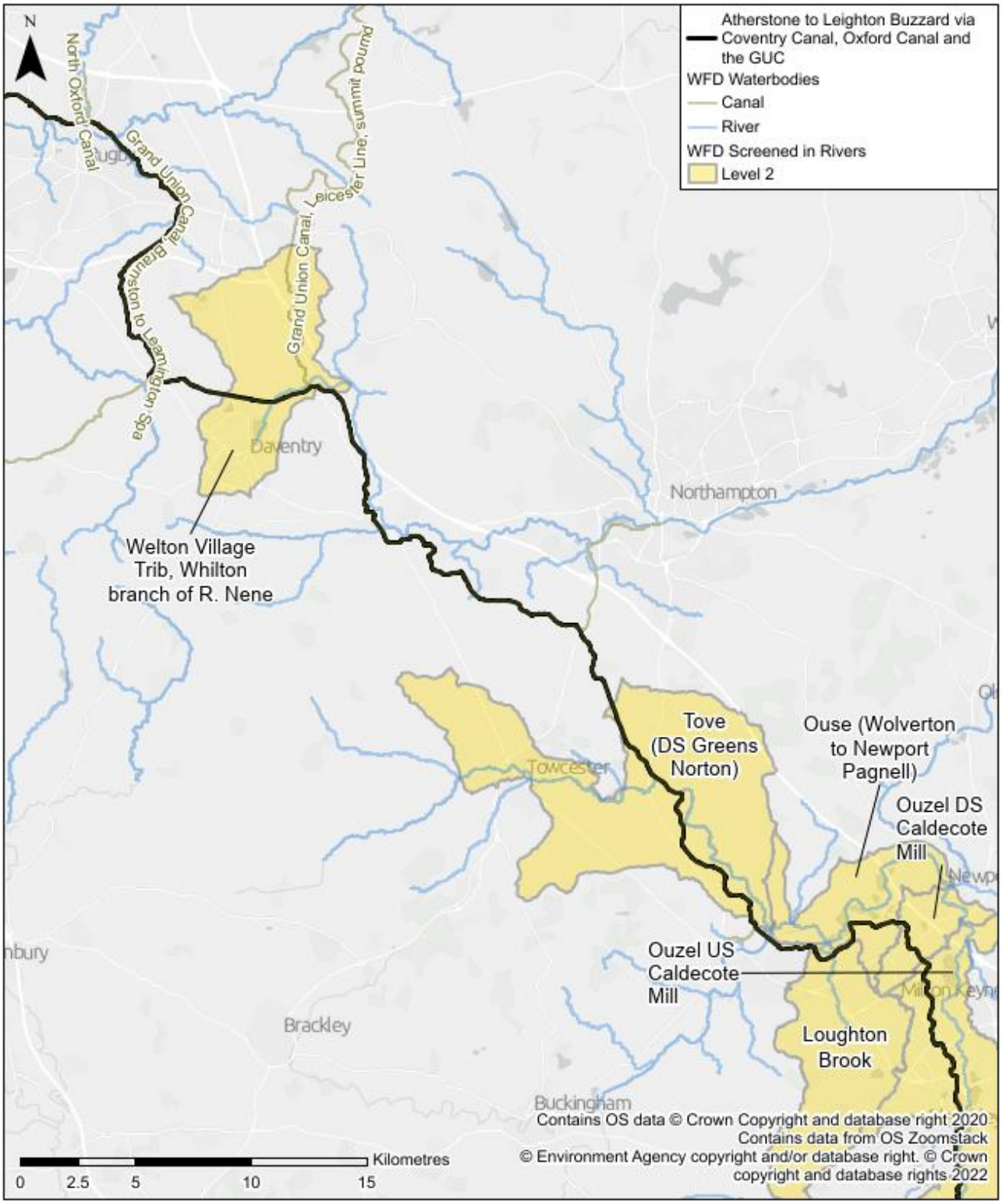
Source: https://environment.data.gov.uk/catchment-planning/ *DNRA = Does Not Require Assessment

B. WFD waterbody maps

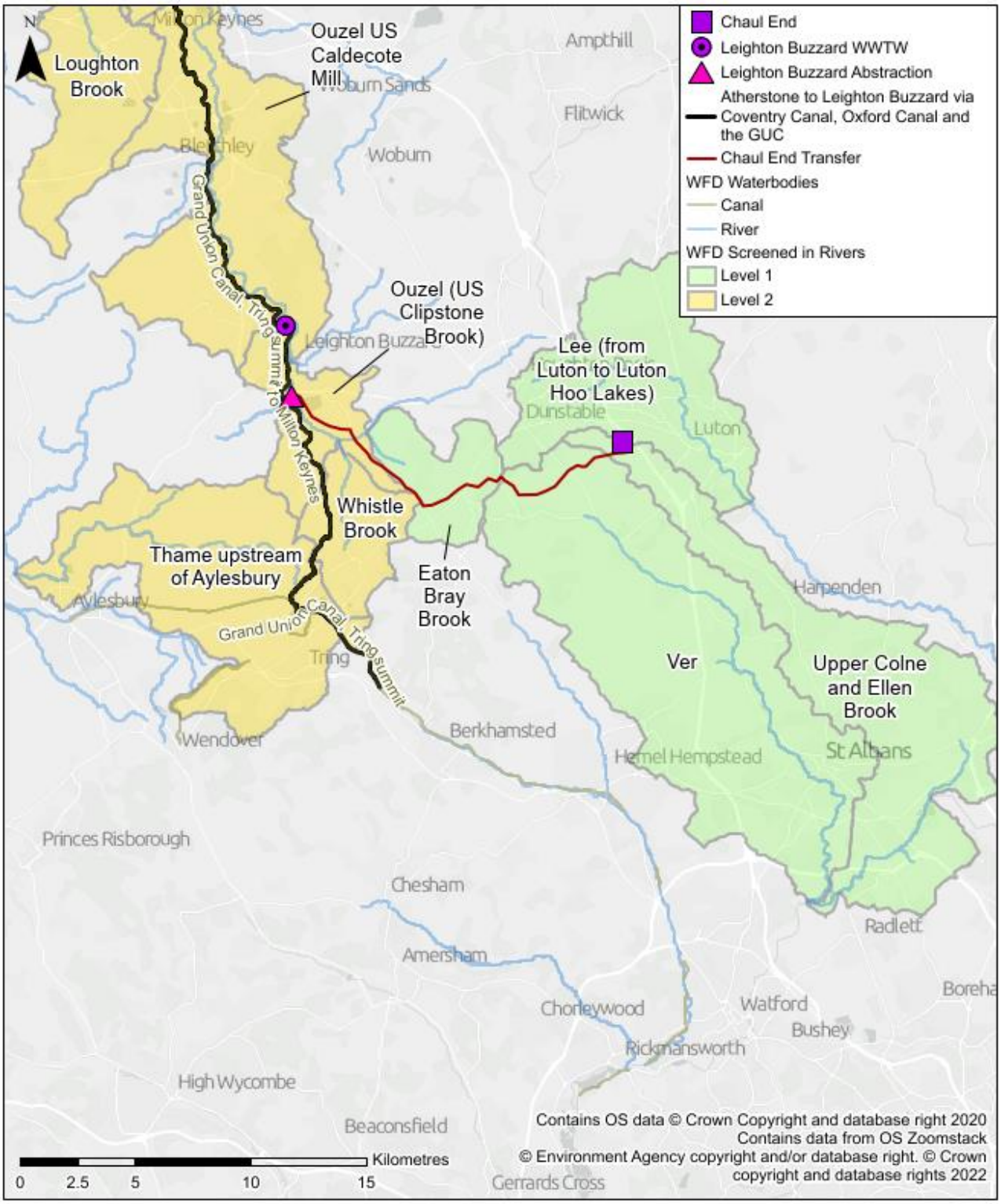
Map B.1: WFD waterbodies (1 of 3 – north part of transfer route)



Map B.2: WFD waterbodies (2 of 3 – central part of transfer route)



Map B.3: WFD waterbodies (3 of 3 – south part of transfer route)



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