[redacted]

Environmental Assessment Reports

The content of this document is draft and relates to material [or data] which is still in the course of completion in travel to Gate 2 and should not be relied upon at this early stage of development. We continue to develop our thinking and our approach to the issues raised in the document in preparation for Gate 2.

Minworth SRO

Severn Trent Water & Affinity Water

Creating a world
fit for the future

RICARDO

Minworth SRO
Draft Environmental Report

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Report for Severn Trent Water and Affinity Water

[redacted] | Issue number 4 | Date 29/06/2021

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Severn Trent Water and Affinity Water

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Approved by:

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1	28/04/2021	Draft for STW / AW review	[redacted]		
2	29/04/2021	Update following STW / AW comments			
3	28/05/2021	Update for Minworth 100 / GUC option			
4	29/06/21	Final			

Ref: [redacted]

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1 Introduction

1.1 Background and purpose of report

Ofwat, through the PR19 Final Determination, has identified the potential for companies to jointly deliver strategic regional water resources solutions to secure long-term resilience on behalf of customers while protecting the environment and benefiting wider society. As part of the assessment of companies' PR19 business plans, Ofwat introduced proposals to support the delivery of Strategic Regional Water Resource Options over the next 5 to 15 years with solutions required to be 'construction ready' for the 2025-2030 period. Ofwat's Final Determination[1] in December 2019 set out a gated process for development of Strategic Resource Options (SROs) for the co-ordination and development of a consistent set of SROs.

This gated process provides a mechanism for the industry, regulators, stakeholders and customers to input into the development and scheduling of these strategic solutions, through a combined set of statutory and regulatory processes. These include the National Framework, Drinking Water Safety Plans, Business Plans and Water Resource Management Plans (WRMPs). The group of Water Companies involved in developing SROs (known as the All Company Working Group - ACWG), (consisting of Affinity Water (AW), Anglian Water, Severn Trent Water (STW), Southern Water, South West Water, Thames Water, United Utilities (UU) and Wessex Water) published a joint company statement reiterating a commitment to continue working with the Regulators' Alliance for Progressing Infrastructure Development (RAPID), the Environment Agency (EA), Natural Resources Wales (NRW), Ofwat and the Drinking Water Inspectorate (DWI) to make all of the planning processes and statutory timetables a success.

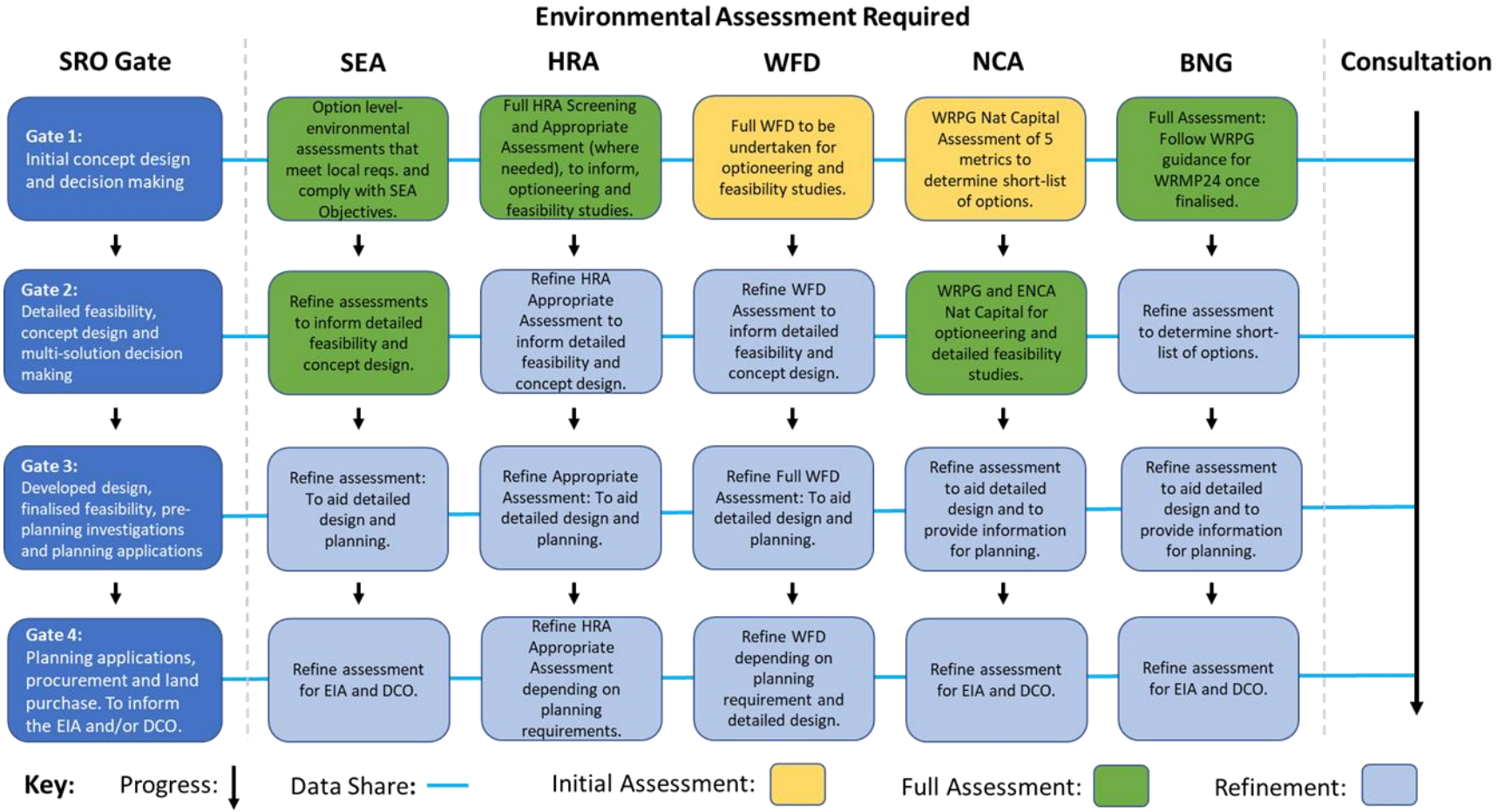
Minworth has been identified as an SRO in the PR19 Final Determination, with funding allocated to STW and AW.

In October 2020, the ACWG, published a methodology[2] for environmental assessment methods for SROs which is aligned to the draft Water Resources Planning Guideline (WRPG): Working Version for Water Resource Management Plan 2024 (WRMP24) to increase the consistency of environmental assessment of the SROs and the evaluation of impacts on environmental water quality in particular.

The ACWG methodology indicates that the process requires Water Companies to provide the following information related to each SRO at the stage outlined (see Figure 1.1).

[1] Ofwat (2019), PR19 Final Determinations, Strategic regional water resource solutions appendix
[2] Mott MacDonald Limited (2020). All Companies Working Group WRMP environmental assessment guidance and applicability with SROs. Published October 2020

Figure 1.1 Environmental Assessment Integration with SRO Gates



In line with Ofwat's PR19 Final Determination the following is required at gate-1:

- "*Initial option-level Strategic Environmental Assessment and Habitat Risks Assessments*[3] *requirements, including consideration of in-combination effects and identification of environmental risks that need mitigating through the solution design and costing*"

It was confirmed in the RAPID letter dated April 2019[4], that a full statutory Strategic Environmental Assessment (SEA) is not required for gate-1. In consequence, a formal statutory SEA for submission at gate-1 has not been undertaken, and this report does not include a formal SEA Scoping Report, initial assessments, or associated public consultation.

At gate-1, the principles of SEA have been applied to the Minworth SRO to inform an overall assessment of the environmental feasibility and deliverability of the solution. A statutory SEA is not required.

This report provides this initial option-level SEA of the Minworth SRO. The report sets out the objectives and methodologies that will be used for SEA at later stages of the process and uses the principles of SEA to inform an overall assessment of the feasibility of the schemes, from an environmental perspective.

The environmental assessment of the Minworth SRO schemes has been undertaken in the context of the ACWG guidance. This approach has been adopted to assess the various schemes within the Minworth SRO thus determining the environmental risk of the Minworth SRO in a manner consistent with the assessments that will be undertaken for the regional and individual water company WRMPs.

1.2 Structure of this report

The report is divided into the following sections:

- Section 1: This introduction
- Section 2: Provides a background to the Minworth SRO
- Section 3: Provides the methodology adopted for the SEA
- Section 4: Provides the results of the scheme assessments
- Section 5: Conclusions and recommendations to inform gate-2 assessments.

[3] Clarified by RAPID as being Habitats Regulations Assessment.
[4] Ofwat 3 April 2020 Strategic Regional Water Resource Solutions: Gate one assessment. Letter issued via email to Regulatory Directors of companies with strategic regional water resource solutions.

2 Minworth SRO

2.1 Introduction

The Minworth SRO is considered integral to a Severn to Thames Transfer (STT) System and in the delivery of the Grand Union Canal (GUC) transfer SRO.

A STT conveying raw water from the lower River Severn into the upper or middle River Thames via an interconnector would increase the catchment area from which water resources can be drawn to the south-east of England. In addition to any flows that may be available to be abstracted under licence from the River Severn, a range of raw water transfer supporting source options for the STT are under consideration to provide additional resource.

The STT SRO comprises 2 principal aspects:

1. Severn to Thames Conveyance – Deerhurst to Culham pipeline or canal conveyance, including piping to Culham.
2. Source rivers used to transport water associated with supported abstractions (rivers Vyrnwy, Severn, Avon and Thames).

In order for all of the STT Support Elements to be able to deliver the water into the STT System there is a requirement for these water supplies to be replaced with other water sources (aspect 2 above). The provision of this additional water is covered under separate SROs that provide the facilities to enable supporting flows for the STT System.

These SROs include the Minworth SRO, STW Sources SRO, UU Sources SRO and UU Lake Vyrnwy SRO. The STT System, therefore, comprises the STT SRO and the source SROs which would be required to work as a combined system to deliver the required outputs into the River Thames.

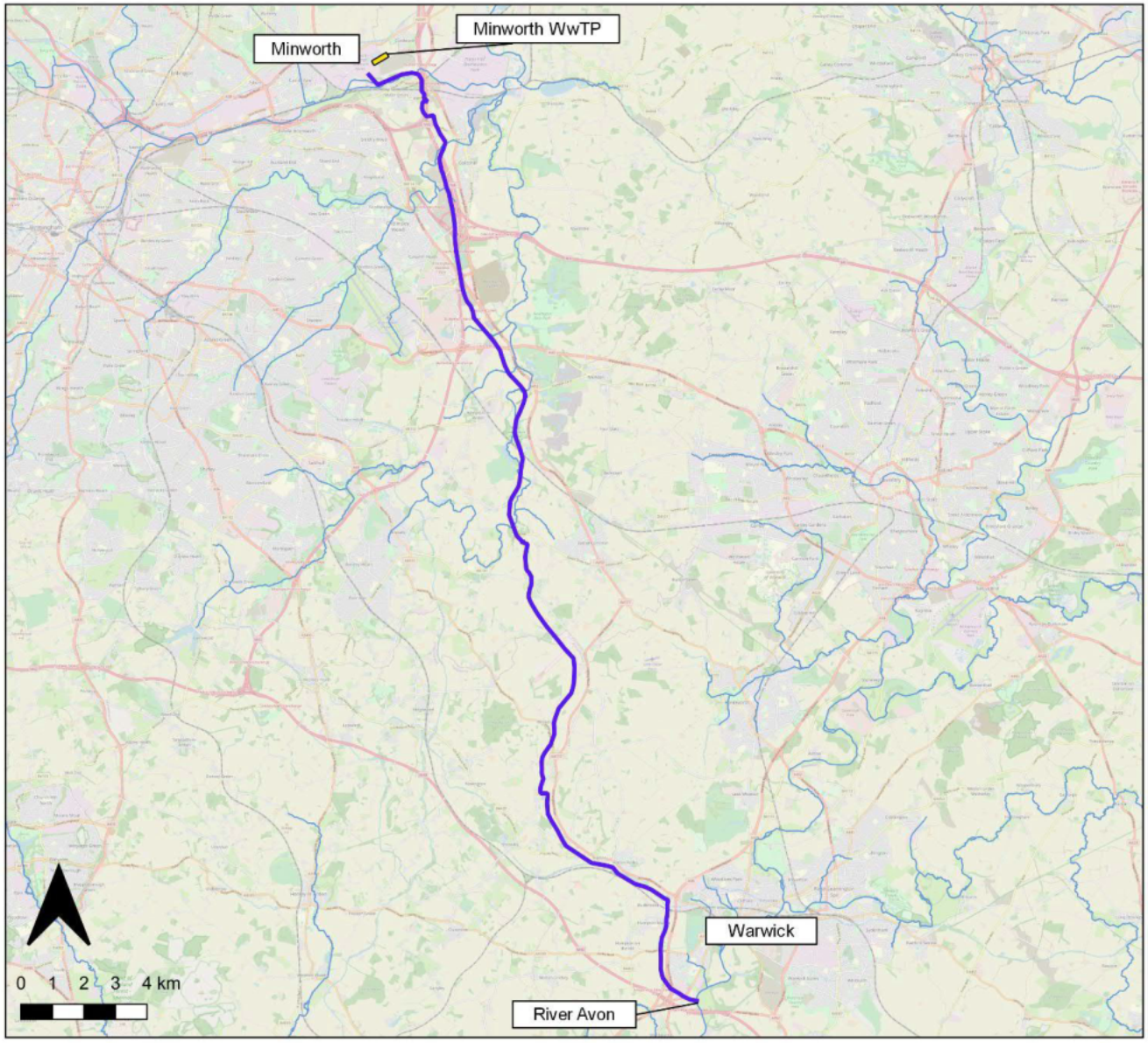
As noted above, the Minworth SRO is also critical in the delivery of the GUC Transfer SRO which will comprise of the transfer of treated wastewater down the GUC to supply AW. This comprises a direct discharge into the canal network, canal transfer to a new abstraction near Hemel Hempstead, and the onward transfer of raw water to a new water treatment works and expanded reservoir. It is expected that this work is jointly managed in partnership between the water companies and Canal & River Trust. This solution ranges from 50 to 100 Ml/d in capacity.

Minworth SRO includes three schemes:

- Minworth / STT (115 Ml/d)
- Minworth Combined (215 Ml/d)
- Minworth / GUC (100 Ml/d)

The locations of these three schemes are shown on Figure 2.1.

A more detailed description of each scheme is provided in the sections below.



RICARDO

Minworth / GUC (100 Ml/d)
Minworth /STT (115 Ml/d) and Minworth Combined (215 Ml/d)
Rivers

Project title:
Minworth SRO Environmental Assessment

Figure title:
Minworth SRO Schemes

Figure 2.1	**Date:** 27/04/2021
NGR: SP 21[redacted] 80[redacted]	**Scale:** 1:260000

2.1.1 Minworth / STT (115 Ml/d)

Currently treated wastewater from the Minworth Wastewater Treatment Works (WwTW) is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 115 Ml/d portion of this treated wastewater to a new outfall on the River Avon and hence into the River Severn catchment to support STT abstraction from the River Severn at Deerhurst or Gloucester Docks.

There would be an upgrade to the existing Minworth WwTW to improve the existing quality of wastewater to an acceptable standard for discharge to the River Avon. The discharge into the River Avon will require additional treatment technologies. The upgrades for this option will include the installation of a Ballasted Magnetite Coagulation (CoMagTM, Evoqua) Technology, UV disinfection units and Granular Activated Carbon units. All construction will be within the existing boundaries of the Minworth WwTW site.

In addition, this element comprises a pumping station at the Minworth WwTW site and pipeline from the Minworth WwTW site to a new outfall on the River Avon. The pipeline from Minworth WwTW to the River Avon outfall would be some 37.6km in length. The pipeline route is based on the current conceptual design, which may be subject to refinement during later design stages. The outfall location has been identified, during studies undertaken a gate-1, and would be located on the River Avon to the south of Warwick.

This assessment relates to the upgrade of the WwTW site associated with the discharge into the River Avon, and the pipeline to the River Avon. This assessment also considers any impacts on the River Tame system regarding the diversion of up to 115 Ml/d of treated wastewater discharge from Minworth.

The assessment of the discharge of some 115 Mld to the River Avon is considered as part of the STT SRO and does not form part of this assessment.

2.1.2 Minworth Combined (215 Ml/d)

Currently treated wastewater from the Minworth WwTW is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 215 Ml/d portion of this treated wastewater. With a 115 Ml/d portion being diverted to a new outfall on the River Avon and hence into the River Severn catchment to support STT abstraction from the River Severn at Deerhurst or Gloucester Docks and 100 Ml/d being diverted to the GUC.

There would be upgrades to the existing Minworth WwTW site necessary to improve the existing quality of wastewater to an acceptable standard for each discharge location (as noted below). As a result of the analysis of the receiving water quality (canal and river) and the location of the potential wastewater discharges, different levels of treatment would be required for each option.

The discharge into the GUC will require upgrades to ensure discharges of a maximum of 0.2mg/l Total Phosphorous. This will consist of the installation of Ballasted Magnetite Coagulation (CoMag^{TM}, Evoqua) Technology.

The discharge into the River Avon will require additional treatment technologies. The upgrades for this option will include the installation of a Ballasted Magnetite Coagulation (CoMagTM, Evoqua) Technology, UV disinfection units and Granular Activated Carbon units.

The upgrade works in both cases will be located in the same area of the existing WwTW site. All construction will be within the existing boundaries of the Minworth WwTW site.

In addition, this element comprises a pumping station at the Minworth WwTW site and a pipeline from the Minworth WwTW site to a new outfall on the River Avon. The pipeline from Minworth WwTW to the River Avon outfall would be some 37.6km in length. The pipeline route is based on the current conceptual design, which may be subject to refinement during later design stages. The outfall location has been identified, during studies undertaken at gate-1, and would be located on the River Avon to the south of Warwick.

This assessment relates to the upgrade of the WwTW site associated with discharges to both the River Avon and the GUC, and the pipeline to the River Avon. This assessment also considers any impacts

on the River Tame system regarding the diversion of up to 215 Ml/d of treated wastewater discharge from Minworth.

The assessment of the discharge of some 115 Mld to the River Avon is considered as part of the STT SRO and does not form part of this assessment. The pipeline and discharge of 100Ml/d to the GUC is considered under the GUC Transfer SRO and does not form part of this assessment.

2.1.3 Minworth / GUC (100 Ml/d)

Currently treated wastewater from the Minworth WwTW is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 100 Ml/d portion of this treated wastewater to the GUC system.

This assessment relates to the upgrade to the WwTW site associated with the discharge into the GUC and with a capacity of up to 100 Ml/d. The discharge into the GUC will require upgrades to ensure discharges of a maximum of 0.2mg/l Total Phosphorous. This will consist of the installation of Ballasted Magnetite Coagulation (CoMag^{TM}, Evoqua) Technology. All construction will be within the existing boundaries of the Minworth WwTW site.

This assessment also considers any impacts on the River Tame system regarding the diversion of up to 100 Ml/d of treated wastewater discharge from Minworth.

The pipeline and discharge of 100Ml/d to the GUC is considered under the GUC Transfer SRO and does not form part of this assessment.

3 Methodology

3.1 Methodology for gate-1

3.1.1 Overall approach

The objective of SEA is to provide a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans with a view to promoting sustainable development.

The requirement for SEA was brought into legislation by the SEA Regulations[5]. These regulations transposed the requirements of EU Directive 2001/42/EC (the SEA Directive) into English legislation. Following Brexit, minor amendments, to correct deficiencies and terminology, were made to the SEA Regulations through the Environmental Assessments and Miscellaneous Planning (Amendment) (EU Exit) Regulations 2018.

It is recognised that the SEA approach can assist in the identification of likely significant environmental effects (positive and negative) of water resource components, both individually and in-combination, and that knowledge of these effects can help to identify preferred options and programmes of options.

Whilst it is acknowledged that there is no requirement for a statutory SEA with respect to SROs, adoption of some of the principles of SEA in the assessment of SROs can help inform decision-making by bringing different environmental considerations into one place. In the same way that a statutory SEA, is informed by the HRA and WFD assessments, the approach adopted to the environmental assessment approach for gate-1 has equally had regard to the assessment conclusions of the HRA and WFD assessment work that has been undertaken to inform the submission at gate-1.

3.1.2 Assessment

An objectives-led approach to SEA has become standard practice in the assessment of both WRMPs and Drought Plan (DPs). An objective-led approach to this environmental assessment has therefore been adopted. The establishment of SEA objectives are commonly derived from a review of baseline conditions and of relevant plans, programmes and policies. Key issues that were identified from a review of baseline conditions and of relevant plans, programmes and policies undertaken during the development of STW's WRMP24 SEA Scoping Report have been reviewed as part of this assessment. These are summarised in **Appendix A1**.

In undertaking this environmental assessment work the list of SEA objectives set out in Table 6.1 of the ACWG Strategic Environmental Assessment: Core Objective Identification report (October 2020) have been adopted. These SEA objectives were identified by the ACWG following a review of Water Company approaches to SEA and an updated assessment of legislation, policies and guidance.

Regarding the Minworth SRO for gate-1, the principles of SEA, HRA and WFD have been adopted. The ACWG guidelines have been followed with regard to the approach to SEA. The approach adopted included for updates, such as in relation to carbon levels for assessing climatic factors, that were subsequently advised by the authors to the ACWG SEA methodology.

The key issues identified in **Appendix A1** have been used to create a number of key guide questions related to each SEA topic. These key guide questions have been used as prompts in the assessments to help ensure consistent and robust assessment for each of the SEA topic areas. As with the development of the SEA objectives the development of the guide questions has also drawn upon other sources of information including:

- the SEA guide questions set out in the WRSE Regional Plan SEA Scoping Report September 2020; and
- the SEA guide questions included in the SEAs of recent WRMPs.

[5] The Environmental Assessment of Plans and Programmes Regulations 2004 (Statutory Instrument 2004 No. 1633) apply to any plan or programme which relates solely or in part to England.

The list of SEA topics, SEA objectives and associated key guide questions adopted for the SEA undertaken for the Minworth SRO are set out in **Table 3.1** below.

Table 3.1 SEA objectives and key guide questions

SEA topic	SEA objective	Key guide questions
Biodiversity, flora and fauna	1.1 To protect designated sites and their qualifying features	• Is the option likely to affect the conservation status of any SPAs, SACs, Ramsar sites, SSSIs or National Nature Reserves? • Will it affect HRA compliance (taken from HRA assessment results)? • Will the option affect the marine environment, habitats and species (including MCZs and MPAs)? • Is the option likely to affect ancient woodland?
	1.2 To avoid a net reduction, and where possible enhance, in non-monetised natural capital assets	• Are there any opportunities for habitat creation or restoration and a net benefit/gain for biodiversity? • Will the option contribute to the loss or gain in habitat connectivity? • Does it protect, conserve and enhance biodiversity natural capital and the ecosystem services the natural capital provides (taken from the natural capital assessment results)?
	1.3 To protect and enhance biodiversity, priority habitats and species	• Will the option protect and enhance priority habitats and species? • Will the option affect a priority habitat on the priority habitat inventory?
	1.4 To avoid and, where required, manage invasive and non-native species (INNS)	• Is there a possibility for INNS to be spread/ introduced? • Is there an opportunity to improve biodiversity value through removal of INNS?
	1.5 To meet WFD objectives relating to biodiversity	• Will it affect WFD compliance e.g. good ecological potential/status?
Soil	2.1 To protect and enhance the functionality, quantity and quality of soils, including the protection of high-grade agricultural land	• Will the option affect high grade agricultural land? • Will the option promote the efficient use of land? • Will the option prevent soil erosion and retain soil stocks as a natural resource? • Will the option involve use of brownfield or greenfield land? • Is the option likely to affect SSSIs of geological importance?
Water	3.1 To minimise or manage flood risk, taking climate change into account	• Is the option vulnerable to flood risk? • Will the option contribute to the risk of flooding? • Will the option protect and enhance the environmental resilience of the water environment to climate change, flood risk and drought?
	3.2 To enhance or maintain groundwater quality and resources	• Will the option affect groundwater quality or quantity?
	3.3 To enhance or maintain surface water quality, flows and quantity	• Will the option affect surface water quality or quantity?
	3.4 To meet WFD objectives	• Is the option likely to contribute to or conflict with the achievement of WFD objectives (taken from the WFD assessment results)?
	3.5 To improve water efficiency through provision of access to a resilient and sustainable supply of water.	• Does the option provide a reliable and sustainable water supply which meets changing demand?
Air	4.1 To minimise air emissions during construction and operation	• Is the option in an air quality management area (AQMA)? • Will the option affect local air quality?
Climatic Factors	5.1 To introduce climate mitigation where required and improve the	• Is there potential for the option to incorporate climate mitigation measures to reduce its carbon footprint, such as lower embodied carbon or incorporating renewable energy?

	climate resilience of assets and natural systems	• Is the option vulnerable to climate change effects? • Does the option include climate resilience measures?
	5.2 To minimise embodied and operational emissions	• Will the option affect carbon or other greenhouse gas (GHG) emissions? • Will the option minimise energy demand during construction and operation?
Landscape	6.1 To conserve, protect and enhance landscape and townscape character and visual amenity	• Will the option have an effect on the character of the landscape or townscape, including views? • Will the option improve access to the countryside? • Will the option create or improve green infrastructure which contributes to access to the landscape? • Will the option protect and enhance designated landscapes and features? • Will the option affect visual amenity?
Historic Environment	7.1 To conserve/protect and enhance historic assets/cultural heritage and their setting, including archaeological important sites	• Will the option affect designated historic assets, sites and features? • Will the option affect the setting and/or significance of a historic asset? • Will the option affect archaeological important sites?
Population and Human Health	8.1 To maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	• Will the option allow for economic development? • Will the option provide employment opportunities? • Will the option affect road or rail infrastructure? • Will the option minimise disturbance from noise, light, visual, and transport? • Will the option affect the local area in terms of noise emissions?
	8.2 To maintain and enhance tourism and recreation	• Will the option have an effect on active lifestyles, such as impacts on active travel through disruption to pedestrian and cycle routes? • Will the option affect Public Rights of Way? • Will the option maintain or enhance tourism? • Will the option affect water resources that are used to provide tourist facilities?
	8.3 To secure resilient water supplies for the health and wellbeing of customers	• Will the option secure resilient water supplies for the health and wellbeing of customers? • Does the option promote water efficiency and encourage a reduction in water consumption?
	8.4 To increase access and connect customers to the natural environment, provide education or information resources for the public	• Does the option improve access to the natural environment for recreation, including those living within deprived areas?
Material Assets	9.1 To minimise resource use and waste production	• Will the option minimise the use of resources? • Will the option minimise the production of waste?
	9.2 To avoid negative effects on major built assets and infrastructure	• Will the option reuse existing infrastructure? • Will the option affect major built assets and infrastructure, including transport infrastructure?

As can be seen from **Table 3.1** the SEA is informed by the results of the HRA and WFD assessments undertaken. In particular the HRA assessment results help inform the assessment of objectives related to biodiversity, flora and fauna whilst the WFD assessment results help to inform the assessment of objectives 1.5 and 3.4. Furthermore, the natural capital and biodiversity assessments undertaken as part of the SRO have assisted the conclusions reached in terms of the SEA topic area of biodiversity, flora and fauna.

As well as the baseline being used to inform the SEA objectives it is also important in helping to determine the effects of the proposed options. The ACWG document entitled 'WRMP environmental assessment guidance and applicability with SROs' states that: "*it is envisaged that, the majority of the front-end SRO environmental assessment(s) required for gate-1 would be carried out using a GIS-based system to allow for rapid assessment of multiple options*". The gate-1 option-level environmental assessment has utilised a GIS-based system to help identify and map environmental constraints within the study area. The datasets used in this detailed assessment, as provided in **Appendix A2**, have been updated from those used in the WRMP19 assessments to reflect the current baseline. Figures that illustrate the baseline environment with regard to key environmental constraints in proximity to the Minworth SRO schemes are provided in **Appendix A3**.

The results of the SEA scheme assessments are presented in output tables, which reflects the SEA outputs set out in Table A.1 of the ACWG guidelines. The SEA assessment table that has been adopted in the assessment of the Minworth SRO is provided in **Appendix A4**. Further details and explanation on the content of the detailed SEA assessment output tables is provided below.

The first and second columns of the assessment output table set out the SEA topics and objectives. The third and fourth columns provide the assessment results, positive and negative effects, during the construction phase and the fifth and sixth columns provide the positive and negative effects, during the operational phase. These assessment results have regard to embedded mitigation (mitigation measures identified as part of the proposed scheme subject to assessment) that have been costed into the design of the scheme. For assessment purposes embedded mitigation includes best practice mitigation and any additional specific mitigation included as part of option design as set out in the conceptual design report (CDR) for the STW Minworth schemes.

In line with best practice the negative and positive effects are assessed separately for each objective and are not aggregated or "netted off" in any way. This approach has been adopted to maintain transparency of negative and positive effects.

The seventh column provides commentary and evaluation of the effects of the element on the SEA objective, with reference to the guide questions (outlined in **Table 3.1**). This commentary is split into construction and operational aspects and outlines the key details that underpin the assessment against that SEA objective, providing transparency as to how the significance of effects has been determined.

The eighth column provides details of any further measures to mitigate adverse effects or enhance beneficial effects that are recommended but not committed to as part of the proposed scheme. The residual negative and positive effects (after application of further mitigation measures) during construction are identified in the ninth and tenth columns respectively. Whilst the eleventh and twelfth columns provide the residual positive and negative effects, during the operational phase.

The assessment of the elements has been carried out applying the SEA assessment significance ratings shown in **Table 3.2** below.

Table 3.2 Significance ratings

Effect	Description
+++	Major Positive
++	Moderate Positive
+	Minor Positive
0	Neutral
-	Minor Negative
--	Moderate Negative
---	Major Negative
?	Uncertain

The definitions for the significance of effects are provided in **Appendix A5**, and have had regard both to those set out in Table B.1 of the ACWG guidance, although in order to be consistent with the WRSE

regional plan have been updated, for example, to reflect consideration of INNS and a revised carbon threshold scale. The assessment conclusions also consider the sensitivity of the environmental receptor and magnitude of the effect, the latter of which is a factor of the scale of effect, whether the effects arise in the short, medium or long term, and whether the effects are permanent or temporary.

Where qualitative and/or quantitative information was available (e.g. as identified by the HRA or WFD assessment process, conceptual design information, public domain datasets including GIS datasets), this has been used to inform the assessment. Objectives or key guide questions that were not supported by available data or information have been evaluated using spatial analysis, professional judgement and applicable assessment guidelines relating to that topic/objective.

The SEA process has been applied to test the performance of the Minworth SRO schemes against environmental objectives to see how far they meet these objectives. This approach enables the environmental performance of these elements to be used to inform decision-making.

With regard to in-combination effects, there is no specific requirement to undertake a full cumulative effects assessment at gate-1, and indeed at this stage in the absence of outputs from the regional plans and clarity as to which SRO schemes may proceed or not through to gate-2 such an assessment would be of limited value. An assessment of the likely significant environmental effects of the Minworth SRO in combination with those of other relevant plans, programmes or projects, including the regional water resource plans, WRMPs, DPs and other major plans, programmes and projects will be undertaken for gate-2.

3.1.3 Limitations of the study

SEA is a strategic assessment aimed at highlighting potential environmental concerns. The environmental data used in this assessment are based on those that are readily available from existing sources. Limitations in undertaking this SEA included the requirement to rely on conceptual designs appropriate to the development of the SRO scheme for gate-1 and which therefore have a lower level of detail to inform assessment of very specific impacts on specific receptors. Assessment of impacts is necessarily limited when, for example, pipeline routes are at the outline conceptual design stage only.

The level of detail used in the environmental assessments produced for gate-1 submission is consistent with the strategic nature of SEA and the outline level of detail of the Minworth SRO schemes at gate-1. The scope of the assessment has not strayed into the statutory Environmental Impact Assessment (EIA) process which is a detailed project-level assessment using detailed design information. Such detailed information will not be available for the Minworth SRO until later in the RAPID gated process. For example, assessment of the potential impacts on protected species will be carried out as the option is taken forward for detailed design and environmental surveys are carried out for protected species to inform the assessments. This approach is supported in national guidance[6] on SEA. It is recognised that if schemes are progressed, there would be more detailed assessment work (including EIA where relevant) to support the detailed design as well as any subsequent planning application and that further engagement with stakeholders would be undertaken during this period.

Where particular limitations or outstanding issues are known, these are described in the SEA output assessment table for the relevant element concerned.

[6] For example the ODPM guidance on SEA.

4 Assessments

4.1 Introduction

The SEA assessment tables for each of the three schemes are provided in **Appendix A6**.

The assessment conclusions during construction and operation for each objective have been determined firstly after application of embedded mitigation measures included in the conceptual design (and cost) of each scheme and then subsequently having regard to the application of potential further mitigation measures.

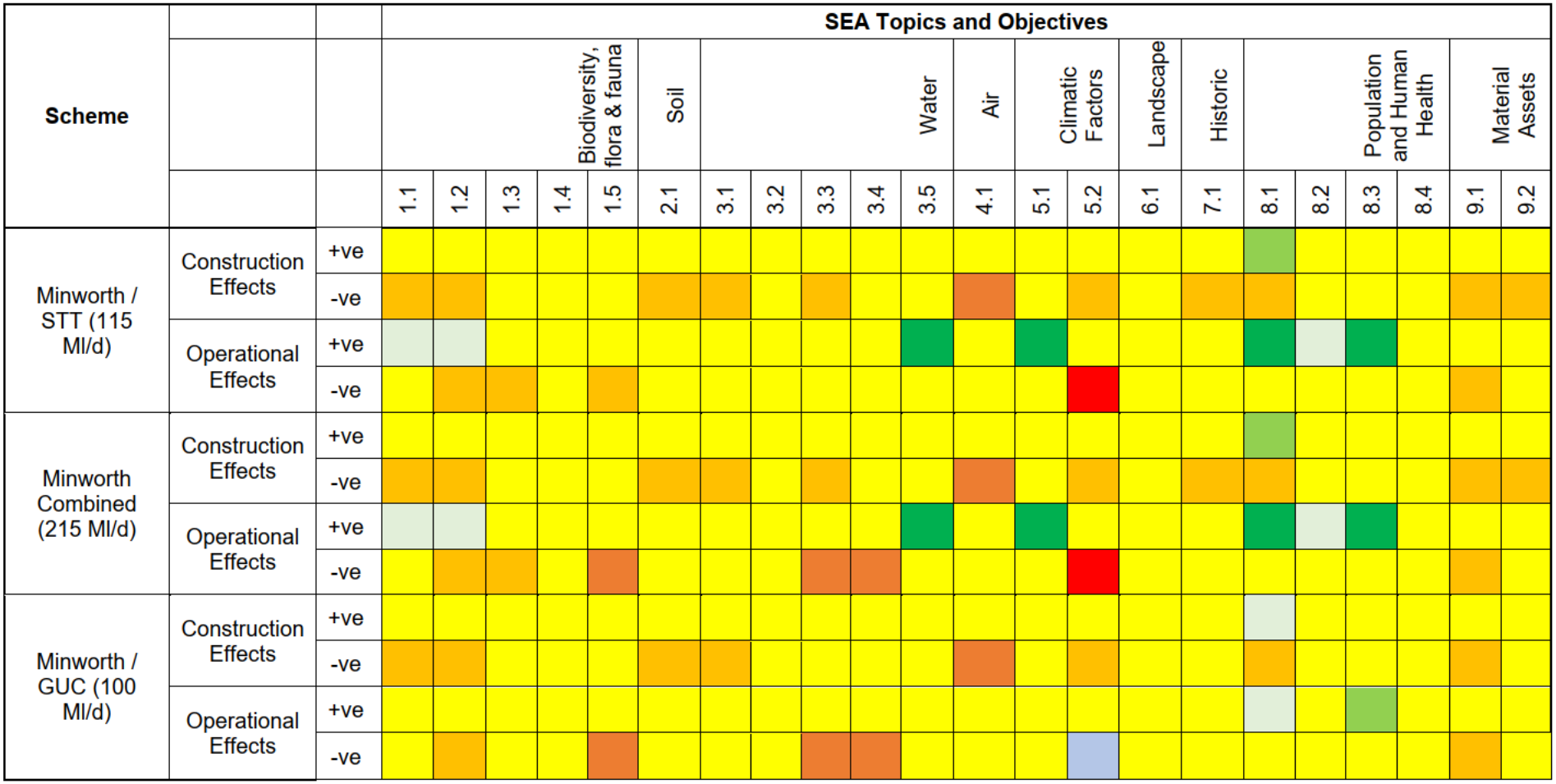
The mitigation included as embedded mitigation in the assessments has been developed through the work undertaken leading to the gate-1 submission. The mitigation measures identified as embedded mitigation have been included in the CDR. These mitigation measures have been costed for in the design and thus have been taken into account in the assessment of likely environmental effects. Where, even after the consideration of these embedded mitigation measures, these assessments have identified potential environmental effects regard has been given to further mitigation measures. These are measures that, although have not been costed for as yet, could be undertaken and implemented in order to reduce or overcome negative effects or increase positive effects.

The assessment conclusions during the construction and operational phases of each scheme after consideration of embedded mitigation are summarised below using a colour-coded visual evaluation summary matrix (**Table 4.2**). The colours in the table reflect the level of significance of the effect as set out in **Table 3.2**. The assessment conclusions during the construction and operational phases of each scheme after consideration of further potential mitigation measures are summarised below using a colour-coded visual evaluation summary matrix (**Table 4.3**).

Table 4.2 SEA Assessment Summary Matrix after embedded mitigation

Scheme			SEA Topics and Objectives																					
			Biodiversity, flora & fauna					Soil	Water					Air	Climatic Factors		Landscape	Historic	Population and Human Health				Material Assets	
			1.1	1.2	1.3	1.4	1.5	2.1	3.1	3.2	3.3	3.4	3.5	4.1	5.1	5.2	6.1	7.1	8.1	8.2	8.3	8.4	9.1	9.2
Minworth / STT (115 Ml/d)	Construction Effects	+ve																						
		-ve																						
	Operational Effects	+ve																						
		-ve																						
Minworth Combined (215 Ml/d)	Construction Effects	+ve																						
		-ve																						
	Operational Effects	+ve																						
		-ve																						
Minworth / GUC (100 Ml/d)	Construction Effects	+ve																						
		-ve																						
	Operational Effects	+ve																						
		-ve																						

Table 4.3 SEA Assessment Summary Matrix after further mitigation



A summary of the key environmental effects of each of the schemes after embedded mitigation measures have been considered are provided below. The potential effects of undertaking the further mitigation measures identified in the SEA assessment output tables is discussed at the end of each assessment.

4.2 Minworth / STT (115 Ml/d)

This scheme has some major and moderate negative and major and moderate positive effects after consideration of currently embedded mitigation measures.

Major negative effects include:

- Biodiversity effects during construction as the scheme crosses two SSSIs and is close to other designated areas.
- Effects on climatic factors due to the expected level of operational carbon resulting from the proposed scheme.

Moderate negative effects include:

- Impacts on local air quality due to increased HGV movements and other activities associated with construction. Part of the scheme would be within an AQMA.
- Effects on heritage assets during construction due to the proximity of scheduled monuments, listed buildings and registered parks and gardens
- Potential effects on the health and well-being of the local community during construction of the proposed development.

Major positive effects are identified in respect of the scheme contributing to a resilient water supply. The additional water resource from this scheme will provide essential water supply infrastructure to help support a sustainable socio-economy. Furthermore, with respect to climatic factors this scheme provides additional water resource and will during operation assist the reliable transfer of water, therefore reducing the vulnerability to drought risks associated with climate change and improving resilience to the likely effects of climate change. A further moderate positive effect was identified with respect to potential economic opportunities during construction.

Some of the major and moderate negative effects identified after consideration of the currently costed for embedded mitigation measures could potentially be further mitigated. Through the implementation of further mitigation measures these currently identified effects could be reduced to a minor negative or neutral effect. These measures, which are proposed to be investigated further during gate-2, include:

- Re-routing the pipeline away from SSSIs and consultation with Natural England regarding SSSI and ancient woodland protection measures.
- Investigate potential for an energy recovery option to reduce climate emissions during operation.
- Consideration of heritage aspects when further developing the alignment of the pipeline. This should be done during design development and in consultation with Historic England and Council officers.
- Sensitive siting of construction compounds, routing of construction traffic and limiting hours of working. This could reduce effects on the environment and amenity to a minor negative effect.

In regard to the major negative climatic effects due to the expected level of operational carbon resulting from the proposed scheme, further mitigation measures have been identified but may not reduce this effect. The moderate negative effect relating to potential effects on air emissions during construction of the proposed scheme is not anticipated to alter following the implementation of further mitigation measures.

As illustrated in Table 4.3 as well as major and moderate effects being reduced through the implementation of further mitigation measures, the adoption of further mitigation measures also reduces a number of identified minor negative effects to neutral effects.

4.3 Minworth Combined (215 Ml/d)

This scheme has some major and moderate negative and major and moderate positive effects after consideration of currently embedded mitigation measures.

Major negative effects include:

- Biodiversity effects during construction as the scheme crosses two SSSIs and is close to other designated areas.
- Effects on WFD biodiversity objectives during operation due to effects of discharge reduction from Minworth WwTW on the downstream Rivers Tame and Trent, a major negative flow effect with risk to WFD deterioration in five river water bodies (further details provided in the WFD report);
- Effects on flows in the Rivers Tame and Trent. (further details provided in the WFD report);
- Effects on WFD objectives during operation due to effects of discharge reduction from Minworth WwTW on the downstream Rivers Tame and Trent (further details provided in the WFD report); and
- Effects on climatic factors due to the expected level of operational carbon resulting from the proposed scheme.

Moderate negative effects include:

- Impacts on local air quality due to increased HGV movements and other activities associated with construction. Part of the scheme would be within an AQMA.
- Effects on heritage assets during construction due to the proximity of scheduled monuments, listed buildings and registered parks and gardens
- Potential effects on the health and well-being of the local community during construction of the proposed development.

Major positive effects are identified in respect of the scheme contributing to a resilient water supply. The additional water resource from this scheme will provide essential water supply infrastructure to help support a sustainable socio-economy. Furthermore, with respect to climatic factors this scheme provides additional water resource and will during operation assist the reliable transfer of water, therefore reducing the vulnerability to drought risks associated with climate change and improving resilience to the likely effects of climate change. A further moderate positive effect was identified with respect to potential economic opportunities during construction.

Some of the major and moderate negative effects identified after consideration of the currently costed for embedded mitigation measures could potentially be further mitigated. Through the implementation of further mitigation measures these currently identified effects could be reduced to a minor negative or neutral effect. These measures, which are proposed to be investigated further during gate-2, include:

- Re-routing the pipeline away from SSSIs and consultation with Natural England regarding SSSI and ancient woodland protection measures.
- Investigate potential for an energy recovery option to reduce climate emissions during operation.
- Consideration of heritage aspects when further developing the alignment of the pipeline. This should be done during design development and in consultation with Historic England and Council officers.
- Sensitive siting of construction compounds, routing of construction traffic and limiting hours of working. This could reduce effects on the environment and amenity to a minor negative effect.

The further development of operating conditions for wastewater transfer and further hydro-ecological and water quality assessment of effects of major change in flow regime in the Rivers Tame and Trent could reduce a major adverse effects on both WFD biodiversity and Water flows objectives to moderate. In regard to the major negative climatic effects due to the expected level of operational carbon resulting from the proposed scheme, further mitigation measures have been identified but may not reduce this effect. The moderate negative effect relating to potential effects on air emissions during construction of

the proposed scheme is not anticipated to alter following the implementation of further mitigation measures.

As illustrated in Table 4.3 as well as major and moderate effects being reduced through the implementation of further mitigation measures, the adoption of further mitigation measures also reduces a number of identified minor negative effects to neutral effects.

4.4 Minworth / GUC (100 Ml/d)

This scheme has three major negative effects, one moderate negative effect and one moderate positive effect after consideration of currently embedded mitigation measures.

Major negative effects are associated with risk to WFD deterioration for biodiversity related objectives; effects on water flows in the Rivers Tame and Trent and also water quality; in addition to potential non compliance with targets in five WFD river water bodies.

The moderate negative effect is associated with effects on local air quality due to increased HGV movements and other activities associated with construction. The scheme would be within an AQMA.

Moderate positive effects are identified in respect of the scheme contributing to a resilient water supply. The additional water resource from this scheme will provide essential water supply infrastructure to help support a sustainable socio-economy.

As illustrated in Table 4.3 the three major negative effect on biodiversity WFD objectives; surface water flows and quality; and WFD objectives could potentially be reduced to three moderate negative effects with adoption of further mitigation measures. These measures would comprise further development of operating conditions for effluent transfer and further hydro-ecological and water quality assessment of effects of major change in flow regime in the Rivers Tame and Trent.

The adoption of further mitigation measures specified would also potentially reduce five minor negative effects to neutral effects.

5 Conclusions and recommendations

5.1 Introduction

As set out in section 4, some major and moderate negative and positive effects have been identified for each of the three schemes assessed within the Minworth SRO, which is to be expected given the scale of the proposed schemes.

The negative effects in particular are dependent on the specific geographical setting of the option and its proximity (or otherwise) to sensitive environmental, human and built receptors. Some of these major negative effects identified are temporary in nature and largely unavoidable while construction works take place. Some exist as a consequence of the scale of the proposed works, whilst others may be able to be mitigated with investigation of further measures. The beneficial effects have been identified in respect of providing additional water resource, contributing to a resilient water supply, helping to support a sustainable socio-economy and reducing the vulnerability to drought risks associated with climate change and improving resilience to the likely effects of climate change.

In discussions with WRSE it is understood that the SEA assessments undertaken for the WRSE regional plan, whilst broadly consistent, show some variances mainly around the benefits of this large scale option. For example, in terms of this option providing economic and social benefits to the South East by delivering a reliable and secure water supply as well as in terms of positive effects during construction such as employment and economic benefits. Both of these factors are considered relevant, especially when considering this large scale potential development. Whilst these factors have not been taken into account in the WRSE regional plan assessments consideration of these potential benefits have been taken into account in the SEA assessment of the Minworth SRO schemes. As set out above and in the SEA assessment output tables in **Appendix A6**.

Section 4 sets out the key major and moderate effects, prior to the adoption of potential further mitigation measures. Section 5.2 sets out proposed gate-2 works, which includes a summary of key further investigations and works proposed during gate-2 that will help to identify further mitigation measures to potentially reduce the identified effects further. It should be noted that the further mitigation measures identified have not been costed for or integrated into detailed design at this stage. In consequence, these measures are subject to more detailed assessment and at this stage the effectiveness of these measures has still to be fully determined.

In addition to the identification and assessment as to the effectiveness of further mitigation measures it is proposed as part of gate-2 activities to reaffirm the identified embedded mitigation measures set out as part of these assessments.

Further work on co-ordination with the regional plan assessments are proposed to be undertaken as part of gate-2 activities.

5.2 Gate 2 works

The environmental assessment work will be iterative throughout the gated process drawing on additional engineering design, modelling and data that becomes available as work progresses.

It is recommended that gate-2 works should both confirm the proposed embedded mitigation measures set out in the assessment tables in **Appendix A6** and the conceptual design reports and include consideration and review of the recommended further mitigation measures. These recommended further mitigation measures are identified within each of the SEA output tables in **Appendix A6.**

Consideration of potential cumulative effects and interactions with other major projects identified in programmes and plans should also be assessed during gate-2.

Key gate-2 works during construction and operation, are outlined below.

5.2.1 Key gate-2 works for Minworth / STT (115 Ml/d)

Key recommended further mitigation measures to be undertaken during gate-2 works during construction for the Minworth / STT 115 Ml/d scheme include:

- Review and confirm the proposed embedded mitigation measures set out in the SEA assessment output tables and conceptual design reports;
- Discussions with regulators and stakeholders on pipeline routing;
- Re-routing the pipeline away from SSSIs and consultation with Natural England regarding SSSI and ancient woodland protection measures.
- Investigate further key areas for BNG opportunities;
- Consideration of heritage aspects when further developing the alignment of the pipeline. This should be done during design development and in consultation with Historic England and Council officers.
- Sensitive siting of construction compounds, routing of construction traffic and limiting hours of working. This could reduce effects on the environment and amenity to a minor negative effect.
- Obtain relevant biological record centre data once common pipeline corridors are identified, to aid pipeline route optimisation;
- Desk based assessment of recreational impacts once site selection work and pipeline optimisation complete;
- Desk based assessment with ground truthing of acceptable crossing points of the watercourses (where there is existing infrastructure, no wetland habitat) to identify common crossing points to be used by pipelines where possible;
- Desk based air quality assessments to be completed, once construction information available (duration of works, plant, HGV movements) to further assess risk of exceeding critical loads during construction;
- Where site selection and common pipeline corridors can be determined, obtain relevant protected species information;
- Development of measures to be included in the CEMP for example approved traffic routes;
- Consideration of additional tunnelling to avoid sensitive areas for example all A roads, water courses, priority habitats;
- Consider minimising the extent of construction works and the level of pipeline works being undertaken at any one point to mitigate impacts on designated landscapes and agricultural land;
- Investigate use of renewables.

Key recommended further mitigation measures to be undertaken during gate-2 works during operation for the Minworth / STT 115 Ml/d scheme include:

- Review and confirm the proposed embedded mitigation measures set out in the SEA assessment output tables and conceptual design reports.
- Discussions with regulators and stakeholders on permitted discharges;
- Further detailed studies to assess the effects on aquatic ecology at specific locations. These studies would increase confidence in the assessment conclusions and lead to the identification of additional targeted and specific mitigation measures to be incorporated into the detailed design;
- Further consideration of the operational regime during key migration periods for biodiversity including further survey work and monitoring to confirm the magnitude of impacts on river margins downstream of the discharge pipeline and also to understand the magnitude of flow effects in the River Tame;
- Further development of the delivery of Biodiversity Net Gain (BNG) to offset construction losses;
- Monitoring of impacts on river margins;
- Investigate waste minimisation;
- Investigate use of renewables; and

- Development of enhancement measures. For example, there is the opportunity to improve footpaths and connections in and around parts of the schemes as part of the construction work. In addition, the achievement of environmental net gain and biodiversity net gain may need to consider offsite locations.

5.2.2 Key gate-2 works for Minworth Combined (215 Ml/d)

Key recommended further mitigation measures to be undertaken during gate-2 works during construction for the Minworth combined 215 scheme would be the same as those identified for the Minworth / STT 115 Ml/d scheme set out in section 5.2.1 of this report.

Key recommended further mitigation measures to be undertaken during gate-2 works during operation for the Minworth 215 combined scheme include:

- Review and confirm the proposed embedded mitigation measures set out in the SEA assessment output tables and conceptual design reports.
- Discussions with regulators and stakeholders on permitted discharges;
- Further detailed studies to assess the effects on aquatic ecology at specific locations. These studies would increase confidence in the assessment conclusions and lead to the identification of additional targeted and specific mitigation measures to be incorporated into the detailed design;
- Further consideration of the operational regime for wastewater transfer;
- Further consideration hydro-ecological and water quality assessments and monitoring to understand the magnitude of flow effects in the Rivers Tame and Trent;
- Further development of the delivery of Biodiversity Net Gain (BNG) to offset construction losses;
- Monitoring of impacts on river margins;
- Investigate waste minimisation;
- Investigate use of renewables; and
- Development of enhancement measures. For example, there is the opportunity to improve footpaths and connections in and around parts of the schemes as part of the construction work. In addition, the achievement of environmental net gain and biodiversity net gain may need to consider offsite locations.

5.2.3 Key gate-2 works for Minworth / GUC (100 Ml/d)

Key gate-2 works during construction for the Minworth / GUC scheme include:

- Review and confirm the proposed embedded mitigation measures set out in the SEA assessment output tables and CDRs.
- If site specific ecological assessments identify any impacts to protected species or habitats associated with the construction work, appropriate mitigation measures will be identified and implemented including (where appropriate) relocation of such species in advance of the works being undertaken;
- Ground investigations to be undertaken prior to commencement of works to identify necessary mitigation measures;
- Consideration of the use of rail for transporting construction materials and application of approved traffic routes for construction traffic to minimise impacts on local roads.
- Investigate use of renewables;
- Consider minimising the extent of construction works within the greenbelt;
- Consultation with Historic England to identify mitigation measures in particular in relation to the listed buildings and conservation area within proximity;
- Construction compounds to be sited sensitively and away from residential areas. Also the hours of working associated with the construction of the treatment works, other sites and pipeline route to be limited to minimise amenity and environmental impacts; and
- Investigate waste minimisation.

Key gate-2 works during operation for the Minworth / GUC scheme include:

- Review and confirm the proposed embedded mitigation measures set out in the SEA assessment output tables and CDRs.
- Hydrological surveys of the River Trent to understand the risk of reduced inflows from the Tame and subsequently the Humber Estuary. This would inform further mitigation to be implemented.
- Further development of the delivery of Biodiversity Net Gain (BNG) to offset construction losses;
- For the effects on priority species, further survey work and monitoring is required to understand the magnitude of flow effects in the River Tame;
- For effects on WFD objectives and surface water flows and quality, further development of operating conditions for effluent transfer and further hydro-ecological and water quality assessment of effects of major change in flow regime in the Rivers Tame and Trent is required.
- Investigate potential for an energy recovery option; and
- Screening where settings of heritage assets would be affected.

Appendices

A1 Summary of Key Issues

A summary of the issues associated with the SEA topic areas that has helped inform the development of the SEA objectives and associated indicator questions is set out below.

Biodiversity, Flora and Fauna Key Issues

The key sustainability issues arising from the baseline assessment for biodiversity are :

- The need to protect or enhance the region's biodiversity, particularly protected sites designated for nature conservation.
- The need to avoid activities likely to cause irreversible damage to natural heritage.
- The need to take opportunities to improve connectivity between fragmented habitats.
- The need to control the spread of Invasive Non-Native Species (INNS).
- The need to engage more people in biodiversity issues so that they personally value biodiversity and know what they can do to help, including through recognising the value of the ecosystem services.

Soil Key Issues

The key sustainability issues arising from the baseline assessment for soil are:

- The need to protect geological features of importance and maintain and enhance soil function and health.
- The need to manage the land more holistically at the catchment level, benefitting landowners, other stakeholders, the environment and sustainability of natural resources (including water resources).
- The need to make use of previously developed land (brownfield land) and to reduce the prevalence of derelict land in the region.

Water Key Issues

The key sustainability issues arising from the baseline assessment for water are:

- The need to maintain the quantity and quality of groundwater resources taking into account WFD status targets.
- The need to improve the resilience, flexibility and sustainability of water resources in the region, particularly in light of potential climate change impacts on surface waters and groundwaters.
- The need to ensure sustainable abstraction.
- The need to ensure that people understand the value of water.
- The need to reduce and manage flood risk.

Air Key Issues

The key sustainability issue arising from the baseline assessment for air quality is:

- The need to reduce air pollutant and greenhouse emissions and limit air emissions to comply with air quality standards.

Climatic Key Issues

The key issues arising from the baseline assessment for climate are:

- The need to reduce greenhouse gas emissions (industrial processes and transport).
- The need to mitigate against climate change through the reduction in greenhouse gas emissions in order to contribute to risk reduction over the long term.
- The need to adapt to the impacts of climate change for example through, sustainable water resource management, water use efficiencies, specific aspects of natural ecosystems (e.g. connectivity), as well as accommodating potential opportunities afforded by climate change.

Landscape and Visual Amenity Key Issues

The key issue arising from the baseline assessment for landscape and visual amenity is:

- The need to protect and improve the natural beauty of the region's AONBs, National Parks and other areas of natural beauty.

Historic Environment Key Issues

The key issue arising from the baseline assessment for the historic environment is:

- The need to conserve or enhance sites of archaeological importance and cultural heritage interest, and their settings, particularly those which are sensitive to the water environment.

Population and Human Health Key Issues

The key sustainability issues arising from the baseline assessment for population and human health are:

- The need to ensure water supplies remain affordable especially for deprived or vulnerable communities
- The need to ensure public awareness of drought conditions and importance of maintaining security of supply without the need for emergency drought measures.
- The need to ensure water quantity and quality is maintained for other users including tourists, recreational users and other users such as farmers.
- The need to ensure a balance between different aspects of the built and natural environment that will help to provide opportunities local residents and tourists, including opportunities for access to recreation resources and the natural and historic environment.
- The need to accommodate an increasing population
- Sites of nature conservation importance, heritage assets, water resources, important landscapes and public rights of way contribute to recreation and tourism opportunities and subsequently health and well-being and the economy.

Material Assets Key Issues

The key sustainability issues arising from the baseline assessment for material assets are:

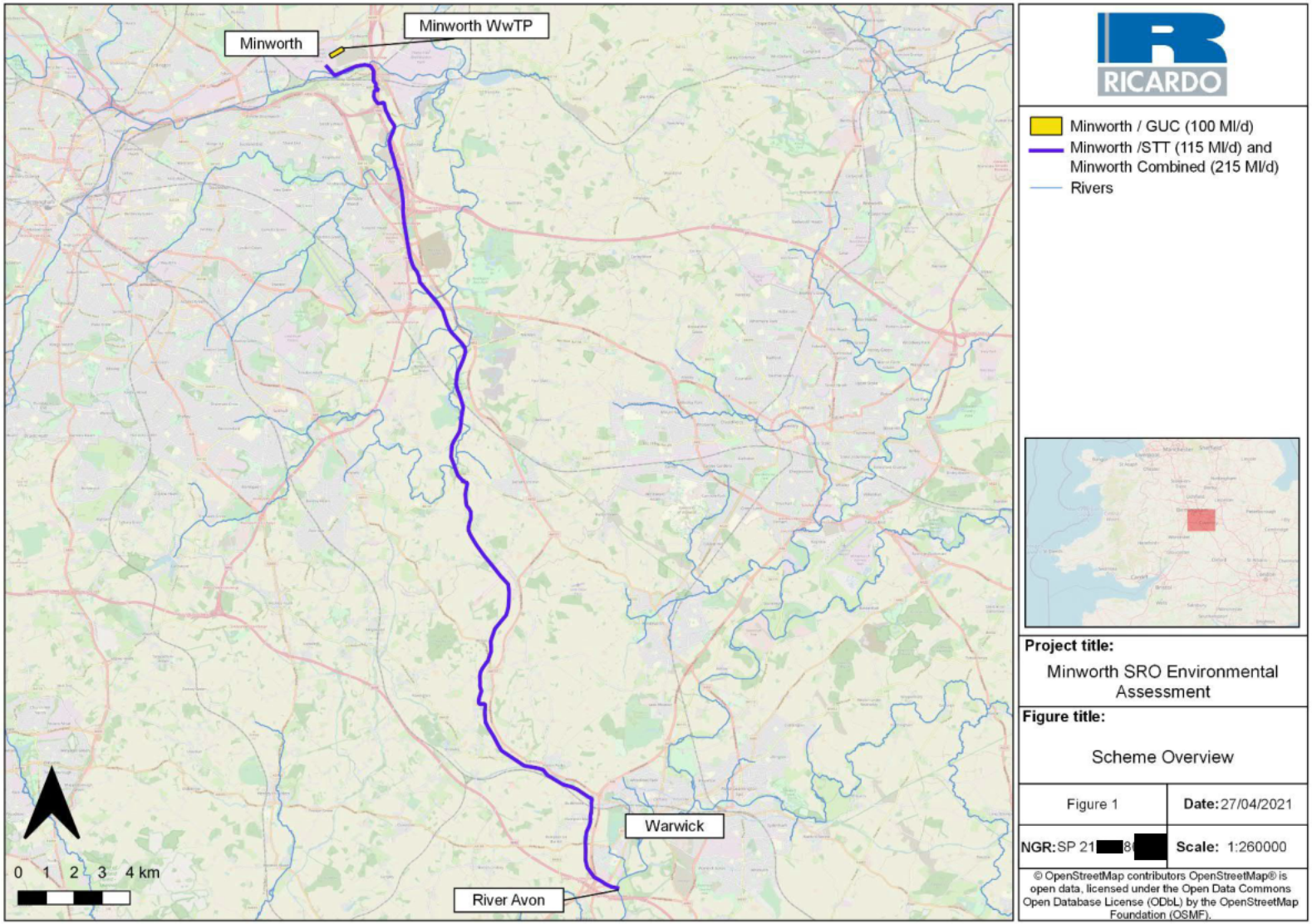
- The need to minimise the consumption of resources, including water and energy.
- Need to reduce leakage from the water supply system.
- Daily consumption of water resources is higher than the national average in the area and there is a need to encourage more efficient use.
- The need to reduce the total amount of waste produced in the region, from all sources, and to reduce the proportion of this waste sent to landfill.

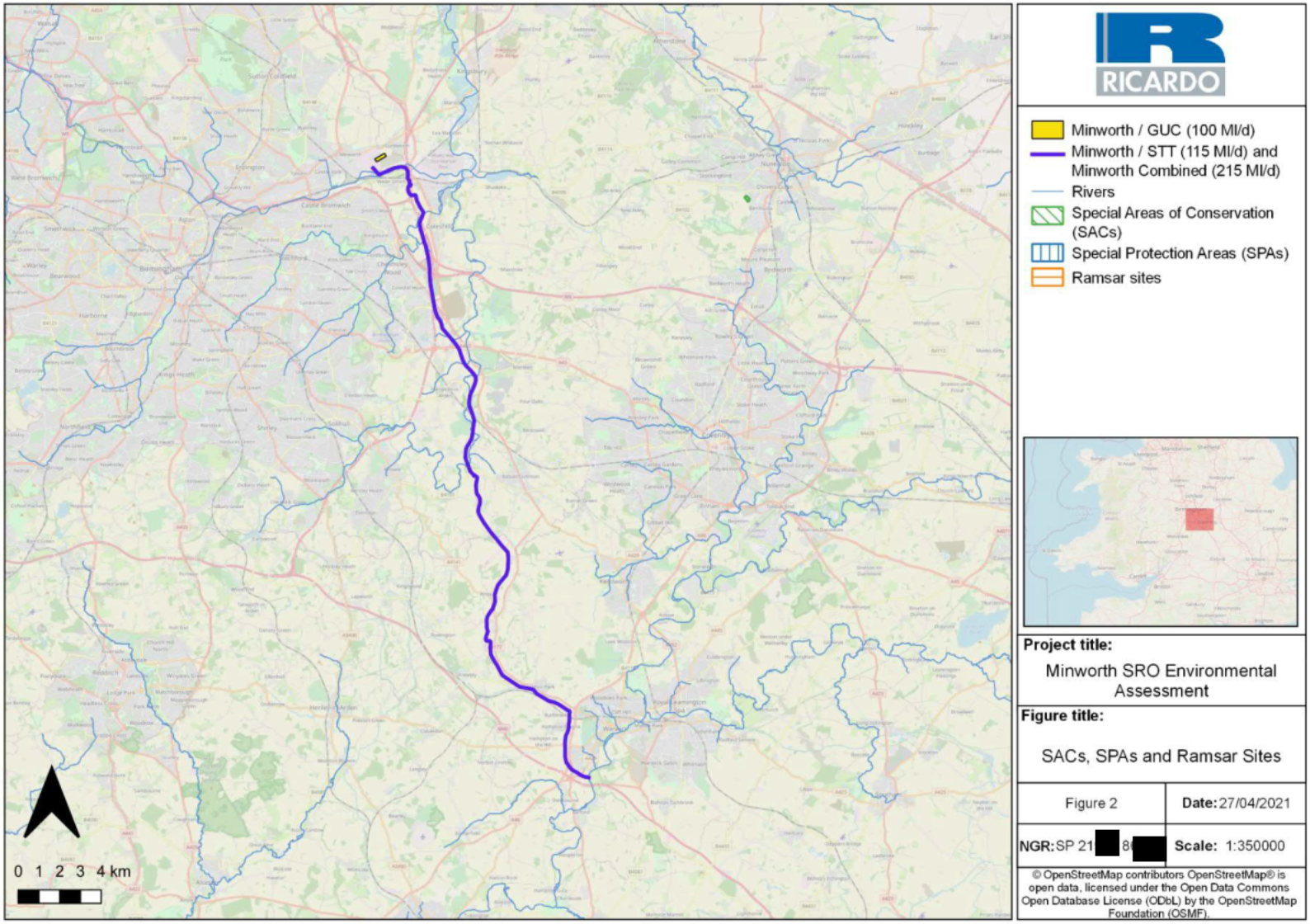
A2 List of datasets

Data Source	Publisher	Year	Date Downloaded
Air Quality Management Areas	DEFRA	2020	01/10/2020
Noise Action Planning Important Areas Round 2 England	DEFRA	2020	06/10/2020
Special Protection Areas (England)	Natural England	2020	12/10/2020
Special Areas for Conservation (England)	Natural England	2020	12/10/2020
Ramsar	Natural England	2020	12/10/2020
Sites of Special Scientific Interest (England)	Natural England	2020	12/10/2020
SSSI Impact Risk Zones (England)	Natural England	2020	06/11/2020
Special Areas of Conservation (SACs) with marine components (all UK waters)	JNCC	2020	02/11/2020
Possible Special Areas of Conservation (England)	Natural England	2020	06/11/2020
Special Protection Areas (SPAs) with marine components (all UK waters)	JNCC	2020	02/11/2020
Potential Special Protection Areas (England)	Natural England	2020	06/11/2020
Marine Conservation Zones (England)	Natural England	2020	05/05/2020
National Nature Reserves (England)	Natural England	2020	12/10/2020
Ancient Woodland (England)	Natural England	2020	12/10/2020
Local Nature Reserves (England)	Natural England	2020	12/10/2020
Priority Habitat Inventory (England)	Natural England	2020	12/10/2020
Ancient Woodland (England)	Natural England	2020	12/10/2020
Nature Improvement Areas	Natural England	2020	02/11/2020
National Priority Focus Areas	Natural England	2020	02/11/2020
OS Open Greenspace	Ordnance Survey	2020	30/10/2020
Country Parks (England)	Natural England	2020	12/10/2020
CRoW Act 2000 - Section 4 Conclusive Registered Common Land	Natural England	2020	12/10/2020
CRoW Act 2000 - Section 15 Land	Natural England	2020	12/10/2020
OS OpenMap - Roads	Ordnance Survey	2020	04/10/2020
OS OpenMap - Railways	Ordnance Survey	2020	04/10/2020
OS OpenMap Local - Buildings	Ordnance Survey	2020	04/10/2020
National Cycle Network (Public)	Sustrans	2020	02/11/2020
English indices of deprivation 2015	Ministry of Housing, Communities and Local Government	2015	02/11/2020
Agricultural Land Classification (ALC) Grades - Post 1988 Survey (polygons)	Natural England	2020	12/10/2020
Permitted Waste Sites - Authorised Landfill Site Boundaries	Environment Agency	2020	12/10/2020
Historic Landfill Sites	Environment Agency	2020	12/10/2020
LVMF protected vistas - GIS files	Greater London Authority	2018	02/11/2020
English Local Authority Green Belt Dataset	Ministry of Housing, Communities and Local Government	2019	29/09/2020
Areas of Outstanding Natural Beauty (England)	Natural England	2020	12/10/2020
National Character Areas (England)	Natural England	2020	02/11/2020
Flood Map for Planning (Rivers and Sea) - Flood Zone 2	Environment Agency	2020	12/10/2020
Flood Map for Planning (Rivers and Sea) - Flood Zone 3	Environment Agency	2020	12/10/2020
Statutory Main River Map	Environment Agency	2020	12/10/2020
OS Open Rivers	Ordnance Survey	2020	15/10/2020
Source Protection Zones	Environment Agency	2020	12/10/2020

Data Source	Publisher	Year	Date Downloaded
WFD River Canal and Surface Water Transfer Cycle 2	Environment Agency	2020	12/10/2020
WFD Groundwater Bodies Cycle 2	Environment Agency	2020	12/10/2020
Listed Buildings	Historic England	2020	12/10/2020
Registered Parks and Gardens	Historic England	2020	12/10/2020
Protected Wrecks	Historic England	2020	12/10/2020
Registered Battlefields	Historic England	2020	12/10/2020
Scheduled Monuments	Historic England	2020	12/10/2020
World Heritage Sites	Historic England	2020	12/10/2020
Built-up Areas (December 2011) Boundaries V2 - 350 metre buffer used	Office for National Statistics	2017	04/10/2020
National Trails	Natural England	2020	29/09/2020

A3 Environmental Baseline




RICARDO
Minworth / GUC (100 Ml/d)
Minworth / STT (115 Ml/d) and Minworth Combined (215 Ml/d)
Rivers
Special Areas of Conservation (SACs)
Special Protection Areas (SPAs)
Ramsar sites
0 1 2 3 4 km
Project title:
Minworth SRO Environmental Assessment
Figure title:
SACs, SPAs and Ramsar Sites
Figure 2
Date: 27/04/2021
NGR: SP 21 [redacted] 8[redacted]
Scale: 1:350000
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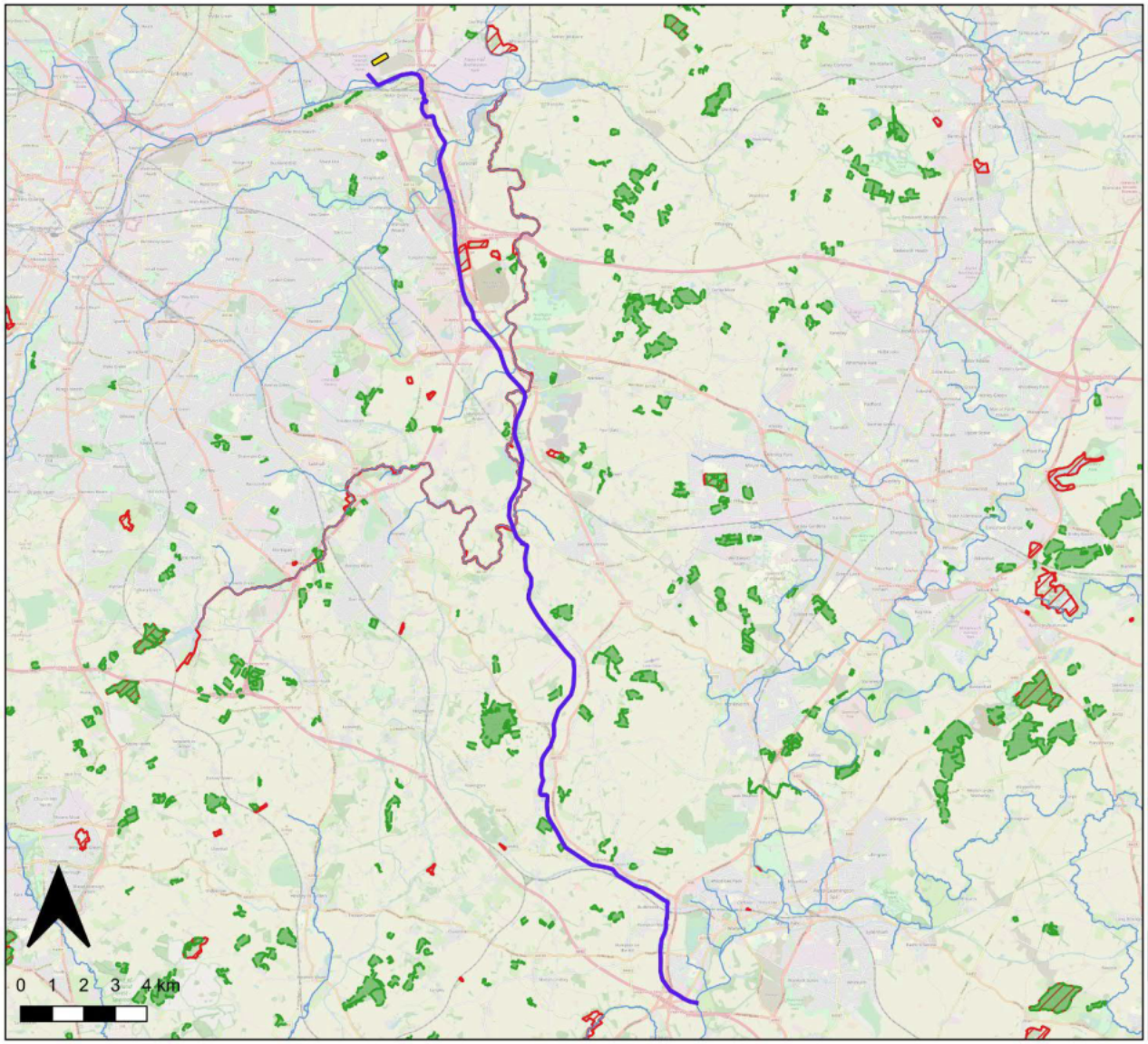


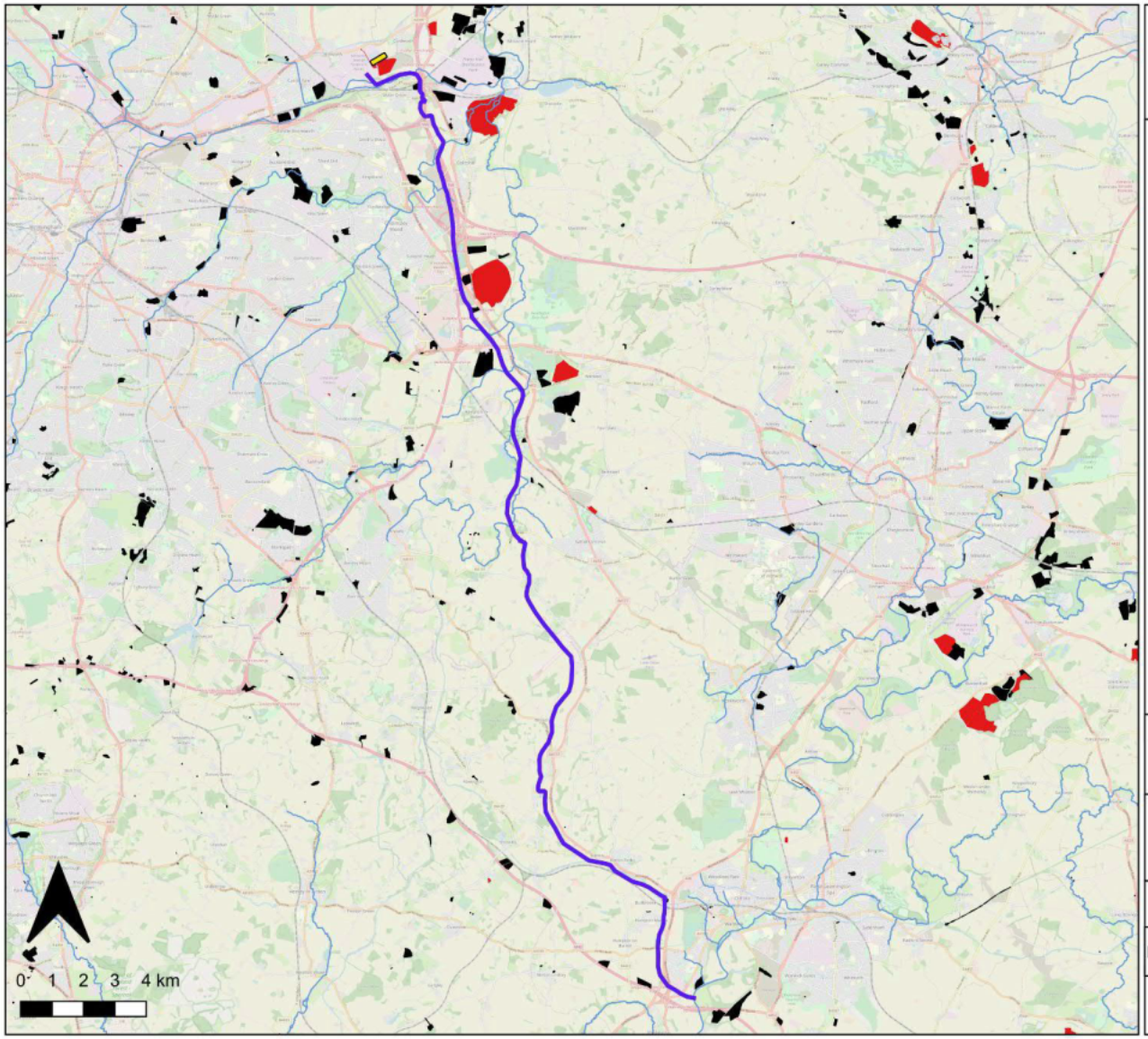
RICARDO

Minworth / GUC (100 Ml/d)
Minworth / STT (115 Ml/d) and Minworth Combined (215 Ml/d)
Rivers
Sites of Special Scientific Interest (SSSIs)
Ancient woodland

Project title:
Minworth SRO Environmental Assessment

Figure title:
SSSIs and Ancient Woodland

Figure 3	**Date:** 27/04/2021
NGR: SP 21[redacted] 80[redacted]	**Scale:** 1:260000



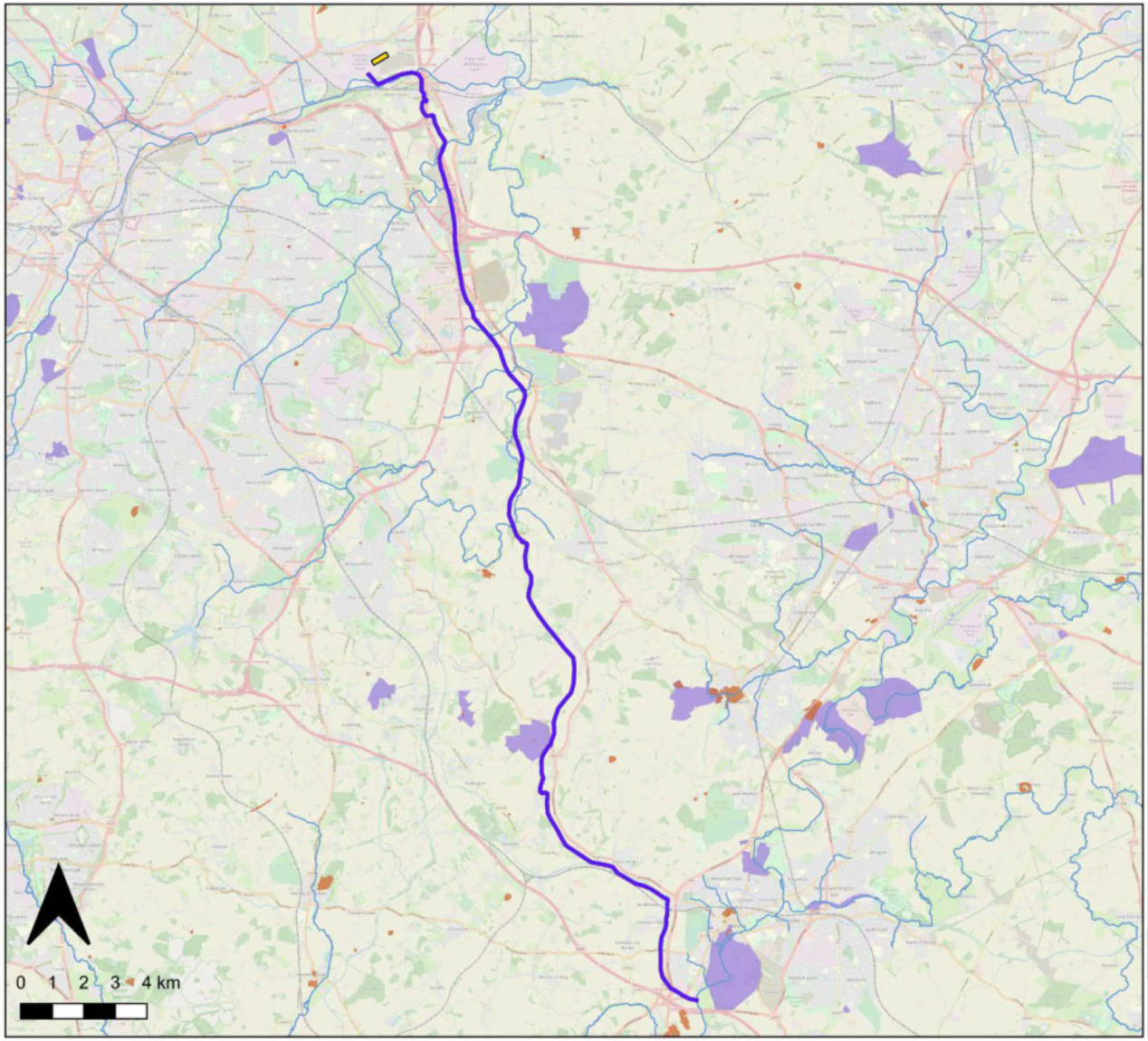
RICARDO

Minworth / GUC (100 Ml/d)
Minworth / STT (115 Ml/d) and Minworth Combined (215 Ml/d)
Rivers
Permitted Landfills
Historic Landfills

Project title:
Minworth SRO Environmental Assessment

Figure title:
Landfills

Figure 4	**Date:** 27/04/2021
NGR: SP 2[redacted] 80[redacted]	**Scale:** 1:260000



RICARDO

Minworth / GUC (100 Ml/d)
Minworth / STT (115 Ml/d) and Minworth Combined (215 Ml/d)
Rivers
Flood Zone 2
Flood Zone 3

Project title:
Minworth SRO Environmental Assessment

Figure title:
Flood zones

Figure 5	**Date:** 27/04/2021
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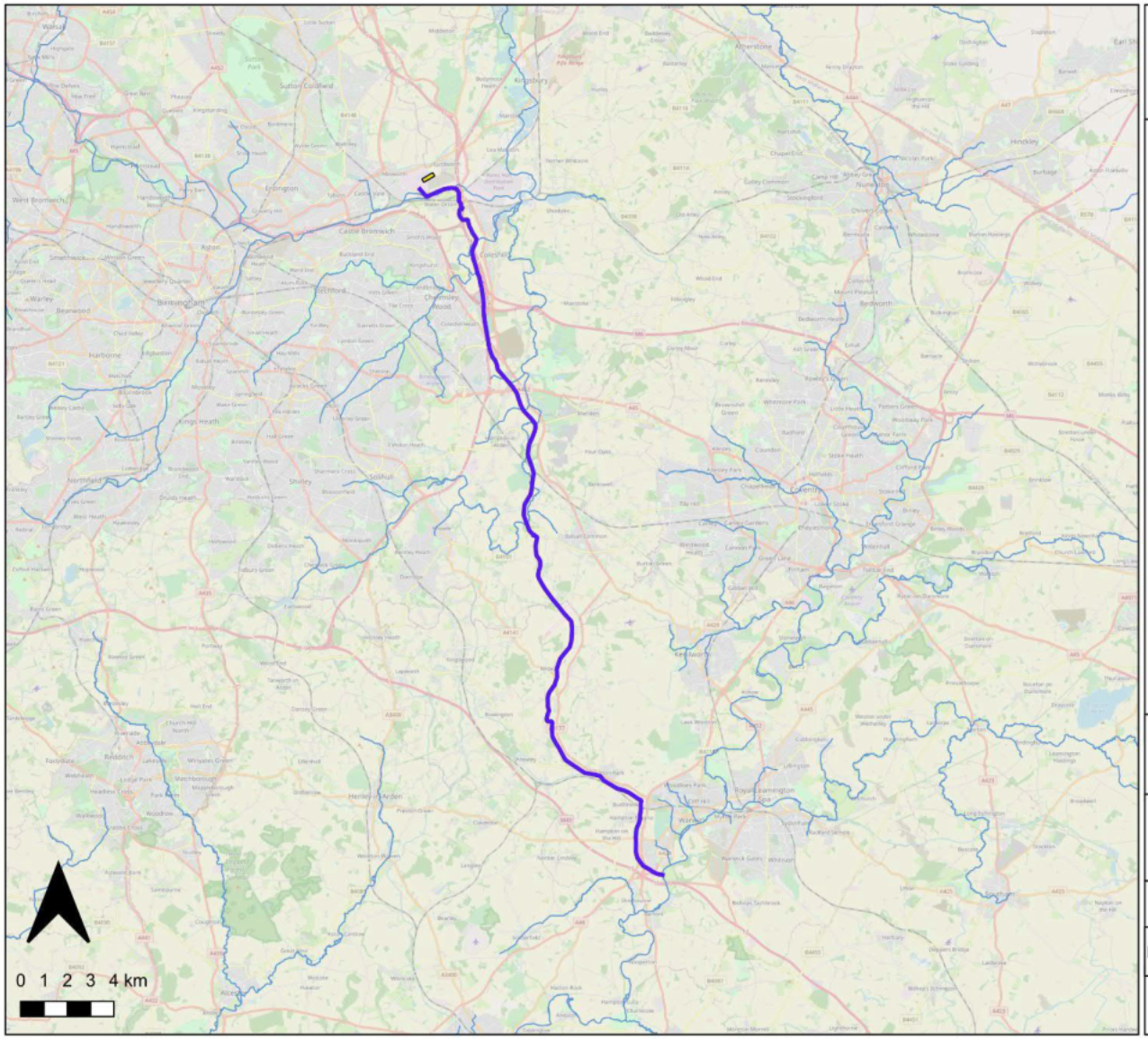


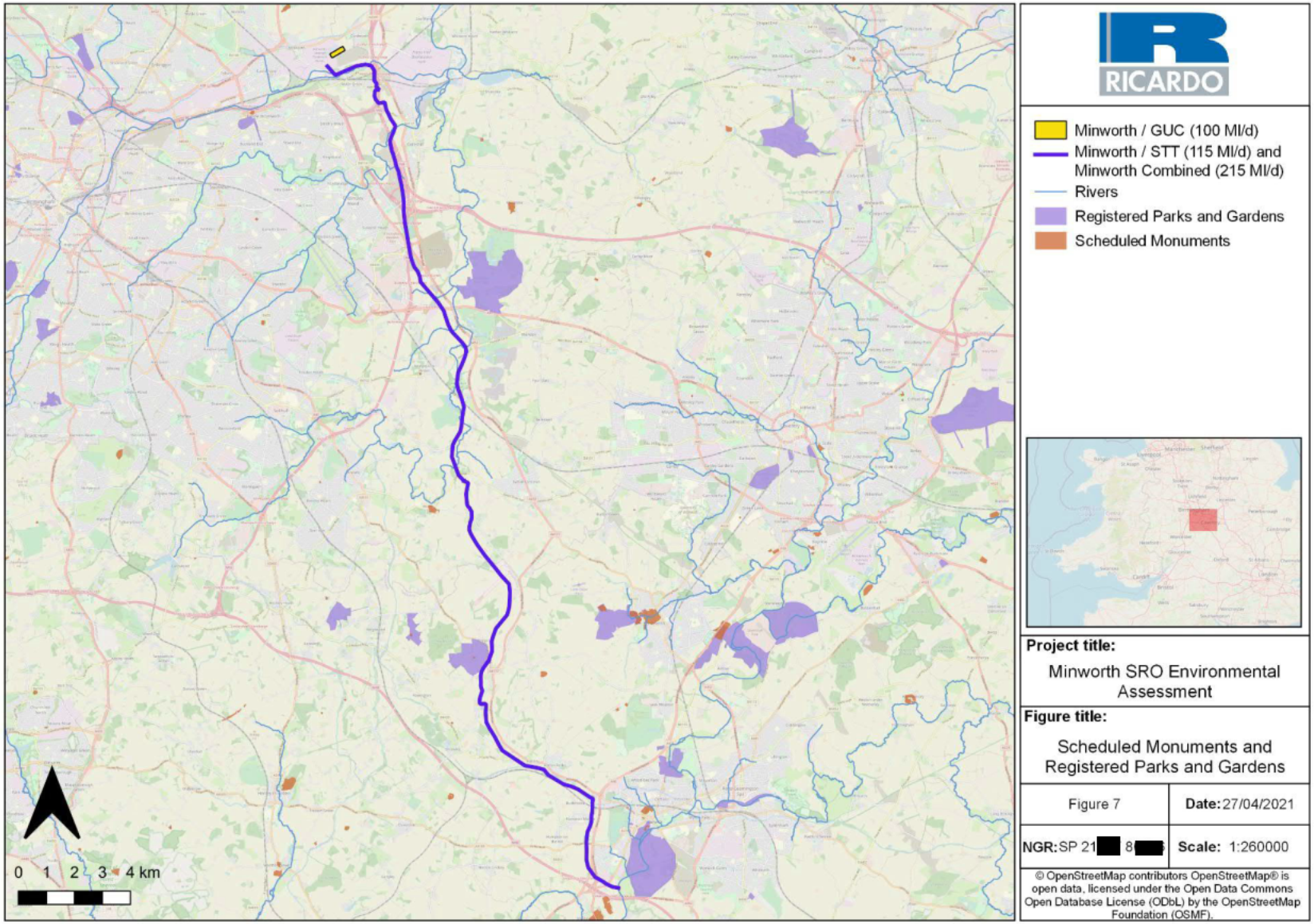
RICARDO

Minworth / GUC (100 Ml/d)
Minworth / STT (115 Ml/d) and Minworth Combined (215 Ml/d)
Rivers
Areas of Outstanding Natural Beauty (AONBs)
National Parks

Project title:
Minworth SRO Environmental Assessment

Figure title:
AONBs and National Parks

Figure 6	**Date:** 27/04/2021
NGR: SP 21[redacted]	**Scale:** 1:350000


RICARDO
Minworth / GUC (100 Ml/d)
Minworth / STT (115 Ml/d) and Minworth Combined (215 Ml/d)
Rivers
Registered Parks and Gardens
Scheduled Monuments
0 1 2 3 4 km
Project title:
Minworth SRO Environmental Assessment
Figure title:
Scheduled Monuments and Registered Parks and Gardens
Figure 7
Date: 27/04/2021
NGR: SP 21[redacted] 8[redacted]
Scale: 1:260000
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A4 SEA Output Table

Scheme Name	
Scheme Reference	
Description	

3.1 SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
Biodiversity, flora and fauna	1.1To protect designated sites and their qualifying features					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	1.2To avoid a net reduction, and where possible enhance, in non-monetised natural capital assets					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	1.3To protect and enhance biodiversity, priority habitats and species					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	1.4To avoid and, where required, manage invasive and non-native species (INNS)					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	1.5To meet WFD objectives relating to biodiversity					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
Soil	2.1To protect and enhance the functionality, quantity and quality					Construction effects:	Construction mitigation:				

3.1 SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	of soils, including the protection of high-grade agricultural land					Operation effects:	Operation mitigation:				
Water	3.1To minimise or manage flood risk, taking climate change into account					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	3.2To enhance or maintain groundwater quality and resources					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	3.3To enhance or maintain surface water quality, flows and quantity					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	3.4 To meet WFD objectives					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	3.5 To improve water efficiency through provision of access to a resilient and sustainable supply of water.					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
Air	4.1 To minimise air emissions during construction and operation					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
Climatic Factors	5.1 To introduce climate mitigation where required and improve the climate resilience of assets and natural systems					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				

3.1 SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	5.2 To minimise embodied and operational emissions					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
Landscape	6.1 To conserve, protect and enhance landscape and townscape character and visual amenity					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
Historic Environment	7.1 To conserve/protect and enhance historic assets/cultural heritage and their setting, including archaeological important sites					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
Population and Human Health	8.1 To maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	8.2 To maintain and enhance tourism and recreation					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	8.3 To secure resilient water supplies for the health and wellbeing of customers					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
	8.4 To increase access and connect customers to the natural environment, provide education or information resources for the public					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				
Material Assets	9.1 To minimise resource use and waste production					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				

3.1 SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	9.2 To avoid negative effects on built assets and infrastructure					Construction effects: Operation effects:	Construction mitigation: Operation mitigation:				

A5 SEA Scoring Criteria

SEA Objective	Effect	Description	
Biodiversity, Flora, Fauna:	+++	Major Positive	The option would result in a major enhancement on the quality of designated sites / habitats due to changes in flow or groundwater levels, water quality or habitat quality and availability. The option would result in a major increase in the population of a priority species. Effects could be caused by beneficial changes in water flows/water quality, or large amounts of creation or enhancement of habitat, promoting a major increase in ecosystem structure and function. The option would result in a major reduction or management of INNS.
	++	Moderate Positive	The option would result in a moderate enhancement on the quality of designated and/or non-designated sites / habitats due to changes in flow or groundwater levels, water quality or habitat creation and enhancement measures. The option would result in a moderate increase in the population of a priority species. Effects could be caused by beneficial changes in water flows/water quality, or moderate amounts of creation or enhancement of habitat, promoting a moderate increase in ecosystem structure and function. The option would result in a moderate reduction or management of INNS.
	+	Minor Positive	The option would result in a minor enhancement of the quality of designated and/or non-designated sites / habitats due to changes in flow or groundwater levels, water quality or habitat creation and enhancement measures. The option would result in a minor increase in the population of a priority species. Effects could be caused by beneficial changes in water flows/water quality, or small amounts of creation or enhancement of habitat, promoting a minor increase in ecosystem structure and function. The option would result in a minor reduction or management of INNS.
	0	Neutral	The option would not result in any effects on designated or non-designated sites including habitats and/or species). It will not have an effect on INNS.
	-	Minor Negative	The option would result in a minor negative effect on the quality of designated and/or non-designated sites / habitats due to changes in flow or groundwater levels, water quality or habitat loss or degradation. The option would result in a minor decrease in the population of a priority species. Effects could be caused by detrimental changes in flows/water quality, or small losses or degradation of habitat leading to a minor loss of ecosystem structure and function. The option would result in a minor increase or spread of INNS.

SEA Objective	Effect	Description	
	--	Moderate Negative	The option would result in a moderate negative effect on the quality of designated and/or non-designated sites / habitats due to changes in flow or groundwater levels, water quality or habitat loss or degradation. The option would result in a moderate decrease in the population of a priority species. Effects could be caused by detrimental changes in flows/water quality, or moderate loss or degradation of habitat leading to a moderate loss of ecosystem structure and function. The options would result in a moderate increase or spread of INNS.
	---	Major Negative	The option would result in a major negative effect on the quality of designated and/or non-designated sites / habitats due to changes in flow or groundwater levels, water quality or habitat loss or degradation. The option would result in a major decrease in the population of a priority species. Effects could be caused by detrimental changes in flows/water quality, or large losses or degradation of habitat leading to a major loss of ecosystem structure and function. The option would result in a major increase or spread of INNS.
	?	Uncertain	From the level of information available the effect that the option would have on this objective is uncertain
Soil: Protect and enhance the functionality, quantity and quality of soils	+++	Major Positive	The option would result in a major enhancement on the quality of soils through the implementation of catchment approaches, remediation or other measures.
	++	Moderate Positive	The option would result in a moderate enhancement on the quality of soils through the implementation of catchment approaches, remediation or other measures.
	+	Minor Positive	The option is located on a brownfield site and has no effect on soils or existing land use. The option results in the remediation of contaminated land.
	0	Neutral	The option would not result in any effects on soils or land use.
	-	Minor Negative	The option is not located on a brownfield site and/or results in a minor loss of best and most versatile agricultural land or is in conflict with existing land use. The option results in land contamination.
	--	Moderate Negative	The option will result in a moderate loss of best and most versatile agricultural land or is in substantial conflict with existing land use. The option is partially overlying mineral resources leading to partial mineral sterilisation.
	---	Major Negative	The option will result in a major loss of best and most versatile agricultural land or is in substantial conflict with existing land use. The option results in land contamination. The option is directly overlying mineral resources leading to mineral sterilisation.
	?	Uncertain	From the level of information available the effect that the option would have on this objective is uncertain

SEA Objective	Effect	Description	
Water: Increase resilience and reduce flood risk Protect and enhance the quality of the water environment and water resources Deliver reliable and resilient water supplies	+++	Major Positive	The option results in addressing failure of WFD Good Ecological Status / Good Ecological Potential. The option would result in a major improvement to flood risk. The option would result in a major improvement in water efficiency, reduces demand and improves resilience.
	++	Moderate Positive	The option achieves savings through demand management and does not require abstraction to achieve yield. The option contributes to addressing failure of WFD Good Ecological Status / Good Ecological Potential. The option would result in a moderate improvement to flood risk. The option would result in a moderate improvement in water efficiency, reduces demand and improves resilience.
	+	Minor Positive	The option achieves savings through demand management and does not require abstraction to achieve yield. The option would result in a minor improvement to flood risk. The option would result in a minor improvement in water efficiency, reduces demand and improves resilience.
	0	Neutral	The option would have no discernible effect on river flows or surface/coastal water quality or on groundwater quality or levels. The option would not have an effect on or be affected by flood risk.
	-	Minor Negative	The option would result in minor decreases in river flows. River and/or coastal water quality may be affected and lead to short term or intermittent effects on receptors (e.g. designated habitats, protected species or recreational users of rivers and the coastline) that could not be avoided but could be mitigated. The option would result in minor decreases in groundwater quality or levels. The option is located in Flood Zone 2. The option would result in minor decreases in water efficiency, increases demand and reduces resilience.
	--	Moderate Negative	The option would result in moderate decreases in river flows. River and/or coastal water quality may be affected and lead to long term or continuous effects on receptors (e.g. designated habitats, protected species or recreational users of rivers and the coastline) that could not reasonably be mitigated. The option results in the likely deterioration of WFD classification. The option would result in moderate decreases in groundwater quality or levels. The option is located in Flood Zone 3. The option would result in moderate decreases in water efficiency, increases demand and reduces resilience.
	---	Major Negative	The option would result in major decreases in river flows. River and/or coastal water quality may be affected and lead to long term or continuous effects on receptors (e.g. designated habitats, protected species or recreational users of rivers and the coastline) that could not reasonably be mitigated. The option results in the deterioration of WFD classification. The option would result in major decreases in groundwater quality or levels. The option is located in Flood Zone 2 or 3 and further contributes to flood risk. The option would result in major decreases in water efficiency, increases demand and reduces resilience.
	?	Uncertain	From the level of information available the effect that the option would have on this objective is uncertain.

SEA Objective	Effect	Description	
Air: Reduce and minimise air emissions	+++	Major Positive	The option would result in a major enhancement of the air quality within one or more AQMAs.
	++	Moderate Positive	The option would result in a moderate enhancement of the air quality within one or more AQMAs.
	+	Minor Positive	The option would result in an enhancement of the air quality.
	0	Neutral	The option would not result in any effects on Air Quality and AQMAs.
	-	Minor Negative	The option would result in a decrease of the air quality.
	--	Moderate Negative	The option would result in a decrease of the air quality within one or more AQMAs.
	---	Major Negative	The option would result in a major decrease in the air quality within one or more AQMAs.
	?	Uncertain	From the level of information available the effect that the option would have on this objective is uncertain.
Climate Factors: Reduce embodied and operational carbon emissions Reduce vulnerability to climate change risks and hazards	+++	Major Positive	The option will generate significant additional zero carbon energy that can be fed back into the grid/reduce carbon emissions (see carbon scale) The option will result in a major increase in carbon sequestration. The option will increase resilience/decrease vulnerability to climate change effects.
	++	Moderate Positive	The option will increase resilience/decrease vulnerability to climate change effects. The option will result in a moderate increase in carbon sequestration. The option will generate moderate additional zero carbon energy that can be fed back into the grid/reduce carbon emissions (see carbon scale)
	+	Minor Positive	The option will increase resilience/decrease vulnerability to climate change effects. The option will result in a minor increase in carbon sequestration. The option will generate minor additional zero carbon energy that can be fed back into the grid/reduce carbon emissions (see carbon scale)
	0	Neutral	The option would have no discernible effect on greenhouse gas emissions, nor would the option increase resilience/decrease vulnerability to climate change effects.
	-	Minor Negative	The option will have a minor impact on resilience/decrease vulnerability to climate change effects. The option will generate minor construction carbon emissions (1 - 6,964,452 tCO2e) and/or operational carbon emissions (1 - 3,492 tCO2e).

SEA Objective	Effect	Description	
	--	Moderate Negative	The option will have a moderate impact on resilience/significantly decrease vulnerability to climate change effects. The option will generate moderate construction carbon emissions (6,964,453 - 20,000,000 tCO2e) and/or operational carbon emissions (3,493 - 10,000 tCO2e). The option will result in a moderate release of previously sequestered carbon.
	---	Major Negative	The option will have a major impact on resilience/significantly decrease vulnerability to climate change effects. The option will generate significant construction carbon emissions (Above 20,000,000 tCO2e) and/or operational carbon emissions (Above 10,000 tCO2e). The option will result in a major release of previously sequestered carbon.
	?	Uncertain	From the level of information available the effect that the option would have on this objective is uncertain.
Landscape: Conserve, protect and enhance landscape, townscape and seascape character and visual amenity	+++	Major Positive	The option would have a major positive contribution to designated landscape (AONB or National Park) management plan objectives The option results in new, above ground infrastructure that significantly enhances the local landscape, townscape or seascape.
	++	Moderate Positive	The option would have a moderate positive contribution to designated landscape management plan objectives The option results in new, above ground infrastructure that has a moderate positive effect on the local landscape, townscape or seascape.
	+	Minor Positive	The option results in new, above ground infrastructure that has a minor positive effect on the local landscape, townscape or seascape.
	0	Neutral	The option would not result in any effects on the local landscape, townscape or seascape.
	-	Minor Negative	The option results in new, above ground infrastructure that has a minor negative effect on the local landscape, townscape or seascape.
	--	Moderate Negative	The option would have a moderate negative effect on a designated landscape or feature (i.e. significant visually intrusive infrastructure) whose effects could not be reasonably mitigated. The option results in new, above ground infrastructure that has a moderate negative effect on the local landscape, townscape or seascape.
	---	Major Negative	The option would have a negative effect on a designated landscape or feature (i.e. significant visually intrusive infrastructure) whose effects could not be reasonably mitigated. The option results in new, above ground infrastructure that has a major negative effect on the local landscape, townscape or seascape.
	?	Uncertain	From the level of information available the effect that the option would have on this objective is uncertain.
Historic Environment Conserve, protect and enhance the historic environment, including archaeology	+++	Major Positive	The option will result in enhancements to designated heritage assets and/or their setting, fully realising the significance and value of the asset, such as: - Securing repairs or improvements to heritage assets, especially those identified in the Historic England Buildings/Monuments at Risk Register; - Improving interpretation and public access to important heritage assets.

SEA Objective	Effect	Description	
	++	Moderate Positive	The option will result in enhancements to designated heritage assets and/or their setting. Improving interpretation and public access to important heritage assets.
	+	Minor Positive	The option will result in enhancements to non-designated heritage assets and/or their setting.
	0	Neutral	The option will have no effect on cultural heritage assets or archaeology.
	-	Minor Negative	The option will result in the loss of significance of undesignated heritage assets and/or their setting, notwithstanding remedial recording of any elements affected. There will be limited damage to known, undesignated archaeology important sites with a consequent loss of significance only partly mitigated by archaeological investigation.
	--	Moderate Negative	The option will result in the loss of significance of undesignated heritage assets and/or their setting, notwithstanding remedial recording of any elements affected. The option will diminish of significance of designated heritage assets and/or their setting, notwithstanding remedial recording of any elements affected.
	---	Major Negative	The option will diminish the significance of designated heritage assets and/or their setting such as: - Demolition or further deterioration in the condition of designated heritage assets especially those identified in the Historic England Buildings/Monuments at Risk Register. - Loss of public access to important heritage assets and lack of appropriate interpretation. - There will be major damage to known, designated archaeology important sites with a consequent loss of significance only partly mitigated by archaeological investigation.
	?	Uncertain	From the level of information available the effect that the option would have on this objective is uncertain.
Population, Human Health Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing Maintain and enhance tourism and recreation	+++	Major Positive	The option leads to major positive effect on the health of local communities and will ensure that surface water and bathing water quality is maintained within statutory limits. The option creates new, and significantly enhances existing, recreational facilities, publicly accessible greenspace and/or tourism within the operational area.
	++	Moderate Positive	The option leads to positive effect on the health of local communities and will ensure that surface water and bathing water quality is maintained within statutory limits. The option enhances existing, recreational facilities, publicly accessible greenspace and/or tourism within the operational area
	+	Minor Positive	The option has a temporary positive effect on the health of local communities and will ensure that surface water and bathing water quality is maintained within statutory limits.
	0	Neutral	The option would not result in any effects on human health and existing recreational facilities and/or tourism.

SEA Objective	Effect	Description	
	-	Minor Negative	The option has a temporary effect on human health (e.g. noise or air quality). The option reduces the availability and quality of existing recreational facilities and/or tourism within the operational area.
	--	Moderate Negative	The option results in the permanent removal of existing recreational facilities, publicly accessible greenspace and/or tourism within the operational area.
	---	Major Negative	The option has a significant long-term effect on human health (e.g. noise or air quality). The option results in the removal of existing recreational facilities, publicly accessible greenspace and/or tourism within the operational area.
	?	Uncertain	From the level of information available the effect that the option would have on this objective is uncertain.
Material Assets Minimise resource use and waste production Avoid negative effects on built assets and infrastructure	+++	Major Positive	The option will re-use or recycle substantial quantities of waste materials and any new infrastructure will incorporate substantial sustainable design measures and materials. There will be no increase in energy consumption or energy will be from 100% renewable sources. The option improves national cycle routes or national trails.
	++	Moderate Positive	The option will re-use or recycle moderate quantities of waste materials and any new infrastructure will incorporate some sustainable design measures and materials. There will be no increase in energy consumption or energy will be from 90% renewable sources. The option improves national cycle routes or national trails.
	+	Minor Positive	The option will re-use or recycle a limited quantity of waste materials and any new infrastructure will incorporate some limited sustainable design measures and materials. There will be no increase in energy consumption or energy will be from 80% renewable sources. The option improves national cycle routes or national trails.
	0	Neutral	The option would not result in any effects on material assets.
	-	Minor Negative	The option will require new infrastructure with only limited opportunities for the re-use or recycling of waste materials. There are limited opportunities for sustainable design or the use of sustainable materials. The option results in a minor increase in energy consumption with no renewable energy options. The option results in a minor disruption on built assets and infrastructure, including transport.
	--	Moderate Negative	The option will require new infrastructure with only limited opportunities for the re-use or recycling of waste materials. The option results in a moderate increase in energy consumption with no renewable energy options. The option results in a moderate disruption on built assets and infrastructure, including transport links.
	---	Major Negative	The option will require significant new infrastructure that cannot be provided through the re-use or recycling of waste materials. There are no opportunities for sustainable design or the use of sustainable materials. The option results in a major increase in energy consumption with no renewable energy options. The option results in a major distribution on built assets and infrastructure, including transport links.
	?	Uncertain	From the level of information available the effect that the option would have on this objective is uncertain.

A6 Assessments

Element Name	Minworth / STT (115 Ml/d)
Element Reference	Minworth_STT_115)
Description	115 Ml/d - Minworth WwTW treated wastewater inter-catchment transfer. This has the capacity to release 115Ml/d into the STT scheme. Piped diversion of 115 Ml/d of final treated wastewater from Minworth WwTW to an outfall at the River Avon downstream of Warwick (no discharge to the River Avon). A total of up to 115 Ml/d of treated wastewater not being discharged into the River Tame, a tributary of the River Trent. Components comprise: • Flow diversion chamber at Minworth WwTW • Tertiary Treatment Plant • Final wastewater high lift pump station • Rising main – [redacted] • Outfall to River Avon downstream of Warwick (no discharge to the River Avon)

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
Biodiversity, flora and fauna	1.1To protect designated sites and their qualifying features	*0*	---	+	-	**Construction effects:** The area for construction includes development within the existing WwTW operational boundary including a new tertiary treatment plant and flow diversion chamber as well as pump station, pipeline and associated construction compounds. An HRA screening has been undertaken. This found that no Likely Significant Effects (LSE) are anticipated on the Severn Estuary SAC and Ramsar site or the Humber Estuary SAC, SPA and Ramsar site due to the distance between the proposed construction works and the designated sites. There would be no impact on the River Mease SAC. The scheme crosses through two SSSIs - Coleshill and Bannerly Pools and River Blythe and is approximately 500m from Berkswell Marsh SSSI. There is a local nature reserve adjacent to the pipeline route at Coleshill. There are areas of ancient woodland within 1km of the pipeline route including one area south of Ballsall Common where the route runs along the edge of the ancient woodland. Due to the crossing of two SSSIs and proximity of other designated sites major adverse effects are anticipated. **Operational effects:** No LSE is anticipated on the River Mease SAC (a tributary of the River Tame) as the qualifying features are not depended on flows in the River Tame. No LSE are anticipated on the Humber Estuary SAC, SPA and Ramsar site as the hydrological impacts downstream of the River Tame confluence with the River Trent is considered minor and the European site is ~150 miles downstream of the Minworth WwTW. The Reaches of the River Tame are not considered to provide off-site functional habitat for the qualifying features of the Humber Europeans site. Habitat enhancement to be realised when reinstating land as well as biodiversity net gain opportunities resulting in minor positive effect.	**Construction mitigation:** The route should be realigned to avoid the SSSIs. Discussions with NE regarding SSSI and ancient woodland protection measures. The detail of the working areas (and in some cases construction areas and pipeline itself) will be reviewed with NE as part of the further detailed design of the scheme. A Phase 1 habitat survey of the River Blythe SSSI, Coleshill and Bannerly SSSI and Cole End LNR should be completed to understand the impacts that nearby works could have on these designated sites. Use of trenchless technology, where possible. If the section through the River Blythe SSSI is proposed to be achieved via tunnelling, then further hydrological assessment would be required to establish whether the tunnelling would have an impact on the hydrology of the SSSI. The need to avoid works during certain times of the year will be identified through the completion of the additional environmental investigations. Further investigation for potential effects on fish habitat in the River Tame. **Operation mitigation:** Further survey work and monitoring is required to understand the magnitude of flow effects in the River Tame.	*0*	-	+	*0*
	1.2To avoid a net reduction, and where possible enhance, in non-monetised natural capital assets	*0*	-	*0*	-	**Construction Effects:** Construction will lead to loss or degradation of enclosed farmland natural capital stock, with potential associated disbenefits to biodiversity, carbon regulation and water purification services. Potential short term impacts to recreation and wellbeing if construction causes loss of access to recreation sites within the zone of influence. The Draft Natural Capital Assessment found a medium risk and therefore a minor negative effect is anticipated during construction. **Operational effects:** The Draft Natural Capital Assessment found a medium risk and therefore a minor negative effect is anticipated during operation.	**Construction mitigation:** No further mitigation proposed. **Operation mitigation:** Delivery of required Biodiversity Net Gain (BNG) to offset construction losses (woodland and traditional orchard creation) will result in benefits to natural capital stocks and ecosystem service provision, including biodiversity, carbon regulation, natural hazard regulation and water purification. Potential benefits to recreation are dependent on design of BNG mitigation.	*0*	-	+	-

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	1 3To protect and enhance biodiversity, priority habitats and species	*0*	-	*0*	-	**Construction effects:** The pipeline passes through a number of priority areas Priority species within the construction zone may be subjected to short term, temporary impacts of a minor magnitude. Best practice construction techniques are assumed. Minor impact pathways to priority species include increases in noise and vibration disturbance, and temporary fragmentation of habitat. It is unlikely that construction will affect priority species such as birds through noise disruption due to distance and proximity from site. In consideration of these impacts the effects on this objective are considered minor negative. **Operational effects:** Loss of terrestrial Priority Habitat would have occurred during construction. Maintenance activities to avoid Priority Habitat areas. Several priority species of fish have been recorded downstream of the Minworth WwTW in the River Tame Hydrological assessment of effects of discharge reduction from Minworth WwTW on the downstream River Tame would have a minor effect on flows and impacts on the priority species are considered negligible	**Construction mitigation:** Tunnelling for all sections of route which goes through priority habitat The detail of the working areas (and in some cases construction areas and pipeline itself) will be reviewed with NE as part of the further detailed design of the scheme. If site specific ecological assessments identify any impacts to protected species or habitats associated with the construction work, appropriate mitigation measures including (where appropriate) relocation of such species will be undertaken in advance of the works being undertaken. **Operation mitigation:** Further survey work and monitoring is required to understand the magnitude of flow effects in the River Tame	*0*	*0*	*0*	-
	1.4To avoid and, where required, manage invasive and non-native species (INNS)	*0*	*0*	*0*		**Construction effects:** Whilst there is a potential risk of spreading INNS during construction. Mitigation measures including best practice construction practices, the identification and removal of invasive species on site in advance of construction and pipeline commissioning with treated water In consideration of these mitigation measures the impacts of these risks are considered neutral **Operational effects:** Wastewater entering the WwTW will be from sanitary sewers comprised of municipal wastewater. INNS entering Minworth WwTW would have the potential to be moved via the pipeline into the Avon catchment. The potential of this occurring, however, is considered minor due to the primary and potentially secondary treatment process In operation there would be an additional 115Ml/d transfer to the River Thames at times when transfer is required below the Hands off Flow conditions on the River Severn. The reduction in flows in the River Tame could potentially be beneficial with regards to the distribution of INNS with decreased volumes of water resulting in a decreased risk in the distribution of INNS that spread via seeds and propagules. However, this effect is uncertain and overall has been assessed as neutral	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** Any transfer of such species (unlikely though that is) would be much more noticeable and rapid in a downstream direction so precautionary monitoring for such species immediately downstream of the discharge would act as an early warning and give sufficient time for appropriate treatment.	*0*	*0*	*0*	*0*
	1 5To meet WFD objectives relating to biodiversity	*0*	-	*0*	-	**Construction effects:** There will be five watercourse and two canal crossings during pipeline construction. Construction impacts, including intake, pipeline and outfall headworks construction are assessed as a minor negative effect. **Operational effects:** Hydrological assessment of effects of discharge reduction from Minworth WwTW on the downstream River Tame have been identified as a minor negative flow effect with negligible risk to WFD deterioration. Further monitoring of the potential magnitude of flow changes in the River Tame is required.	**Construction mitigation:** Tunnelling for all water courses where needed in addition to those specified. With further consideration of watercourses to cross without in-channel works, construction impacts would be neutral for WFD compliance. **Operation mitigation:** Further investigation on the extent of changes in wetted habitat	*0*	*0*	*0*	-
Soil	2.1To protect and enhance the functionality, quantity and quality of soils, including the protection of high-grade agricultural land	*0*	-	*0*	*0*	**Construction effects:** Most of the pipeline route is within grade 3 agricultural land and a small area is within grade 2 The pipeline route runs along the edge of permitted and historic landfills and is within 1km of a number of other landfilled areas. Although the route does not encroach directly onto any landfill areas there is potential for contamination pathways during construction. No imports of materials are envisaged at this time as excavated material will be used for backfill Excavated material on the WwTW site is to remain on site if possible. Overall, the construction impacts are considered minor negative. **Operational effects:** The operation of the scheme will not affect land use, soils, or geology	**Construction mitigation:** Limiting the extent of pipeline construction will minimise the time period for soil disturbance. Review the pipeline route to maximise distance from landfilled areas. Ground investigations to be undertaken prior to commencement of works to identify necessary mitigation measures. **Operation mitigation:** No further mitigation proposed	*0*	-	*0*	*0*
Water	3.1To minimise or manage flood risk, taking climate	*0*	-	*0*	*0*	**Construction effects:** The scheme is within a number of areas of flood zone 2 and 3. It crosses a number of main rivers. Use of trenchless techniques to cross the watercourses.	**Construction mitigation:** Further mitigation measures will be set out in the applications for Flood Defence Consents where these are required for the river crossing construction works.	*0*	-	*0*	*0*

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	change into account					Construction compounds would be sited sensitively and away from flood risk zones. Adequate methods of construction will be adopted to minimise the impact, including sheet piling, dewatering and treatment of the groundwater prior to discharge. Flood compensation ponds will be constructed as part of the enabling works. Earthworks sequencing will include cofferdam formation to avoid flooding of borrow areas during construction. Given the scope of the construction works a minor negative effect on flood risk has been identified. **Operational effects:** The scheme would not affect flood storage once operational and the necessary flood plain compensation are complete	**Operation mitigation:** No further mitigation proposed				
	3.2To enhance or maintain groundwater quality and resources	*0*	-	*0*	*0*	**Construction effects:** The scheme is within a source protection zone to the north west of Hatton Park It is within a WFD groundwater body. During construction of the pipeline, areas with high permeability and high groundwater levels would require permits to be obtained by the contractor from the relevant authorities for the disposal of the groundwater to a suitable location There would also be a need for lagoons to intercept and treat the commissioning wastewater The lagoons would need to be available prior to pressure testing and land would be reinstated after commissioning. All vehicles and any chemical/oil storage will be fully bunded to prevent any accidental pollution of groundwater. Overall a minor negative effect on groundwater is considered. **Operational effects:** The scheme would not affect groundwater quality and resources once operational	**Construction mitigation:** Further mitigation measures will be developed in consultation with the regulators as part of the detailed design process **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
	3.3To enhance or maintain surface water quality, flows and quantity	*0*	-	*0*	*0*	**Construction effects:** A number of rivers (including six main rivers) would be crossed by the scheme and a risk to water quality therefore exists Construction of discharge and abstraction points and pipeline river crossings have the potential to effect water quality in the river and downstream. Five watercourses and two canals would be crossed via tunnelling. Best practice construction methods will also be adopted. Given the scale of the construction activities required and that some water courses may not be tunnelled, minor negative effects are anticipated **Operational effects:** From a water quality perspective, the potential minor reduction in flows in the River Tame (Rea - Blythe) due to wastewater discharge diversion, may improve quality and is considered unlikely to impact WFD status directly.	**Construction mitigation:** Further mitigation measures will be set out in the applications for Flood Defence Consents where these are required for the river crossing construction works Tunnelling for all watercourse crossings **Operation mitigation:** No further mitigation proposed	*0*	-	*0*	*0*
	3.4 To meet WFD objectives	*0*	-	*0*	*0*	**Construction effects:** Option construction impacts, including pipeline and outfall headworks construction are assessed as minor negative effect prior to mitigation. **Operational effects:** The tests of constraint of the option against WFD regulations objectives identify compliance with physico-chemical water quality, aquatic ecology and chemical status targets in the River Tame (Rea Blythe) (GB104028046841) river water body from option operation. As well as the tests of WFD constraint, other WFD objectives relate to whether the option assists the meeting of WFD objectives for the water body, for associated WFD protected areas or reduces the treatment needed to produce drinking water and look to work in partnership with others. The option is considered neutral for these during construction and operation	**Construction mitigation:** With further consideration of watercourses to cross without in-channel works, construction impacts would be neutral for WFD compliance. **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
	3.5 To improve water efficiency through provision of access to a resilient and sustainable supply of water	*0*	*0*	+++	*0*	**Construction effects:** Construction effects are assessed as neutral. **Operational effects:** During operation there would be a major positive effect due to the option contributing to a resilient water supply Whilst this option will provide additional water resource (115 Ml/d) and it will provide essential water supply infrastructure to help support a sustainable socio-economy.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	+++	*0*
Air	4.1 To minimise air emissions during construction and operation	*0*		*0*	*0*	**Construction effects:** The duration of construction would be 60 months There would be approximately 2,500 HGV movements, which will result in vehicle emissions to air. The scheme passes through a number of urban areas and part of the route near Minworth is within the Birmingham AQMA. Therefore there is potential for moderate negative effects on air emissions from construction activities.	**Construction mitigation:** Consider use of rail for transporting materials Approved traffic routes for construction traffic will be applied in order to minimise impacts on local roads	*0*		*0*	*0*

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
						Operational effects: During operation there would be approximately 76 vehicle movements per year Given the scale of the activities required, neutral effects are anticipated.	**Operation mitigation:** No further mitigation proposed				
Climatic Factors	5.1 To introduce climate mitigation where required and improve the climate resilience of assets and natural systems	*0*	*0*	+++	*0*	**Construction effects:** Construction effects are assessed as neutral **Operational effects:** This option provides additional water resource and will during operation assist the reliable transfer of water, therefore reducing the vulnerability to drought risks associated with climate change and improving resilience to the likely effects of climate change Major positive effects are anticipated	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	+++	*0*
	5.2 To minimise embodied and operational emissions	*0*		*0*		**Construction effects:** Construction carbon would be 29,527 tCO2e over 60 months Overall, during construction this option is considered to have a minor negative environmental effect on this objective. **Operational effects:** Operational carbon would be 15,391 tCO2e / y Annual power consumption at full utilisation 16,540,340 kWh Overall, during operation this option is considered to have a major negative environmental effect on this objective	**Construction mitigation:** Investigate use of renewables during construction and operation for energy supply and use of materials with lower embodied carbon. Carbon footprint study could help identify areas for carbon savings or alternative materials. **Operation mitigation:** Potential for an energy recovery option although this would require investigation	*0*		*0*	
Landscape	6.1 To conserve, protect and enhance landscape and townscape character and visual amenity	*0*	-	*0*	*0*	**Construction effects:** The majority of the pipeline is within the greenbelt (Birmingham, North Warwickshire, Solihull and Warwick). The upgrade works to the WwTW site will be contained with the operational land of the WwTW. The construction works will be temporary and the potential for adverse effects on the greenbelt during construction has been assessed as minor **Operational effects:** Landscape planting will be adopted to screen new infrastructure. In the short to medium term, fields would return to their original condition Overall, the operational impacts are considered neutral	**Construction mitigation:** Consider minimising the extent of construction works within the greenbelt Use of trenchless techniques for pipeline construction. **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
Historic Environment	7.1 To conserve/protect and enhance historic assets/cultural heritage and their setting, including archaeological important sites	*0*	--	*0*	-	**Construction effects:** The scheme is approximately 250m from a scheduled Monument, Coleshill Bridge There are others within 1km including Cursus, enclosures and other cropmarks 900m NNW of Barford Church There are three registered parks and gardens within 500m of the pipeline route - Warwick Castle, Wroxall Abbey and Packington Hall. There are also others within 3km with potential to affect views. The pipeline route runs in close proximity to a large number of listed buildings, a number of which are immediately adjacent to the route It is therefore considered that there exists potential moderate negative effects on a number of heritage assets **Operational effects:** There are a number of heritage assets within 3km of the permanent works that would be visible following construction. Therefore minor adverse effects may arise due to potential impacts on the settings of heritage assets	**Construction mitigation:** The alignment of the pipeline should be developed further during design development and further consultation with Historic England should be undertaken during this process. This should include refining mitigation measures in particular in relation to the scheduled monuments, listed buildings and conservation areas within proximity of the pipeline route. Sensitive location of construction compounds to avoid heritage assets and retain a buffer around them to be defined further in consultation with Historic England. The development of an archaeological programme of works including archaeological monitoring is proposed **Operation mitigation:** Screening where settings of heritage assets would be affected	*0*	-	*0*	*0*
Population and Human Health	8.1 To maintain and enhance the health and wellbeing of the local community, including	++	--	+++	*0*	**Construction effects:** The construction of this option would represent significant capital investment which is expected to generate a number of employment opportunities and supply chain benefits. The degree of this benefit will be dependent on the contractors recruitment and supply chain practices and will be temporary. Overall, the benefits are expected to be moderate The duration of construction would be 60 months. There are sensitive buildings such as schools and places of worship within 500m of the pipeline route.	**Construction mitigation:** Tunnelling for all rail and A road crossings Construction compounds to be sited sensitively and away from residential areas. Construction compounds along the pipeline next to a main road, so that there is least disturbance to local traffic.	++	-	+++	*0*

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	economic and social wellbeing					The pipeline route is within five Noise Action Important Areas and adjacent to a number of others. There will be adverse effects such as noise, dust and vibrations during construction associated with construction activities and vehicles which could cause impacts on health and wellbeing at nearby sensitive receptors such as residential properties. The scheme is within 1km of areas of income and health deprivation. The upgrade at the WwTW will be within the site boundary and adjacent to existing treatment structures. No additional noise or landscape screening is envisaged at this time. There would be temporary construction areas adjacent to permanent sites at the outfall and along the pipeline route. Overall, 2500 HGV movements are anticipated during the construction period. Construction activities would cause minor disruption to road and rail infrastructure as a result of crossings. Five railway crossings, four motorway crossings, 11 A/B road crossings and 26 minor road crossings would be via tunnelling Best practice construction techniques are assumed However, there will be adverse effects such as noise, dust and vibrations during construction associated with construction activities and vehicles which could cause impacts on health and wellbeing at nearby sensitive receptors such as residential properties. Due to the scale and duration of the construction works and proximity of sensitive receptors a moderate effect is anticipated. **Operational effects:** In operation, this scheme will increase regional resilience which may support economic and population growth It will help to ensure provision of access to a secure resilient supply of drinking water including during times where additional water resources may not be available. Therefore generating a major positive effect. Traffic during operation expected to be limited therefore a neutral effect is anticipated during operation	The hours of working associated with the construction of the treatment works, other sites and pipeline route limited to minimise amenity and environmental impacts. **Operation mitigation:** No further mitigation proposed				
	8.2 To maintain and enhance tourism and recreation	*0*	-	*0*	*0*	**Construction effects:** The pipeline route is located at the edge of a number of recreational facilities such as a golf course to the west of Meriden and within 500m of a number more The pipeline route crosses a number of PRoW including National Trails and also a cycle route The pipeline route also crosses main rivers and there are areas of CRoW Act section 15 land within 500m. All reasonable effort will be made to avoid temporary closure of public rights of way and diversions will be provided instead. Public rights of way will be reinstated following construction completion Careful siting and use of screening where work locations are in proximity to public rights of way will be undertaken Overall, during construction this option is considered to have a minor negative effect on this objective. **Operational effects:** In operation, there will be limited effects on recreational resources	**Construction mitigation:** Consider reviewing route to avoid recreational areas. Avoid temporary closure of public rights of way and diversions. Public rights of way reinstated following construction completion. Careful siting and use of screening where work locations are in proximity to public rights of way **Operation mitigation:** There is the opportunity to improve footpaths and connections in and around proposed pipeline route as part of the construction work, giving rise to a permanent minor beneficial effect.	*0*	*0*	+	*0*
	8.3 To secure resilient water supplies for the health and wellbeing of customers	*0*	*0*	+++	*0*	**Construction effects:** Construction effects are assessed as neutral **Operational effects:** The option would contribute by providing a resilient water supply. It will provide essential water supply infrastructure to help support a sustainable socio-economy and therefore is considered to have a major positive effect.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	+++	*0*
	8.4 To increase access and connect customers to the natural environment, provide education or information resources for the public	0	0	0	0	**Construction effects:** The scheme is not anticipated to increase access to the natural environment or provide education or information sources. Therefore a neutral effect. **Operational Effects:** Operational effects are assessed as neutral for this objective	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	0	0	0	0
Material Assets	9.1 To minimise resource use and waste production	0	-	0	-	**Construction Effects:** The option would require significant use of raw materials and energy to construct (see also embedded carbon for Climate Change above). The option would generate construction wastes which would include excavated materials. The volume of waste materials from the construction works to landfill would be 21,000m^3 Overall, the construction impacts are considered a minor negative effect. **Operational Effects:**	**Construction mitigation:** Adoption of waste minimisation measures where practicable. Source materials locally and reinstate excavated materials where possible. **Operation mitigation:**	0	-	0	-

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
						Chemical use for treatment would be 758,000 kg/year. However, use of 100 % renewable energy is proposed for this option Overall, the operational impacts are considered a minor negative effect	No further mitigation proposed				
	9 2 To avoid negative effects on built assets and infrastructure	*0*	-	*0*	*0*	A number of urban areas are within proximity of the scheme. The route crosses railways and a number of roads including motorways and A roads. Five railway crossings, four motorway crossings, 11 A/B road crossings and 26 minor road crossings would be via tunnelling During construction there would be potential disruption to built assets, although this would be mitigated through the use of tunnelling and good construction working practices, which would be set out in the CEMPs. The works will also be temporary in nature. Overall, the construction impacts are considered minor. **Operational effects:** Operational effects are assessed as neutral for this objective	**Construction mitigation:** Consider tunnelling all A road crossings. Minimise works on infrastructure where open cut during peak periods **Operation mitigation:** No further mitigation proposed	*0*	-	*0*	*0*

Element Name	Minworth Combined (215 Ml/d)
Element Reference	Minworth_Combined_215
Description	215 Ml/d - Minworth WwTW treated wastewater inter-catchment transfer. This has the capacity to release 115Ml/d into the STT scheme and 100 Ml/d to the GUC system. Piped diversion of 115 Ml/d of final treated wastewater from Minworth WwTW to an outfall at the River Avon downstream of Warwick (no discharge to the River Avon). A total of up to 215 Ml/d of treated wastewater not being discharged into the River Tame, a tributary of the River Trent (no regard to the pipeline to GUC or to any discharge to the GUC system). Components comprise: • Flow diversion chamber at Minworth WwTW • Tertiary Treatment Plant • Final wastewater high lift pump station • Rising main – [redacted] • Outfall to River Avon downstream of Warwick (no discharge to the River Avon)

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
Biodiversity, flora and fauna	1.1To protect designated sites and their qualifying features	*0*	---	+	-	**Construction effects:** The area for construction includes development within the existing WwTW operational boundary including a new tertiary treatment plant and flow diversion chamber as well as pump station, pipeline and associated construction compounds. An HRA screening has been undertaken. This found that no Likely Significant Effects (LSE) are anticipated on the Severn Estuary SAC and Ramsar site or the Humber Estuary SAC, SPA and Ramsar site due to the distance between the proposed construction works and the designated sites. There would be no impact on the River Mease SAC. The scheme crosses through two SSSIs - Coleshill and Bannerly Pools and River Blythe and is approximately 500m from Berkswell Marsh SSSI. There is a local nature reserve adjacent to the pipeline route at Coleshill. There are areas of ancient woodland within 1km of the pipeline route including one area south of Ballsall Common where the route runs along the edge of the ancient woodland. Due to the pipeline to the River Avon crossing of two SSSIs and proximity of other designated sites major adverse effects are anticipated. **Operational effects:** No LSE is anticipated on the River Mease SAC (a tributary of the River Tame) as the qualifying features are not depended on flows in the River Tame. No LSE are anticipated on the Humber Estuary SAC, SPA and Ramsar site as the hydrological impacts downstream of the River Tame confluence with the River Trent is considered minor and the European site is ~150 miles downstream of the Minworth WwTW. The Reaches of the River Tame are not considered to provide off-site functional habitat for the qualifying features of the Humber Europeans site. Habitat enhancement to be realised when reinstating land as well as biodiversity net gain opportunities resulting in minor positive effect.	**Construction mitigation:** The route should be realigned to avoid the SSSIs. Discussions with NE regarding SSSI and ancient woodland protection measures. The detail of the working areas (and in some cases construction areas and pipeline itself) will be reviewed with NE as part of the further detailed design of the scheme. A Phase 1 habitat survey of the River Blythe SSSI, Coleshill and Bannerly SSSI and Cole End LNR should be completed to understand the impacts that nearby works could have on these designated sites. Use of trenchless technology, where possible. If the section through the River Blythe SSSI is proposed to be achieved via tunnelling, then further hydrological assessment would be required to establish whether the tunnelling would have an impact on the hydrology of the SSSI. The need to avoid works during certain times of the year will be identified through the completion of the additional environmental investigations. Further investigation for potential effects on fish habitat in the River Tame. **Operation mitigation:** Further survey work and monitoring is required to understand the magnitude of flow effects in the River Tame.	*0*	-	+	*0*
	1.2To avoid a net reduction, and where possible enhance, in non-monetised natural capital assets	*0*	-	*0*	-	**Construction Effects:** Construction will lead to loss or degradation of enclosed farmland natural capital stock, with potential associated disbenefits to biodiversity, carbon regulation and water purification services. Potential short term impacts to recreation and wellbeing if construction causes loss of access to recreation sites within the zone of influence. The Draft Natural Capital Assessment found a minor negative effect during construction. **Operational effects:** The Draft Natural Capital Assessment found a minor negative effect during operation.	**Construction mitigation:** No further mitigation proposed. **Operation mitigation:** Delivery of required Biodiversity Net Gain (BNG) to offset construction losses (woodland and traditional orchard creation) will result in benefits to natural capital stocks and ecosystem service provision, including biodiversity, carbon regulation, natural hazard regulation and water purification. Potential benefits to recreation are dependent on design of BNG mitigation.	*0*	-	+	-

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	1 3To protect and enhance biodiversity, priority habitats and species	*0*	-	*0*	-	**Construction effects:** The pipeline to the River Avon passes through a number of priority areas Priority species within the construction zone may be subjected to short term, temporary impacts of a minor magnitude. Best practice construction techniques are assumed. Minor impact pathways to priority species include increases in noise and vibration disturbance, and temporary fragmentation of habitat. It is unlikely that construction will affect priority species such as birds through noise disruption due to distance and proximity from site. In consideration of these impacts the effects on this objective are considered minor negative **Operational effects:** Loss of terrestrial Priority Habitat would have occurred during construction. Maintenance activities to avoid Priority Habitat areas. Several priority species of fish have been recorded downstream of the Minworth WwTW in the River Tame Hydrological assessment of effects of discharge reduction from Minworth WwTW on the downstream River Tame would have a minor effect on flows and impacts on the priority species are considered negligible	**Construction mitigation:** Tunnelling for all sections of route which goes through priority habitat The detail of the working areas (and in some cases construction areas and pipeline itself) will be reviewed with NE as part of the further detailed design of the scheme. If site specific ecological assessments identify any impacts to protected species or habitats associated with the construction work, appropriate mitigation measures including (where appropriate) relocation of such species will be undertaken in advance of the works being undertaken. **Operation mitigation:** Further survey work and monitoring is required to understand the magnitude of flow effects in the River Tame	*0*	*0*	*0*	-
	1.4To avoid and, where required, manage invasive and non-native species (INNS)	*0*	*0*	*0*		**Construction effects:** Whilst there is a potential risk of spreading INNS during construction. Mitigation measures including best practice construction practices, the identification and removal of invasive species on site in advance of construction and pipeline commissioning with treated water In consideration of these mitigation measures the impacts of these risks are considered neutral **Operational effects:** Wastewater entering the WwTW will be from sanitary sewers comprised of municipal wastewater. INNS entering Minworth WwTW would have the potential to be moved via the pipeline into the Avon catchment. The potential of this occurring, however, is considered minor due to the primary and potentially secondary treatment process In operation there would be an additional 115Ml/d transfer to the River Thames at times when transfer is required below the Hands off Flow conditions on the River Severn. The reduction in flows in the River Tame could potentially be beneficial with regards to the distribution of INNS with decreased volumes of water resulting in a decreased risk in the distribution of INNS that spread via seeds and propagules. However, this effect is uncertain and overall has been assessed as neutral	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** Any transfer of such species (unlikely though that is) would be much more noticeable and rapid in a downstream direction so precautionary monitoring for such species immediately downstream of the discharge would act as an early warning and give sufficient time for appropriate treatment.	*0*	*0*	*0*	*0*
	1.5To meet WFD objectives relating to biodiversity	*0*	-	*0*	---	**Construction effects:** There will be five watercourse and two canal crossings during the construction of the pipeline to the River Avon. Construction impacts, including intake, pipeline and outfall headworks construction are assessed as a minor negative effect. **Operational effects:** Hydrological assessment of effects of discharge reduction from Minworth WwTW on the downstream Rivers Tame and Trent have identified a major negative flow effect with risk to WFD deterioration in five river water bodies associated wither directly with wetted habitat change; changes in physico-chemical river processes from reduced velocities and increased time of travel; and from reduced buffering capacity from known continuous and intermittent water quality pressures. Further assessment of the potential magnitude of flow changes and pathways of effect in the Rivers Tame and Trent is required.	**Construction mitigation:** Tunnelling for all water courses where needed in addition to those specified. With further consideration of watercourses to cross without in-channel works, construction impacts would be neutral for WFD compliance. **Operation mitigation:** Further development of operating conditions for effluent transfer and further hydro-ecological and water quality assessment of effects of major change in flow regime in the Rivers Tame and Trent is required.	*0*	*0*	*0*	--
Soil	2.1To protect and enhance the functionality, quantity and quality of soils, including the protection of high-grade agricultural land	*0*	-	*0*	*0*	**Construction effects:** Most of the pipeline route to the Avon is within grade 3 agricultural land and a small area is within grade 2 The pipeline route runs along the edge of permitted and historic landfills and is within 1km of a number of other landfilled areas. Although the route does not encroach directly onto any landfill areas there is potential for contamination pathways during construction. No imports of materials are envisaged at this time as excavated material will be used for backfill Excavated material on the WwTW site is to remain on site if possible. Overall, the construction impacts are considered minor negative. **Operational effects:** The operation of the scheme will not affect land use, soils, or geology	**Construction mitigation:** Limiting the extent of pipeline construction will minimise the time period for soil disturbance Review the pipeline route to maximise distance from landfilled areas. Ground investigations to be undertaken prior to commencement of works to identify necessary mitigation measures **Operation mitigation:** No further mitigation proposed	*0*	-	*0*	*0*
Water	3.1To minimise or manage flood risk,	*0*	-	*0*	*0*	**Construction effects:** The pipeline route to the River Avon is within a number of areas of flood zone 2 and 3. It crosses a number of main rivers. Use of trenchless techniques to cross the watercourses.	**Construction mitigation:** Further mitigation measures will be set out in the applications for Flood Defence	*0*	-	*0*	*0*

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	taking climate change into account					Construction compounds would be sited sensitively and away from flood risk zones. Adequate methods of construction will be adopted to minimise the impact, including sheet piling, dewatering and treatment of the groundwater prior to discharge. Flood compensation ponds will be constructed as part of the enabling works. Earthworks sequencing will include cofferdam formation to avoid flooding of borrow areas during construction. Given the scope of the construction works a minor negative effect on flood risk has been identified. **Operational effects:** The scheme would not affect flood storage once operational and the necessary flood plain compensation are complete	Consents where these are required for the river crossing construction works **Operation mitigation:** No further mitigation proposed				
	3.2To enhance or maintain groundwater quality and resources	*0*	-	*0*	*0*	**Construction effects:** The pipeline route to the River Avon is within a source protection zone to the north west of Hatton Park It is within a WFD groundwater body. During construction of the pipeline, areas with high permeability and high groundwater levels would require permits to be obtained by the contractor from the relevant authorities for the disposal of the groundwater to a suitable location There would also be a need for lagoons to intercept and treat the commissioning wastewater The lagoons would need to be available prior to pressure testing and land would be reinstated after commissioning. All vehicles and any chemical/oil storage will be fully bunded to prevent any accidental pollution of groundwater. Overall a minor negative effect on groundwater is considered. **Operational effects:** The scheme would not affect groundwater quality and resources once operational	**Construction mitigation:** Further mitigation measures will be developed in consultation with the regulators as part of the detailed design process **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
	3.3To enhance or maintain surface water quality, flows and quantity	*0*	-	*0*	---	**Construction effects:** A number of rivers (including six main rivers) would be crossed by the pipeline to the River Avon and a risk to water quality therefore exists. Construction of discharge and abstraction points and pipeline river crossings have the potential to effect water quality in the river and downstream. Five watercourses and two canals would be crossed via tunnelling Best practice construction methods will also be adopted Given the scale of the construction activities required and that some water courses may not be tunnelled, minor negative effects are anticipated. **Operational effects:** In operation there would be relocation of 100Ml/d treated final effluent from Minworth WwTW to the GUC for intermittent periods assessed initially as annually from 1 April for six continuous months and intermittent overlapping periods with 115Ml/d treated final effluent transfer to the middle River Avon There would also be intermittent periods in late autumn/early winter of 115Ml/d transfer to the Avon. Each of these would result in a significant reduction in the magnitude and duration of extremely low seasonal flows in the Rivers Tame and Trent along the flow pathway of the option from the River Tame outfall to the River Trent confluence with the River Derwent. From a water quality perspective, the potential major flow reduction could associate with changes in physico-chemical river processes from reduced velocities and increased time of travel; and from reduced buffering capacity from known continuous and intermittent water quality pressures.	**Construction mitigation:** Further mitigation measures will be set out in the applications for Flood Defence Consents where these are required for the river crossing construction works Tunnelling for all watercourse crossings **Operation mitigation:** Further development of operating conditions for effluent transfer and further hydro-ecological and water quality assessment of effects of major change in flow regime in the Rivers Tame and Trent is required.	*0*	-	*0*	--
	3.4 To meet WFD objectives	*0*	-	*0*	---	**Construction effects:** Option construction impacts, including pipeline and outfall headworks construction are assessed as minor negative effect prior to mitigation. **Operational effects:** The tests of constraint of the option against WFD regulations objectives identify potential non-compliance with physico-chemical water quality and aquatic ecology status targets in five WFD river water bodies along the flow pathway of the option from the River Tame outfall to the River Trent confluence with the River Derwent. from option operation. In consequence, a major negative effect is considered As well as the tests of WFD constraint, other WFD objectives relate to whether the option assists the meeting of WFD objectives for the water body, for associated WFD protected areas or reduces the treatment needed to produce drinking water and look to work in partnership with others. The option is considered neutral for these aspects during construction and operation	**Construction mitigation:** With further consideration of watercourses to cross without in-channel works, construction impacts would be neutral for WFD compliance. **Operation mitigation:** Further development of operating conditions for effluent transfer and further hydro-ecological and water quality assessment of effects of major change in flow regime in the Rivers Tame and Trent is required.	*0*	*0*	*0*	--
	3.5 To improve water efficiency through provision of access to a resilient and sustainable supply of water	*0*	*0*	+++	*0*	**Construction effects:** Construction effects are assessed as neutral. **Operational effects:** During operation there would be a major positive effect due to the option contributing to a resilient water supply. Whilst this option will provide additional water resource (215 Ml/d) and it will provide essential water supply infrastructure to help support a sustainable socio-economy	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	+++	*0*

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
Air	4.1 To minimise air emissions during construction and operation	*0*		*0*	*0*	**Construction effects:** The duration of construction would be 60 months There would be approximately 2,500 HGV movements, which will result in vehicle emissions to air. The scheme passes through a number of urban areas and part of the route near Minworth is within the Birmingham AQMA. Therefore there is potential for moderate negative effects on air emissions from construction activities. **Operational effects:** During operation there would be approximately 76 vehicle movements per year. Given the scale of the activities required, neutral effects are anticipated.	**Construction mitigation:** Consider use of rail for transporting materials Approved traffic routes for construction traffic will be applied in order to minimise impacts on local roads **Operation mitigation:** No further mitigation proposed	*0*		*0*	*0*
Climatic Factors	5.1 To introduce climate mitigation where required and improve the climate resilience of assets and natural systems	*0*	*0*	+++	*0*	**Construction effects:** Construction effects are assessed as neutral **Operational effects:** This option provides additional water resource and will during operation assist the reliable transfer of water, therefore reducing the vulnerability to drought risks associated with climate change and improving resilience to the likely effects of climate change. Major positive effects are anticipated.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	+++	*0*
	5.2 To minimise embodied and operational emissions	*0*	-	*0*	---	**Construction effects:** Construction carbon would be 29,527 tCO2e over 60 months. Overall, during construction this option is considered to have a minor negative environmental effect on this objective **Operational effects:** Operational carbon would be 15,391 tCO2e / y. Annual power consumption at full utilisation 16,540,340 kWh Overall, during operation this option is considered to have a major negative environmental effect on this objective	**Construction mitigation:** Investigate use of renewables during construction and operation for energy supply and use of materials with lower embodied carbon Carbon footprint study could help identify areas for carbon savings or alternative materials. **Operation mitigation:** Potential for an energy recovery option although this would require investigation	*0*	-	*0*	---
Landscape	6.1 To conserve, protect and enhance landscape and townscape character and visual amenity	*0*	-	*0*	*0*	**Construction effects:** The majority of the pipeline to the River Avon is within the greenbelt (Birmingham, North Warwickshire, Solihull and Warwick). The upgrade works to the WwTW site will be contained with the operational land of the WwTW. The construction works will be temporary and the potential for adverse effects on the greenbelt during construction has been assessed as minor **Operational effects:** Landscape planting will be adopted to screen new infrastructure. In the short to medium term, fields would return to their original condition. Overall, the operational impacts are considered neutral.	**Construction mitigation:** Consider minimising the extent of construction works within the greenbelt. Use of trenchless techniques for pipeline construction. **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
Historic Environment	7.1 To conserve/protect and enhance historic assets/cultural heritage and their setting, including archaeological important sites	*0*	--	*0*	-	**Construction effects:** The scheme is approximately 250m from a scheduled Monument, Coleshill Bridge. There are others within 1km including Cursus, enclosures and other cropmarks 900m NNW of Barford Church There are three registered parks and gardens within 500m of the pipeline route Warwick Castle, Wroxall Abbey and Packington Hall. There are also others within 3km with potential to affect views. The pipeline route runs in close proximity to a large number of listed buildings, a number of which are immediately adjacent to the route. It is therefore considered that there exists potential moderate negative effects on a number of heritage assets **Operational effects:** There are a number of heritage assets within 3km of the permanent works that would be visible following construction. Therefore minor adverse effects may arise due to potential impacts on the settings of heritage assets	**Construction mitigation:** The alignment of the pipeline should be developed further during design development and further consultation with Historic England should be undertaken during this process. This should include refining mitigation measures in particular in relation to the scheduled monuments, listed buildings and conservation areas within proximity of the pipeline route. Sensitive location of construction compounds to avoid heritage assets and retain a buffer around them to be defined further in consultation with Historic England. The development of an archaeological programme of works including archaeological monitoring is proposed **Operation mitigation:** Screening where settings of heritage assets would be affected.	*0*	-	*0*	*0*

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
Population and Human Health	8.1 To maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	++		+++	*0*	**Construction effects:** The construction of this option would represent significant capital investment which is expected to generate a number of employment opportunities and supply chain benefits. The degree of this benefit will be dependent on the contractors recruitment and supply chain practices and will be temporary. Overall, the benefits are expected to be moderate. The duration of construction would be 60 months. There are sensitive buildings such as schools and places of worship within 500m of the pipeline route to the River Avon The pipeline route is within five Noise Action Important Areas and adjacent to a number of others. There will be adverse effects such as noise, dust and vibrations during construction associated with construction activities and vehicles which could cause impacts on health and wellbeing at nearby sensitive receptors such as residential properties The scheme is within 1km of areas of income and health deprivation The upgrade at the WwTW will be within the site boundary and adjacent to existing treatment structures. No additional noise or landscape screening is envisaged at this time. There would be temporary construction areas adjacent to permanent sites at the outfall and along the pipeline route. Overall, 2500 HGV movements are anticipated during the construction period. Construction activities would cause minor disruption to road and rail infrastructure as a result of crossings Five railway crossings, four motorway crossings, 11 A/B road crossings and 26 minor road crossings would be via tunnelling. Best practice construction techniques are assumed. However, there will be adverse effects such as noise, dust and vibrations during construction associated with construction activities and vehicles which could cause impacts on health and wellbeing at nearby sensitive receptors such as residential properties. Due to the scale and duration of the construction works and proximity of sensitive receptors a moderate effect is anticipated. **Operational effects:** In operation, this scheme will increase regional resilience which may support economic and population growth. It will help to ensure provision of access to a secure resilient supply of drinking water including during times where additional water resources may not be available. Therefore generating a major positive effect. Traffic during operation expected to be limited therefore a neutral effect is anticipated during operation.	**Construction mitigation:** Tunnelling for all rail and A road crossings Construction compounds to be sited sensitively and away from residential areas. Construction compounds along the pipeline next to a main road, so that there is least disturbance to local traffic. The hours of working associated with the construction of the treatment works, other sites and pipeline route limited to minimise amenity and environmental impacts. **Operation mitigation:** No further mitigation proposed	++		+++	*0*
	8.2 To maintain and enhance tourism and recreation	*0*		*0*	*0*	**Construction effects:** The pipeline route to the River Avon is located at the edge of a number of recreational facilities such as a golf course to the west of Meriden and within 500m of a number more. The pipeline route crosses a number of PRoW including National Trails and also a cycle route. The pipeline route also crosses main rivers and there are areas of CRoW Act section 15 land within 500m. All reasonable effort will be made to avoid temporary closure of public rights of way and diversions will be provided instead. Public rights of way will be reinstated following construction completion. Careful siting and use of screening where work locations are in proximity to public rights of way will be undertaken. Overall, during construction this option is considered to have a minor negative effect on this objective **Operational effects:** In operation, there will be limited effects on recreational resources	**Construction mitigation:** Consider reviewing route to avoid recreational areas. Avoid temporary closure of public rights of way and diversions. Public rights of way reinstated following construction completion. Careful siting and use of screening where work locations are in proximity to public rights of way **Operation mitigation:** There is the opportunity to improve footpaths and connections in and around proposed pipeline route as part of the construction work, giving rise to a permanent minor beneficial effect.	*0*	*0*	+	*0*
	8.3 To secure resilient water supplies for the health and wellbeing of customers	*0*	*0*	+++	*0*	**Construction effects:** Construction effects are assessed as neutral **Operational effects:** The option would contribute by providing a resilient water supply It will provide essential water supply infrastructure to help support a sustainable socio-economy and therefore is considered to have a major positive effect.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	+++	*0*
	8.4 To increase access and connect customers to the natural environment, provide education or information resources for the public	0	0	0	0	**Construction effects:** The scheme is not anticipated to increase access to the natural environment or provide education or information sources. Therefore a neutral effect. **Operational Effects:** Operational effects are assessed as neutral for this objective.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	0	0	0	0

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
Material Assets	9.1 To minimise resource use and waste production	0		0		**Construction Effects:** The option would require significant use of raw materials and energy to construct (see also embedded carbon for Climate Change above). The option would generate construction wastes which would include excavated materials. The volume of waste materials from the construction works to landfill would be 21,000m^3 Overall, the construction impacts are considered a minor negative effect. **Operational Effects:** Chemical use for treatment would be 758,000 kg/year However, use of 100 % renewable energy is proposed for this option. Overall, the operational impacts are considered a minor negative effect.	**Construction mitigation:** Adoption of waste minimisation measures where practicable. Source materials locally and reinstate excavated materials where possible. **Operation mitigation:** No further mitigation proposed	0		0	
	9.2 To avoid negative effects on built assets and infrastructure	*0*		*0*	*0*	A number of urban areas are within proximity of the scheme The pipeline route to the River Avon crosses railways and a number of roads including motorways and A roads. Five railway crossings, four motorway crossings, 11 A/B road crossings and 26 minor road crossings would be via tunnelling. During construction there would be potential disruption to built assets, although this would be mitigated through the use of tunnelling and good construction working practices, which would be set out in the CEMPs. The works will also be temporary in nature. Overall, the construction impacts are considered a minor negative effect. **Operational effects:** Operational effects are assessed as neutral for this objective	**Construction mitigation:** Consider tunnelling all A road crossings Minimise works on infrastructure where open cut during peak periods **Operation mitigation:** No further mitigation proposed	*0*		*0*	*0*

Element Name	Minworth / GUC (100Ml/d)
Element Reference	Minworth / GUC (100Ml/d)
Description	Proposed upgrade of Minworth WwTP 100Mld comprising the following components: [redacted] 100Mld not going into the River Tame.

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e. costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
Biodiversity, flora and fauna	1.1To protect designated sites and their qualifying features	*0*	-	*0*	-	**Construction effects:** The Humber Estuary SAC is approximately 141 km north-east and the River Mease SAC is approximately 19.4 km north-east of the proposed development site at Minworth Wastewater Treatment Plant (WwTP), at its closest point. Due to the distance between the sites and proposed works at WwTP and the pipeline installation, no likely significant effects during construction are anticipated on qualifying habitats and species of the designated site. There is an area of ancient woodland approximately 900m from the site and therefore potential for minor adverse effects. Best practice construction techniques are assumed. **Operational effects:** During operation, the reduction in final effluent release on the River Tame and River Trent could cause localised reductions in flow and water level, reducing the extent of wetted habitat at the periphery of the river. Impacts on the River Trent are considered negligible downstream of the River Derwent confluence. Although in hydrological connectivity, the River Mease SAC will not be impacted by the reduced flows (the River Mease is a tributary of the Tame) and the site is not designated for any migratory species. The Humber Estuary is approximately 200 km downstream via hydrological connectivity from two outfall locations where currently final effluent is discharged into the River Tame. No LSE is anticipated on the River Mease. LSE are anticipated on the Humber Estuary to the risk of hydrological impacts on off -site functional habitat. An Appropriate Assessment concluded that adverse effects are not anticipated as there is no evidence that the associated waterbodies provides off-site functional habitat and upstream migration of lamprey is severely restricted by the Cromwell Weir.	**Construction mitigation**: No further mitigation proposed **Operation mitigation**: Hydrological surveys of the River Trent to understand the risk of reduced inflows from the Tame and subsequently the Humber Estuary. This would inform further mitigation to be implemented.	*0*	-	*0*	*0*
	1.2To avoid a net reduction, and where possible enhance, in non-monetised natural capital assets	*0*	-	*0*	-	**Construction effects:** Construction site is located almost entirely on urban land. Risks to natural capital stocks are therefore negligible. The Draft Natural Capital Assessment found a low risk and therefore a neutral to minor negative effect is anticipated during construction. **Operational effects:** The Draft Natural Capital Assessment found a low risk and therefore a neutral to minor negative effect is anticipated during operation.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** Delivery of required Biodiversity Net Gain (BNG) to offset construction losses of deciduous woodland.	*0*	-	*0*	-

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	1.3To protect and enhance biodiversity, priority habitats and species	*0*	-	*0*	-	**Construction effects**: Part of the site area is within Priority Habitat (Coastal and floodplain grazing marsh). It is also close to and within 500m of a number of areas of Priority Habitat. The site is also within a Nature Improvement Area and within 500m of a National Priority Focus Area Best practice construction techniques are assumed. **Operational effects**: Several priority species of fish have been recorded downstream of the Minworth WwTW in the River Tame. Hydrological assessment of effects of discharge reduction from Minworth WwTW on the downstream River Tame would have a minor effect on flows and impacts on the priority species are considered negligible	**Construction mitigation**: If site specific ecological assessments identify any impacts to protected species or habitats associated with the construction work, appropriate mitigation measures including (where appropriate) relocation of such species will be undertaken in advance of the works being undertaken. **Operation mitigation**: Further survey work and monitoring is required to understand the magnitude of flow effects in the River Tame	*0*	*0*	*0*	*0*
	1 4To avoid and, where required, manage invasive and non-native species (INNS)	*0*	*0*	*0*	*0*	**Construction effects:** Whilst there is a potential risk of spreading INNS during construction. Mitigation measures including best practice construction practices, the identification and removal of invasive species on site in advance of construction and pipeline commissioning with treated water. In consideration of these mitigation measures the impacts of these risks are considered neutral **Operational effects:** Wastewater entering the WwTW will be from sanitary sewers comprised of municipal wastewater The treatment process will mitigate against the distribution of INNS via the final effluent. The reduction in effluent and subsequent reduction in flows in the River Tame could potentially be beneficial with regards to the distribution of INNS with decreased volumes of water resulting in a decreased risk in the distribution of INNS that spread via seeds and propagules. However, this effect is uncertain and overall has been assessed as neutral.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
	1.5To meet WFD objectives relating to biodiversity	*0*	*0*	*0*	---	**Construction effects:** Option construction impacts are assessed as neutral. **Operational effects:** Hydrological assessment of effects of discharge reduction from Minworth WwTW on the downstream Rivers Tame and Trent have identified a major negative flow effect with risk to WFD deterioration in five river water bodies associated wither directly with wetted habitat change; changes in physico-chemical river processes from reduced velocities and increased time of travel; and from reduced buffering capacity from known continuous and intermittent water quality pressures Further assessment of the potential magnitude of flow changes and pathways of effect in the Rivers Tame and Trent is required.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** Further development of operating conditions for effluent transfer and further hydro-ecological and water quality assessment of effects of major change in flow regime in the Rivers Tame and Trent is required.	*0*	*0*	*0*	--
Soil	2.1To protect and enhance the functionality, quantity and quality of soils, including the protection of high-grade agricultural land	*0*		*0*	*0*	**Construction effects:** The site is close, approximately 15m, to an area of grade 3 agricultural land and is approximately 200m from an area of grade 2. The site is immediately adjacent to a permitted landfill site No imports of materials are envisaged at this time as excavated material will be used for backfill. Excavated material on the WwTW site is to remain on site if possible. Overall, the construction impacts are considered minor negative	**Construction mitigation:** Ground investigations to be undertaken prior to commencement of works to identify necessary mitigation measures **Operation mitigation:** No further mitigation proposed	*0*		*0*	*0*

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
						Operational effects: The operation of the scheme will not affect land use, soils, or geology					
Water	3.1To minimise or manage flood risk, taking climate change into account	*0*	-	*0*	*0*	**Construction effects:** The site is partly within flood zone 2 and is close to (within 500m) of areas of flood zone 2 and 3. Given the scope of the construction works a minor negative effect on flood risk has been identified **Operational effects:** Operational effects are assessed as neutral.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	-	*0*	*0*
	3.2To enhance or maintain groundwater quality and resources	*0*	*0*	*0*	*0*	**Construction effects:** Option construction effects are assessed as neutral. **Operational effects:** Operational effects are assessed as neutral.	Construction mitigation: No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
	3.3To enhance or maintain surface water quality, flows and quantity	*0*	*0*	*0*	---	**Construction effects:** Option construction impacts are assessed as neutral. **Operational effects:** In operation there would be relocation of 100Ml/d treated final effluent from Minworth WwTW to the GUC for intermittent periods assessed initially as annually from 1 April for six continuous months. This would result in a significant reduction in the magnitude and duration of extremely low seasonal flows in the Rivers Tame and Trent along the flow pathway of the option from the River Tame outfall to the River Trent confluence with the River Derwent. From a water quality perspective, the potential major flow reduction could associate with changes in physico-chemical river processes from reduced velocities and increased time of travel; and from reduced buffering capacity from known continuous and intermittent water quality pressures.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** Further development of operating conditions for effluent transfer and further hydro-ecological and water quality assessment of effects of major change in flow regime in the Rivers Tame and Trent is required	*0*	*0*	*0*	--
	3.4 To meet WFD objectives	*0*	*0*	*0*	---	**Construction effects:** Option construction impacts are assessed as neutral. **Operational effects:** The tests of constraint of the option against WFD regulations objectives identify potential non-compliance with physico-chemical water quality and aquatic ecology status targets in five WFD river water bodies along the flow pathway of the option from the River Tame outfall to the River Trent confluence with the River Derwent from option operation As well as the tests of WFD constraint, other WFD objectives relate to whether the option assists the meeting of WFD objectives for the water body, for associated WFD protected areas or reduces the treatment needed to produce drinking water and look to work in partnership with others The option is considered neutral for these during construction and operation.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** Further development of operating conditions for effluent transfer and further hydro-ecological and water quality assessment of effects of major change in flow regime in the Rivers Tame and Trent is required.	*0*	*0*	*0*	--
	3.5 To improve water efficiency through provision of access to a resilient and sustainable supply of water.	*0*	*0*	*0*	*0*	**Construction effects:** Construction effects are assessed as neutral. **Operational effects:** The option would not by itself provide water and therefore a neutral effect	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
Air	4 1 To minimise air emissions during construction and operation	*0*	--	*0*	*0*	**Construction effects:** The site is within an AQMA There is an urban area, Curdworth, within 500m from the site to the east Also Water Orton is approximately 700m to the south. Therefore there is potential for moderate negative effects on air emissions from construction activities **Operational effects:** Given the scale of the activities associated with the upgrade of an existing site, neutral effects are anticipated.	**Construction mitigation:** Consider use of rail for transporting materials. Approved traffic routes for construction traffic will be applied in order to minimise impacts on local roads **Operation mitigation:** No further mitigation proposed	*0*	--	*0*	*0*
Climatic Factors	5.1 To introduce climate mitigation where required and improve the climate resilience of assets and natural systems	*0*	*0*	*0*	*0*	**Construction effects:** Construction effects are assessed as neutral **Operational effects:** Operational effects are assessed as neutral as the element does not in itself provide additional water.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
	5.2 To minimise embodied and operational emissions	*0*	-	*0*	?	**Construction effects:** Carbon emissions during construction are unknown however due to the scale of the upgrade this option is considered to have a minor negative environmental effect on this objective. **Operational effects:** Carbon emissions during operation are unknown therefore uncertain effects.	**Construction mitigation:** Investigate use of renewables during construction and operation for energy supply and use of materials with lower embodied carbon. Carbon footprint study could help identify areas for carbon savings or alternative materials. **Operation mitigation:** Potential for an energy recovery option although this would require investigation	*0*	-	*0*	?
Landscape	6.1 To conserve, protect and enhance landscape and townscape character and visual amenity	*0*		*0*	*0*	**Construction effects:** The site is located within the Birmingham Greenbelt The upgrade works to the WwTW site will be contained with the operational land of the WwTW. The construction works will be temporary and the potential for adverse effects on the greenbelt during construction has been assessed as minor **Operational effects:** The operational impacts are considered neutral.	**Construction mitigation:** Consider minimising the extent of construction works within the greenbelt. **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
Historic Environment	7.1 To conserve/protect and enhance historic assets/cultural heritage and their setting, including archaeological important sites	*0*	-	*0*	-	**Construction effects:** There is a scheduled monument, Moated Site at Peddimore Hall, approximately 2 1km form the site There are a number of listed buildings between 500m and 1km from the site. There is a conservation area approximately 600m from the site at Water Orton to the south. There is potential for neutral to minor effects on settings of heritage assets. **Operational effects:** Permanent works would be visible following construction Therefore minor adverse effects may arise due to potential impacts on the settings of heritage assets.	**Construction mitigation:** Consultation with HE to identify mitigation measures in particular in relation to the listed buildings and conservation area within proximity **Operation mitigation:** Screening where settings of heritage assets would be affected.	*0*	*0*	*0*	*0*
Population and Human Health	8.1 To maintain and enhance the health and wellbeing of the local community,	+	-	+	*0*	**Construction effects:** The construction of this option would represent capital investment which is expected to generate some employment opportunities and supply chain benefits. The degree of this	**Construction mitigation:** Construction compounds to be sited sensitively and away from residential areas.	+	-	+	*0*

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
	including economic and social wellbeing					benefit will be dependent on the contractors recruitment and supply chain practices and will be temporary Overall, the benefits are expected to be minor There are two noise action important areas approximately 800m from the site – one to the east and one to the south. The site is also within an AQMA There will be adverse effects such as noise, dust and vibrations during construction associated with construction activities and vehicles which could cause impacts on health and wellbeing at nearby sensitive receptors such as residential properties. Regarding indices of multiple deprivation, there are areas of income and health deprivation approximately 1.5km from the site. The upgrade at the WwTW will be within the site boundary and adjacent to existing treatment structures. No additional noise or landscape screening is envisaged at this time. Best practice construction techniques are assumed. However, there will be adverse effects such as noise, dust and vibrations during construction associated with construction activities and vehicles which could cause impacts on health and wellbeing at nearby sensitive receptors such as residential properties. Due to the scale and duration of the construction works and proximity of sensitive receptors a minor effect is anticipated **Operational effects:** In operation, this scheme will increase regional resilience which may support economic and population growth It will help to ensure provision of access to a secure resilient supply of drinking water including during times where additional water resources may not be available as part of an overall scheme. Therefore generating a minor positive effect. Traffic during operation expected to be limited therefore a neutral effect is anticipated during operation.	The hours of working associated with the construction of the treatment works, other sites and pipeline route limited to minimise amenity and environmental impacts **Operation mitigation:** No further mitigation proposed				
	8.2 To maintain and enhance tourism and recreation	*0*	*0*	*0*	*0*	**Construction effects:** There is an area of playing fields and tennis court approximately 280m from the site at Curdworth. There is an area of CRoW land approximately 700m to the south. Assuming the adoption of best practice construction techniques during construction this option is considered to have a neutral effect on this objective. **Operational effects:** In operation, there will be limited effects on recreational resources	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	*0*	*0*
	8.3 To secure resilient water supplies for the health and wellbeing of customers	*0*	*0*	++	*0*	**Construction effects:** Construction effects are assessed as neutral **Operational effects:** The option would contribute by providing a resilient water supply. It will provide essential water supply infrastructure to help support a sustainable socio-economy and therefore is considered to have a moderate positive effect.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	*0*	*0*	++	*0*
	8.4 To increase access and connect customers to the natural environment, provide education or information resources for the public	0	0	0	0	**Construction effects:** The scheme is not anticipated to increase access to the natural environment or provide education or information sources. Therefore a neutral effect. **Operational Effects:** Operational effects are assessed as neutral for this objective.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	0	0	0	0

SEA topic	SEA objective	Construction Effects +ve	Construction Effects -ve	Operational Effects +ve	Operational Effects -ve	Effect Description (including embedded mitigation i.e costed mitigation that is committed to as part of the scheme)	Further Mitigation	Residual Construction Effects +ve	Residual Construction Effects -ve	Residual Operational Effects +ve	Residual Operational Effects -ve
Material Assets	9.1 To minimise resource use and waste production	0		0		**Construction Effects:** The option would require use of raw materials and energy to construct. The option would generate construction wastes. Overall, the construction impacts are considered a minor negative effect **Operational Effects:** Chemical use for treatment would be 758,000 kg/year. However, use of 100 % renewable energy is proposed for this option Overall, the operational impacts are considered a minor negative effect	**Construction mitigation:** Adoption of waste minimisation measures where practicable Source materials locally and reinstate excavated materials where possible. **Operation mitigation:** No further mitigation proposed	0		0	
	9.2 To avoid negative effects on built assets and infrastructure	0	0	0	0	**Construction Effects:** The upgrade works would be within the WwTP site During construction there would be limited disruption to built assets and therefore a neutral effect. **Operational Effects:** Operational effects are assessed as neutral for this objective.	**Construction mitigation:** No further mitigation proposed **Operation mitigation:** No further mitigation proposed	0	0	0	0

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Creating a world
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Minworth SRO

Habitat Regulations Assessment

The content of this document is draft and relates to material [or data] which is still in the course of completion in travel to Gate 2 and should not be relied upon at this early stage of development. We continue to develop our thinking and our approach to the issues raised in the document in preparation for Gate 2.

Report for Severn Trent Water and Affinity Water

[redacted] | Issue number 2 | Date 29/04/2021

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Customer:

Severn Trent Water and Affinity Water

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1	26/04/2021	Draft for ST review	[redacted]			
2	29/04/2021	Updated draft following ST review				

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Executive Summary

Water companies in England and Wales are required to produce a Water Resources Management Plan (WRMP) every five years. The Plan sets out how the company intends to maintain the balance between supply and demand for water over the selected planning horizon (minimum 25 years) in order to ensure security of supply in each of the water resource zones making up its supply area.

Following submission of WRMPs in 2019, Ofwat through the Price Review 2019 (PR19) Final Determination, has identified the potential for companies to jointly deliver strategic regional water resources solutions to secure long-term resilience on behalf of customers while protecting the environment and benefiting wider society.

As part of the assessment of companies' PR19 business plans, Ofwat introduced proposals to support the delivery of Strategic Regional Water Resource Options (SROs) over the next 5 to 15 years with solutions considered to be 'construction ready' for the 2025-2030 period. Ofwat's Final Determination[1] in December 2019 set out a gated process for the co-ordination and development of a consistent set of SROs.

This gated process provides a mechanism for the industry, regulators, stakeholders and customers to input into the development and scheduling of these strategic solutions, through a combined set of statutory and regulatory processes. These include the National Framework, Drinking Water Safety Plans, Business Plans and WRMPs. The group of water companies involved in developing SROs (known as the All Company working Group – ACWG), (consisting of Affinity Water, Anglian Water, Severn Trent Water, Southern Water, South West Water, Thames Water, United Utilities and Wessex Water) published a joint company statement reiterating a commitment to continue working with the Regulators' Alliance for Progressing Infrastructure Development (RAPID), the Environment Agency (EA), Natural Resources Wales (NRW), Ofwat and the Drinking Water Inspectorate (DWI) to make all of the planning processes and statutory timetables a success.

The Minworth SRO has been identified as an SRO in the PR19 Final Determination, with funding allocated to Severn Trent Water (STW) and Affinity Water (AW). The Minworth SRO is a wastewater augmentation option that will provide treated wastewater from the wastewater treatment works which can be discharged into the River Avon to support the River Severn to River Thames Transfer or discharged into the canal network to support the Grand Union Canal transfer. This solution has a capacity up to 215Ml/d.

The ACWG methodology[2] states that the Habitats Regulations Assessment (HRA) for each SRO should be undertaken in accordance with available guidance for England and Wales and should be based on a precautionary approach as required under the HRA process. The requirement for a HRA is established through the Conservation of Habitats and Species Regulations 2017 (as amended), commonly referred to as the Habitats Regulations.

As the gate-1 submission does not form a statutory plan or project, STW and AF have undertaken an assessment of the implications of the different elements contained of the Minworth SRO by adopting the *principles* of the HRA process to help identify risks to feasibility and deliverability of these elements as well as the additional monitoring and assessment work required to inform the formal HRA at gate-2. An in-combination assessments with other SROs, non-SRO options and other plans and projects has not been undertaken. It is understood that such assessments will be undertaken as part of the relevant regional plan or WRMP24 assessment processes.

[1] Ofwat (2019), PR19 Final Determinations, Strategic regional water resource solutions appendix
[2] Mott MacDonald Limited (2020). All Companies Working Group WRMP environmental assessment guidance and applicability with SROs. Published October 2020

The HRA screening has indicated that a risk of Likely Significant Effect (LSE) has been identified for the Minworth wastewater treatment works (WwTW) diversion (215 Ml/d) element (see **Table A**)

As such, further assessment was required subject to the principles of the Stage 2 Appropriate Assessment to identify if the element can meet the requirements of the integrity test and if further survey, assessment and mitigation development is required to provide greater certainty to any conclusions.

Table A: Summary of HRA Stage 1 Screening Assessment of the Minworth SRO

Element	Stage 1 Screening Assessment - risk of likely significant effect on European site(s) alone?	Stage 1 Screening Assessment - risk of likely significant effect on European site(s) In-combination with other elements?
Minworth / GUC (100 Ml/d)	No	No
Minworth / STT (115 Ml/d)	No	No
Minworth Combined (215 Ml/d)	Yes	No

The Appropriate Assessment concluded that adverse effects on the site integrity of the Humber Estuary SAC and Ramsar site was not predicted. Available data suggest that associated waterbodies provide limited off-site functional habitat. In addition, Natural England (NE) has identified that distribution of river and sea lamprey in the River Trent is severely limited by Cromwell weir, which is considered as impassable to river lamprey. Flows and water quality impacts will be limited to the reaches upstream of the confluence of the River Trent and the River Derwent and freshwater inflows, water quality and other estuarine process will be unaffected.

However, it is recommended that detailed monitoring is undertaken, to further understand the hydrological, water quality and geomorphological dynamics along the River Tame and River Trent and to determine if the expected reductions in flow (alone and in-combination with other plans and projects) could impact on qualifying habitats and species and to what extent.

Surveys (including targeted surveys) are also required to confirm that the associated waterbodies do not provide supporting habitat for river and sea lamprey.

The conclusion on the risk of LSE and adverse effects will need to be reviewed and updated (where required) as more information becomes available during completion of the gate-2 assessments, including any bespoke hydrological, habitat and/or water quality modelling.

1 Introduction

1.1 Background and purpose of report

Water companies in England and Wales are required to produce a Water Resources Management Plan (WRMP) every five years. The Plan sets out how the company intends to maintain the balance between supply and demand for water over the selected planning horizon (minimum 25 years) in order to ensure security of supply in each of the water resource zones making up its supply area.

Following submission of WRMPs in 2019, Ofwat through the Price Review 2019 (PR19) Final Determination, has identified the potential for companies to jointly deliver strategic regional water resources solutions to secure long-term resilience on behalf of customers while protecting the environment and benefiting wider society. As part of the assessment of companies' PR19 business plans, Ofwat introduced proposals to support the delivery of Strategic Regional Water Resource Options (SROs) over the next 5 to 15 years with solutions considered to be 'construction ready' for the 2025-2030 period. Ofwat's Final Determination[3] in December 2019 set out a gated process for the co-ordination and development of a consistent set of SROs.

This gated process provides a mechanism for the industry, regulators, stakeholders and customers to input into the development and scheduling of these strategic solutions, through a combined set of statutory and regulatory processes. These include the National Framework, Drinking Water Safety Plans, Business Plans and WRMPs. The group of water companies involved in developing SROs (known as the All Company working Group – ACWG), (consisting of Affinity Water, Anglian Water, Severn Trent Water, Southern Water, South West Water, Thames Water, United Utilities (UU) and Wessex Water) published a joint company statement reiterating a commitment to continue working with the Regulators' Alliance for Progressing Infrastructure Development (RAPID), the Environment Agency (EA), Natural Resources Wales (NRW), Ofwat and the Drinking Water Inspectorate (DWI) to make all of the planning processes and statutory timetables a success.

The Minworth SRO has been identified as an SRO in the PR19 Final Determination, with funding allocated to Severn Trent Water (STW) and Affinity Water (AW). The Minworth SRO is a wastewater augmentation option that will provide treated wastewater from the wastewater treatment works which can be discharged into the River Avon to support the River Severn to River Thames Transfer or discharged into the canal network to support the Grand Union Canal transfer. This solution has a capacity up to 215Ml/d.

In October 2020, the ACWG, published[4] environmental assessment methods for SROs which is aligned to the draft Water Resources Planning Guideline (WRPG): Working Version for Water Resource Management Plan 2024 (WRMP24) to increase the consistency of environmental assessment and the evaluation of impacts on environmental water quality in particular.

The ACWG methodology states that the Habitat Regulation Assessment (HRA) for each SRO should be undertaken in accordance with available guidance for England and Wales and should be based on a precautionary approach as required under the HRA process. The requirement for a Habitat Regulation Assessment is established through the Conservation of Habitats and Species Regulations 2017 (as amended), commonly referred to as the Habitats Regulations. Under Regulations 63 and 105, any plan or project which is likely to have a significant effect on a European site (either alone or in-combination with other plans or projects) and is not directly connected with, or necessary for the management of the site, must be subject to a HRA to determine the implications for the site in view of its conservation objectives.

As such, each SRO should meet the requirements of the Habitats Regulations before implementation.

The amended 2017 Habitats Regulations have created a national site network on land and at sea, including both the inshore and offshore marine areas in the UK. The national site network includes:

[3] Ofwat (2019), PR19 Final Determinations, Strategic regional water resource solutions appendix
[4]

- existing Special Areas of Conservation (SACs)[5] and Special Protected Areas (SPAs)[6]
- new SACs and SPAs designated under these Regulations

Designated Wetlands of International Importance (known as Ramsar sites) do not form part of the national site network. Many Ramsar sites overlap with SACs and SPAs, and may be designated for the same or different species and habitats. All Ramsar sites are protected in the same way as SACs and SPAs.

For ease of reference through this HRA report, these designations are collectively referred to as "European sites". As per Natural England (NE) guidance[7], any HRA should also consider any European Marine Protected Areas (MPAs) within England's inshore waters (out to 12 nautical miles) to support sites in achieving conservation objectives and to guide effective management. No MPAs of European importance or Marine Conservation Zones (MCZs) are associated with the study area and therefore, no further consideration is required to inform the Strategic Environmental Assessment (SEA).

This HRA report aims to establish whether schemes included in the Minworth SRO are likely to have a significant effect on European sites, either alone or in-combination. This is judged in terms of the implications of the plan for a site's conservation objectives, which relate to its 'qualifying features' (i.e. those Annex I habitats, Annex II species, and Annex I bird populations for which it has been designated). Significantly, HRA is based on a rigorous application of the precautionary principle. Where uncertainty or doubt remains, an impact should be assumed, triggering the requirement for Appropriate Assessment of that scheme.

1.2 Requirements for Habitat Regulations Assessments

As the gate-1 submission does not form a statutory plan or project[8], the *principles* of the HRA process have been applied to help identify *risks* to feasibility and deliverability of the schemes (alone and in-combination).

As such there is no competent authority undertaking the integrity test.

HRA Guidance for the appraisal of Plans[9], summarises the Habitats Regulations. Regulation 63 states that the Plan making authority (in this case STW and AW) shall adopt, or otherwise give effect to, the Plan only after having ascertained that it will not adversely affect the integrity of a European site, subject to Regulation 64 or 105 of the Habitats Regulations.

Regulation 64 of the Habitats Regulations states:

64. — (1) If the competent authority is satisfied that, there being no alternative solutions, the plan or project must be carried out for imperative reasons of overriding public interest (which, subject to paragraph (2), may be of a social or economic nature), they may agree to the plan or project notwithstanding a negative assessment of the implications for the European site or the European offshore marine site (as the case may be).

(2) Where the site concerned hosts a priority natural habitat type or a priority species, the reasons referred to in paragraph (1) must be either —

(a) reasons relating to human health, public safety or beneficial consequences of primary importance to the environment; or

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[5] SACs were designated under the Habitats Directive (92/43/EEC) and target particular habitats (Annex 1) and/or species (Annex II) identified as being of European importance.
[6] SPAs were classified under the European Council Directive 'on the conservation of wild birds' (2009/147/EC; 'Birds Directive') for the protection of wild birds and their habitats (including particularly rare and vulnerable species listed in Annex 1 of the Birds Directive, and migratory species).
[7] Help Note: Tips and advice on how to assess potential impacts of water company statutory plans on the marine environment1 – Focussing on Marine Conservation Zones (MCZ)
[8] Ofwat 3 April 2020 Strategic Regional Water Resource Solutions: Gate one assessment. Letter issued via email to Regulatory Directors of companies with strategic regional water resource solutions.

[9] Tyldesley, D. & Chapman, C. (2013) The Habitats Regulations Assessment Handbook, November 2020 edition UK: DTA Publications Limited.

(b) (b) any other reasons which the competent authority, having due regard to the opinion of the Appropriate Authority, consider to be imperative reasons of overriding public interest.

Regulation 105 of the Habitats Regulations states:

105. — (1) Where a land use plan —

(a) is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and

(b) (b) is not directly connected with or necessary to the management of the site, the plan-making authority for that plan must, before the plan is given effect, make an appropriate assessment of the implications for the site in view of that site's conservation objectives.

(2) The plan-making authority must for the purposes of the assessment consult the appropriate nature conservation body and have regard to any representations made by that body within such reasonable time as the authority specify.

(3) They must also, if they consider it appropriate, take the opinion of the general public, and if they do so, they must take such steps for that purpose as they consider appropriate.

(4) In the light of the conclusions of the assessment, and subject to regulation 103 (considerations of overriding public interest), the plan-making authority or, in the case of a regional strategy, the Secretary of State must give effect to the land use plan only after having ascertained that it will not adversely affect the integrity of the European site or the European offshore marine site (as the case may be).

(5) A plan-making authority must provide such information as the appropriate authority may reasonably require for the purposes of the discharge of the obligations of the appropriate authority under this Chapter.

(6) This regulation does not apply in relation to a site which is —

(a) a European site by reason of regulation 8(1)(c), or

(b) a European offshore marine site by reason of regulation 15(c) of the 2007 Regulations (site protected in accordance with Article 5(4) of the Habitats Directive).

Best practice guidance[10] recommends that if there are no alternative solutions and if, in exceptional circumstances, it is proposed that a Plan be adopted despite the fact that it may adversely affect the integrity of a European site, the HRA will need to address and explain the Imperative Reasons of Overriding Public Interest (IROPI) which the Plan making authority considers to be sufficient to outweigh the potentially adverse effects on the European site(s). As noted above, the HRA process will be applied to help identify risks to feasibility and deliverability of the schemes. As such, it is expected that schemes that are likely to result in adverse effects on site integrity will either be amended or will not be taken forward for consideration in gate-2.

1.3 Structure of the report

The report is divided into the following sections:

- Section 1: This introduction
- Section 2: Provides a background to the Minworth SRO
- Section 3: Provides the methodology adopted for the HRA
- Section 4: Provides the results of the screening of the individual Minworth schemes
- Section 5: Information to inform the Appropriate Assessment
- Section 6: Conclusions and Recommendations

[10] Tyldesley, D. & Chapman, C. (2013). The Habitats Regulations Assessment Handbook, February 2021 edition UK: DTA Publications Limited..

2 Minworth SRO

2.1 Introduction

The Minworth SRO considered integral to a Severn to Thames Transfer (STT) System and in the delivery of the Grand Union Canal (GUC) transfer SRO.

A STT conveying raw water from the lower River Severn into the upper or middle River Thames via an interconnector would increase the catchment area from which water resources can be drawn to the south-east of England. In addition to any flows that may be available to be abstracted under licence from the River Severn, a range of raw water transfer supporting source options for the STT are under consideration to provide additional resource.

The STT SRO comprises 2 principal aspects:

1. Severn to Thames Conveyance – Deerhurst to Culham pipeline or canal conveyance, including piping to Culham.
2. Source rivers used to transport water associated with supported abstractions (rivers Vyrnwy, Severn, Avon and Thames).

In order for all of the STT Support Elements to be able to deliver the water into the STT System there is a requirement for these water supplies to be replaced with other water sources (aspect 2 above). The provision of this additional water is covered under separate SROs that provide the facilities to enable supporting flows for the STT System.

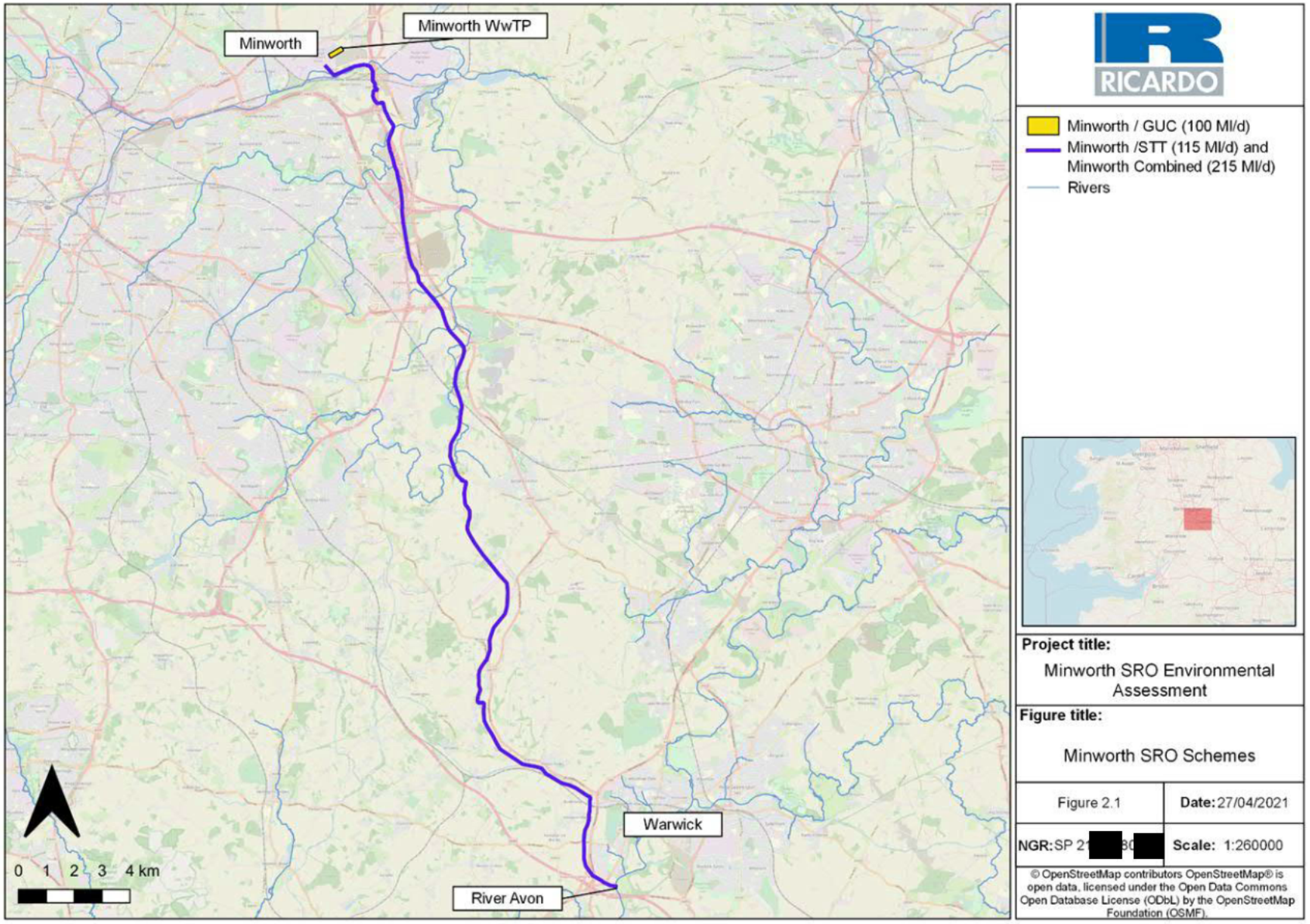
These SROs include the Minworth SRO, STW Sources SRO, UU Sources SRO and UU Lake Vyrnwy SRO. The STT System, therefore, comprises the STT SRO and the source SROs which would be required to work as a combined system to deliver the required outputs into the River Thames.

As noted above, the Minworth SRO is also critical in the delivery of the GUC Transfer SRO which will comprise of the transfer of treated wastewater down the GUC to supply AW. This comprises of a new tertiary treatment process before a direct discharge into the canal network, canal transfer to a new abstraction near Hemel Hempstead, and the onward transfer of raw water to a new water treatment works and expanded reservoir. The HRA for GUC is considered within the GUC SRO submission, and it is just the tertiary treatment and the removal of up to 100 Ml/d of wastewater discharge to the River Tame, which is being assessed within this HRA study. The GUC work is jointly managed in partnership between the water companies and Canal & River Trust. This solution ranges from 50 to 100 Ml/d in capacity.

Minworth SRO includes three schemes:

1. Minworth / GUC (100 Ml/d)
2. Minworth / STT (115 Ml/d)
3. Minworth Combined (215 Ml/d)

A more detailed description of each element is provided in the Figure 2.1 and in the sections below.


Minworth
Minworth WwTP
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RICARDO
Minworth / GUC (100 Ml/d)
Minworth /STT (115 Ml/d) and
Minworth Combined (215 Ml/d)
Rivers
Project title:
Minworth SRO Environmental Assessment
Figure title:
Minworth SRO Schemes
Figure 2.1
Date: 27/04/2021
NGR: SP 21 [redacted]
Scale: 1:260000
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2.2 Minworth / GUC (100 Ml/d)

Currently treated wastewater from the Minworth wastewater treatment works (WwTW) is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 100 Ml/d portion of this treated wastewater to the GUC system.

This assessment relates to the upgrade to the WwTW site associated with the discharge into the GUC and with a capacity of up to 100 Ml/d. The discharge into the GUC will require upgrades to ensure discharges of a maximum of 0.2mg/l Total Phosphorous. This will consist of the installation of Ballasted Magnetite Coagulation (CoMag™, Evoqua) Technology. All construction will be within the existing boundaries of the Minworth WwTW site. This assessment also considers any impacts on the River Tame system regarding the diversion of up to 100Ml/d of treated wastewater discharge from Minworth.

The pipeline and discharge of 100Ml/d to the GUC is considered under the GUC Transfer SRO and does not form part of this assessment.

2.3 Minworth / STT (115 Ml/d)

Currently treated wastewater from the Minworth WwTW is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 115 Ml/d portion of this treated wastewater to a new outfall on the River Avon and hence into the River Severn catchment to support STT abstraction from the River Severn at Deerhurst or Gloucester Docks.

There would be an upgrade to the existing Minworth WwTW to improve the existing quality of wastewater to an acceptable standard for discharge to the River Avon. The discharge into the River Avon will require additional treatment technologies. The upgrades for this option will include the installation of a Ballasted Magnetite Coagulation (CoMagTM, Evoqua) Technology, UV disinfection units and Granular Activated Carbon units. All construction will be within the existing boundaries of the Minworth WwTW site.

In addition, this element comprises a pumping station at the Minworth WwTW site and pipeline from the Minworth WwTW site to a new outfall on the River Avon. The pipeline from Minworth WwTW to the River Avon outfall would be some 37.6km in length. The outfall location has been identified, during studies undertaken a gate-1, and would be located on the River Avon to the south of Warwick.

This assessment relates to the upgrade of the WwTW site associated with the discharge into the River Avon, and the pipeline to the River Avon. This assessment also considers any impacts on the River Tame system regarding the diversion of up to 115Ml/d of treated wastewater discharge from Minworth.

The assessment of the discharge of some 115 Mld to the River Avon is considered as part of the STT SRO and does not form part of this assessment.

2.4 Minworth Combined (215 Ml/d)

Currently treated wastewater from the Minworth WwTW is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 215 Ml/d portion of this treated wastewater. With a 115 Ml/d portion being diverted to a new outfall on the River Avon and hence into the River Severn catchment to support STT abstraction from the River Severn at Deerhurst or Gloucester Docks and 100 Ml/d being diverted to the GUC.

There would be upgrades to the existing Minworth WwTW site necessary to improve the existing quality of wastewater to an acceptable standard for each discharge location (as noted below). As a result of the analysis of the receiving water quality (canal and river) and the location of the potential wastewater discharges, different levels of treatment would be required for each option.

The discharge into the GUC will require upgrades to ensure discharges of a maximum of 0.2mg/l Total Phosphorous. This will consist of the installation of Ballasted Magnetite Coagulation (CoMag™, Evoqua) Technology.

The discharge into the River Avon will require additional treatment technologies. The upgrades for this option will include the installation of a Ballasted Magnetite Coagulation (CoMagTM, Evoqua) Technology, UV disinfection units and Granular Activated Carbon units.

The upgrade works in both cases will be located in the same area of the existing WwTW site. All construction will be within the existing boundaries of the Minworth WwTW site.

In addition, this element comprises a pumping station at the Minworth WwTW site and a pipeline from the Minworth WwTW site to a new outfall on the River Avon. The pipeline from Minworth WwTW to the River Avon outfall would be some 37.6km in length. The outfall location has been identified, during studies undertaken at gate-1, and would be located on the River Avon to the south of Warwick.

This assessment relates to the upgrade of the WwTW site associated with discharges to both the River Avon and the GUC, and the pipeline to the River Avon. This assessment also considers any impacts on the River Tame system regarding the diversion of up to 125Ml/d of treated wastewater discharge from Minworth.

The assessment of the discharge of some 115 Mld to the River Avon is considered as part of the STT SRO and does not form part of this assessment. The pipeline and discharge of 100Ml/d to the GUC is considered under the GUC Transfer SRO and does not form part of this assessment.

3 Methodology

3.1 Introduction

The ACWG guidelines indicate that a HRA should be undertaken in accordance with available guidance[1112131415161718] and should be based on a precautionary approach as required under the Conservation of Habitats and Species Regulations 2017 (as amended).

The HRA required for gate-1 has been carried out in line with the ACWG current guidance for SRO Environmental Assessment. The requirements and outputs of the assessment are consistent with those in the WRSE Regional Plan Environmental Assessment Methodology Guidance, as well as the WRPG guidance for WRMP24.

The objective of this HRA is to establish whether any of the schemes for the Minworth SRO is likely to have a significant effect on European sites (alone and in combination with each other when forming the Minworth SRO).

In-combination assessments with other SROs, non-SRO options and other plans and projects in regional plans and WRMP24 will be undertaken as part of the relevant regional plan or WRMP24 assessment processes.

As the gate-1 submission does not form a statutory plan or project, the principles of the HRA process were applied to help identify *risks to feasibility* and deliverability of the schemes. A Stage 1 (screening) assessment was undertaken as part of the initial screening exercise for each of the elements, and the *risk* of failing the integrity test was reviewed for each element, using the principles of the Stage 2 (Appropriate Assessment) assessment (where required).

3.1.1 Stage 1 Screening

For gate-1, each scheme (either alone or in-combination) was considered to determine whether there were any risk of Likely Significant Effect (LSE) arising from construction or implementation activities and/or operation of the schemes on one or more European sites.

GIS data was used to map the locations and boundaries of European sites in relation to the three different schemes; within 10km of construction and operation works and 500m of rivers associated with the current discharge of treated wastewater. The attributes of the European sites, which contribute to and define their integrity, current conservation status and the specific sensitivities of the site were considered with reference to:

- Standard Data forms for SACs and SPAs and Information Sheets for Ramsar sites. An analysis of these information sources has enabled the identification of the site's qualifying features.
- Article 12 and 17 reporting,
- Site conservation objectives,
- Supplementary advice to the conservation objectives (SACO) where available
- Site Improvement Plans, and
- the supporting Site of Special Scientific Interest's favourable condition tables where relevant and no SACOs applicable to the features were available.

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[11] Court of Justice for the European Union's ruling on People Over Wind and Sweetman ('Sweetman II') vs Coillte Teoranta, Case C-323/17.
[12] UK Government (2019). Guidance on the use of Habitats Regulations Assessment.
[13] UK Government (2019). Conservation of Habitats and Species Regulations (Amendment) (EU Exit).
[14] Natural England (2020). Guidance on how to use Natural England's Conservation Advice Packages in Environmental Assessments.
[15] Tyldesley, D. & Chapman, C. (2013). The Habitats Regulations Assessment Handbook, February 2021 edition UK: DTA Publications Limited.
[16] Environment Agency and Natural Resources Wales (2017). Water resources planning guideline – April 2017
[17] European Commission (2018). Managing Natura 2000 sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC. European Union, 1-86.
[18] Defra (2012). The Habitats and Wild Birds Directives in England and its seas: Core guidance for developers, regulators & land/marine managers.

Analysis of how potential impacts of each element could affect a European site was undertaken using this information.

The qualifying habitats and species of European sites are vulnerable to a wide range of impacts such as physical loss or damage of habitat, disturbance from noise, light, human presence, changes in hydrology (e.g. changes in water levels/flow, flooding), changes in water or air quality and biological disturbance (e.g. direct mortality, introduction of disease or non-native species). The assessment considered the construction and operational effects.

In determining the likelihood of significant effects on European sites, particular consideration was given to the possible source-receptor pathways through which effects may be transmitted from activities associated with each element, to features contributing to the integrity of the European sites (e.g. surface water catchments, air, etc.).

Screening for LSEs was determined on a proximity basis for many of the types of impacts, based on the proximity of the potential location of the elements, to each European site. Where impact pathways were identified at greater distances (>10km) as a result of hydrological connectivity for example, designated sites were screened in as appropriate. Different types of impacts can occur over different distances, and as such the assumptions and distances used in the HRA and a justification for their use are provided in **Table 3.1**.

Consideration was also given to the Natural England (NE) SSSI Impact Risk Zone (IRZ) datasets. The IRZs are reviewed regularly to ensure they reflect the current understanding of specific site sensitivities and potential risks posed to SSSIs. Where the notified features of a European site and SSSI are different, the SSSI IRZs have been set so that they reflect both. As such, these IRZs were used as part of a HRA to assist with determining whether there are likely to be significant effects from a particular development on the interest features of the European site.

Table 3.1: Potential impacts of scheme on European sites.

Broad categories of potential impacts on European sites, with examples	*Examples of operations responsible for impacts* (distance assumptions in italics)
Physical loss: • Removal (including offsite effects, e.g. foraging habitat, and removal of supporting habitat within boundary of a SPA) • Smothering	*Development of infrastructure associated with scheme, e.g. new or temporary pipelines, transport infrastructure, temporary weirs.* *Indirect effects from a reduction in flows e.g. drying out marginal habitat.* Physical loss is most likely to be significant where the boundary of the scheme extends within the boundary of the European site, or within an offsite area of known foraging, roosting, breeding habitat (that supports species for which a European site is designated).
Physical damage: • Sedimentation / silting • Prevention of natural processes including coastal and fluvial bank stabilisation, prevention of long-shore drift etc. • Habitat degradation • Erosion • Fragmentation • Severance/barrier effect • Edge effects	*Reduction in river flow leading to permanent and/or temporary loss of available habitat, sedimentation/siltation, fragmentation, etc.* Physical damage is likely to be significant where the boundary of the scheme extends within or is directly adjacent to the boundary of the European site, or within/adjacent to an offsite area of known foraging, roosting, breeding habitat (that supports species for which a European site is designated, or where natural processes link the scheme to the site, such as through hydrological connectivity downstream of a scheme, long shore drift along the coast, or the scheme impacts the linking habitat).
Non-physical disturbance: • Noise (incl. underwater)	*Noise from temporary construction or temporary pumping activities.*

Broad categories of potential impacts on European sites, with examples	*Examples of operations responsible for impacts* (distance assumptions in italics)
• Visual presence • Human presence • Light pollution • Vibration (incl. underwater).	Taking into consideration the noise level generated from general building activity (c. 122dB(A)) and considering the lowest noise level identified in appropriate guidance as likely to cause disturbance to bird species, it is concluded that noise impacts could be significant up to 1km from the boundary of the European site[19]. *Noise from vehicular traffic during operation of a scheme.* Noise from construction traffic is only likely to be significant where the transport route to and from the scheme is within 3-5km of the boundary of the European site. *Plant and personnel involved in in operation of the scheme.* These effects (noise, visual/human presence) are only likely to be significant where the boundary of the scheme extends within or is directly adjacent to the boundary of the European site, or within/adjacent to an offsite area of known foraging, roosting, breeding habitat (that supports species for which a European site is designated). *Schemes which might include artificial lighting, e.g. for security around a temporary pumping station.* Effects from light pollution are only likely to be significant where the boundary of the scheme is within 500m of the boundary of the European site. *Vibration from temporary construction* From a review of Environment Agency internal guidance on HRA and various websites/sources[20,21,22] it is considered that effects of vibration are more likely to be significant if development is within 500m of a European site.
Water table/availability: • Drying • Flooding / stormwater • Changes to surface water levels and flows including both increases and reductions. • Changes in groundwater levels and flows • Changes to coastal water movement	*Changes to water levels and flows due to increased water abstraction, reduced storage or reduced flow releases from reservoirs to river systems.* These effects are only likely to be significant where the boundary of the scheme extends within the same ground or surface water catchment as the European site. However, these effects are dependent on hydrological continuity between the scheme and the European site, and sometimes, whether the scheme is up or down stream from the European site.

[19] British Standards Institute (BSI) (2009) BS5228 - Noise and Vibration Control on Construction and Open Sites. BSI, London.
[20] Institute of Lighting Professionals (2011) Guidance Notes for the Reduction of Obtrusive Light GN01:2011
[21] Environment Agency (2013 Bird Disturbance from Flood and Coastal Risk Management Construction Activities. Overarching Interpretive Summary Report. Prepared by Cascade Consulting and Institute of Estuarine and Coastal Studies.
[22] Cutts N, Hemingway K and Spencer J (2013) The Waterbird Disturbance Mitigation Toolkit Informing Estuarine Planning and Construction Projects. Produced by the Institute of Estuarine and Coastal Studies (IECS). Version 3.2.

Broad categories of potential impacts on European sites, with examples	*Examples of operations responsible for impacts* (distance assumptions in italics)
Toxic contamination: • Water pollution • Soil contamination • Air Pollution	*Reduced dilution in downstream or receiving waterbodies due to changes in abstraction or reduced compensation flow releases to river systems.* These effects are only likely to be significant where the boundary of the scheme extends within the same ground or surface water catchment as the European site. However, these effects are dependent on hydrological continuity between the scheme and the European site, and sometimes, whether the scheme is up or down stream from the European site. *Air emissions associated with plant and vehicular traffic during construction and operation of schemes.* The effect of dust is only likely to be significant where site is within or in proximity to the boundary of the European site[23,24]. Without mitigation, dust and dirt from the construction site may be transported onto the public road network and then deposited/spread by vehicles on roads up to 500m from large sites, 200m from medium sites, and 50m from small sites as measured from the site exit. Effects of road traffic emissions from the transport route to be taken by the project traffic are only likely to be significant where the protected site falls within 200 metres of the edge of a road affected[25].
Non-toxic contamination: • Nutrient enrichment (e.g. of soils and water) • Algal blooms • Changes in salinity • Changes in water chemistry (e.g. pH, calcium balance etc) • Changes in thermal regime • Changes in turbidity • Changes in sedimentation/silting	*Changes to water salinity, nutrient levels, turbidity, thermal regime due to increased water abstraction, storage, or reduced compensation flow releases to river systems.* These effects are only likely to be significant where the boundary of the scheme extends within the same ground or surface water catchment as the European Site. However, these effects are dependent on hydrological continuity between the scheme and the European site, and sometimes, whether the scheme is up or down stream from the European site.
Biological disturbance: • Direct mortality • Changes to habitat availability • Out-competition by non-native species • Selective extraction of species • Introduction of disease • Rapid population fluctuations • Natural succession	*Potential for changes to habitat availability, for example reductions in wetted width of rivers leading to desiccation of macrophyte beds due to changes in abstraction or reduced compensation flow releases to river systems. In addition, via removal of vegetation (including hedgerows and trees) used by based as foraging, roosting and hibernation sites and birds as roosting and nesting sites.* *Creation of new pathway of non-native invasive species.* This effect is only likely to be significant where the scheme is situated within the European site or an upstream tributary of the European site (or affects

[23] Highways Agency (2003) Design Manual for Roads and Bridges (DMRB), Volume 11.
[24] Institute of Air Quality Management (2014) Guidance on the assessment of dust from demolition and construction v1.1.
[25] NE Internal Guidance – Approach to Advising Competent Authorities on Road Traffic Emissions and HRAs V1.4 Final - June 2018

Broad categories of potential impacts on European sites, with examples	*Examples of operations responsible for impacts* (distance assumptions in italics)
	groundwater levels supporting these sites or tributaries) *Entrapment during in-river or terrestrial construction works causing injury and/or mortality of mobile species* Likely to be a risk of entrapment, injury and/or mortality where the boundary of the option extends within or is directly adjacent to the boundary of a European site or within/adjacent to offsite functionally linked habitat. Mobile species could include fish, bats and European otters for example. *Potential for changes to habitat availability via removal of vegetation (including hedgerows and trees) to facilitate construction activities and potential entrapment, injury and/or mortality of breeding birds and roosting/hibernating bats.* This effect is dependent on the requirement to remove vegetation (if it cannot be avoided), ecological surveys to determine species presence and timing of removal based on species specific ecological considerations.

3.1.2 Stage 2 Appropriate Assessment

Where an LSE is identified for a scheme at the screening stage (noting the precautionary principle), the scheme will be subject to the *principles* of the Stage 2 Appropriate Assessment, noting again that the gate-1 submission does not form a statutory plan or project and as such there is no competent authority undertaking the integrity test.

Further assessment will, therefore, be undertaken to identify where it is predicted that the integrity test cannot be met, and to identify further surveys, assessment and mitigation requirements to provide greater certainty to any conclusions.

The Appropriate Assessment will consider the potentially damaging aspects of the elements, both construction and operation, and the potential effects on the associated European site's qualifying features and achievement of the conservation objectives and characterised the impacts in terms of their likelihood, nature, scale, severity and duration.

The potential for adverse effects on the integrity of a European site depends on the scale and magnitude of the action and its predicted impacts, taking into account the distribution of the qualifying features across the site in relation to the predicted impact and the location, timing and duration of the proposed activity and the level of understanding of the effect, such as whether it has been recorded before and, based on current ecological knowledge, whether it can be expected to operate at the site in question.

Impacts

To determine adverse effect on site integrity, the following parameters will be used as appropriate to define the impact (i.e. mechanism by which effects are caused):

- Impact type - direct or indirect, positive or negative
- Magnitude of impact – the 'amount' or intensity of an impact. This may sometimes (but not always) be synonymous with 'extent' (see below) for certain impacts, such as habitat loss.
- Extent of impact – the area over which the impact will be felt.
- Duration of impact – how long it will occur. The guidelines suggest that ecological impact durations should be described in terms of ecological characteristics (e.g. species lifecycles/longevity) rather than human timeframes. The definitions of duration based on this approach and using professional judgement are detailed in **Table 3.2**.

- Timing of impact – when it will occur, taking note of seasonality.
- Frequency of impact – how often it will occur.
- Reversibility of impact – whether recovery or reinstatement is possible.

Table 3.2: Definitions of impact duration

Duration	Habitats	*Species*
Short-term	The typical regrowth period for many submerged macrophytes, grass and herb communities – as a rough guide, up to two years	*Impact is measurable up to one (breeding/wintering, migration, spawning etc.) season – as a rough guide, up to a year for fauna*
Medium-term	The typical regrowth period for many shrub and hedge communities, slower growing macrophytes and reedbeds – as a rough guide, two to eight years	*Impact is measurable up to one typical reproductive lifespan (in the wild). This varies depending on species, but generally anything from one year to 5 years as a rough guide for most fauna*
Long-term	A period lasting longer than the typical scrub/hedge regrowth period – as a rough guide, more than 8 years	*Impact is measurable over several (species) generations*
Permanent	An impact where no reasonable chance of recovery/restoration is evident within the foreseeable future	

These impacts then need to be considered in terms of the effects to the qualifying habitats and species.

Adverse Effect

Where required, the possible impacts associated with each element will be considered in the context of their effect on the qualifying features for the sites under consideration.

An Adverse Effect on the sites Integrity (AEoI) is likely to be one which undermines achievement of the sites conservation objectives and prevents the qualifying feature from progressing towards favourable conservation status.

This includes a monitoring programme for the freshwater communities and initial modelling of the potential physical environmental impacts. These data will be used (where applicable) to inform the Appropriate Assessment for those elements where LSEs were identified.

Any further data requirements, including the need for specific monitoring, will be identified in the Appropriate Assessment (if required) for consideration during gate-2 and gate-3. As such, the data that will be used in the more detailed assessments will be limited to that readily available.

The recommendations in this report will, therefore, inform the monitoring programmes in gate-2 and gate-3.

3.1.3 Integrity Test

The integrity test is the conclusion of an Appropriate Assessment and requires the competent authority (in this case STW and AW) to ascertain whether the proposed scheme (either alone or in-combination with other plans or projects), will have no adverse effect on site integrity. The following definition of site integrity is provided by Defra: the integrity of the site is "*the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the level of populations of the species for which it was classified*"[26].

At gate-1, the potential for AEoI will be assessed against the conservation objectives as far as possible, and where it is predicted that the integrity test cannot be met, these will be identified for further consideration for the gate-2 assessments.

[26]Defra Circular 01/2005.

3.1.4 Mitigation measures and monitoring

The assessment considered measures that may be available to reduce the likelihood, magnitude, scale, and duration of the effect to a lower level, which can be applied at the Appropriate Assessment stage to inform the overall integrity test[27]. These measures will include both avoidance and reduction measures, with the former being the preferred option.

Where necessary, the report will also recommended additional survey work that will be required to inform the gate-2 HRA and any monitoring deemed necessary either for the purposes of validating the findings of the Appropriate Assessment (where required), or 'early warning' monitoring which would enable any actions to be stopped, paused, reduced in scale or altered should an unexpected adverse effect be recorded when the SRO is being implemented.

The need for further investigation of potential mitigation measures that will be required as part of the gate-2 process will be defined as part of the Appropriate Assessment (if required) (see section 5 and 6).

3.1.5 Limitations

Information provided by third parties, including publicly available information and databases, is considered correct at the time of submission. Due to the dynamic nature of the environment, conditions may change in the period between the preparation of this report, and the construction and operation of the proposed configuration.

The compilation of information to support an assessment has been undertaken in as detailed a way as possible, using all available open source data where they exist. However, the conclusions drawn from this is necessarily limited by the age, type, coverage and availability of data. Any uncertainties and the limitations of the assessment process are acknowledged and highlighted.

Recommendations for avoidance and mitigation measures to address the potential adverse effects on European Site integrity identified by this report are also based on the information available at the time of the assessment.

It is recognised that there are still a number of uncertainties and risks that need to be managed, with further iterations of the assessment required as more detailed engineering information and modelling work becomes available, prior to gate-2. While an in-combination assessment has been undertaken of the individual elements, the in-combination assessments with other SROs, non-SRO options and other plans and projects has not been undertaken, It is understood that such assessments will be undertaken as part of the relevant regional plan or WRMP24 assessment processes.

As such, the conclusion on the risk of LSE and predictions regarding adverse effects will need to be reviewed and updated (where required) as more information becomes available during completion of the gate-2 assessments. This includes consideration of any monitoring and modelling outputs made available between submission of this report and the end date if the gate-2 assessments and any changes in the applicability and/or availability of mitigation measures.

[27] The "People over Wind" or "Sweetman" judgment ruled that Article 6(3) of the Habitats Directive must be interpreted as meaning that mitigation measures should be assessed within the framework of an Appropriate Assessment and that it is not permissible to take account of mitigation measures at the screening stage.

4 HRA Screening of Minworth SRO

4.1 Risk of Likely Significant Effects of Minworth SRO

The Minworth SRO is associated with a number of European and Internationally designated sites including SACs[28], SPAs[29] and Ramsar[30] sites as identified in **Table 4.1** below.

Table 4.1 European designated sites potentially affected by Minworth SRO

European designated site	Associated Element
Humber Estuary SAC	Minworth / GUC (100 Ml/d) Minworth / STT (115 Ml/d) Minworth Combined (215 Ml/d)
Humber Estuary SPA	Minworth / GUC (100 Ml/d) Minworth / STT (115 Ml/d) Minworth Combined (215 Ml/d)
Humber Estuary Ramsar	Minworth / GUC (100 Ml/d) Minworth / STT (115 Ml/d) Minworth Combined (215 Ml/d)
River Mease SAC	Minworth / GUC (100 Ml/d) Minworth / STT (115 Ml/d) Minworth Combined (215 Ml/d)

As described in Sections 3, this HRA has screened all of the elements located within a 10km radius of any of the European sites in the study area and 500m of rivers transferring excess water. The SSSI IRZ has also been considered when selecting European Sites that require assessment. As indicated in Section 3.1.1, to further inform the likelihood of any impacts on European sites the NE SSSI IRZ datasets were also applied. The IRZs are reviewed regularly to ensure they reflect the current understanding of specific site sensitivities and potential risks posed to SSSIs. Where the notified features of a European site and SSSI are different, the SSSI IRZs have been set so that they reflect both. As such, these IRZs can be used as part of a HRA to assist with determining whether there are risks of likely to be significant effects from a particular development on the interest features of the European site.

The HRA screening assessments of identified European sites within 10km radius or hydrologically connected to the elements for potential effects is provided in **Table 4.2.** Where uncertainty has been identified, this uncertainty indicates that a confident conclusion of no risk of LSE is not yet possible, in most cases due to the very early stage of option development (meaning specific design and location information may not be available to allow a full appraisal of the risk of likely effects). Where uncertainty remains, an Appropriate Assessment is required to either confirm a risk of LSE related to a scheme or to confirm that no risk LSE are expected.

No MPAs of European importance or MCZs are associated with the study area and therefore, no further consideration is required to inform the SEA.

[28] Special Areas of Conservation (SACs) are strictly protected sites designated under the EC Habitats Directive. Article 3 of the Habitats Directive requires the establishment of a European network of important high-quality conservation sites that will make a significant contribution to conserving the 189 habitat types and 788 species identified in Annexes I and II of the Directive (as amended). www.jncc.org.uk

[29] Special Protection Areas (SPAs) are strictly protected sites classified in accordance with Article 4 of the EC Directive on the conservation of wild birds (79/409/EEC), also known as the Birds Directive, which came into force in April 1979. They are classified for rare and vulnerable birds, listed in Annex I to the Birds Directive, and for regularly occurring migratory species. www.jncc.org.uk

[30] Ramsar sites are wetlands of international importance designated under the Ramsar Convention

Table 4.2: Screening assessments of identified European sites within 10km radius or hydrologically connected to the proposed Minworth Strategic Resource Options for potential effects.

European Site name:	Humber Estuary (UK0030170)	
Designation type: (SAC, SPA, Ramsar):	SAC	
Qualifying features:	H1130 Estuaries H1140 Mudflats and sandflats not covered by seawater at low tide H1110 Sandbanks which are slightly covered by sea water all the time H1150 Coastal lagoons *Priority feature H1310 Salicornia and other annuals colonizing mud and sand H1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H2110 Embryonic shifting dunes H2120 "Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")" H2130 "Fixed coastal dunes with herbaceous vegetation ("grey dunes")" * Priority feature H2160 Dunes with *Hippopha rhamnoides* S1095 Sea lamprey *Petromyzon marinus* S1099 River lamprey *Lampetra fluviatilis* S1364 Grey seal *Halichoerus grypus*	**Water Dependent?** Yes – all the qualifying features are classified as being water dependent.
Current conservation status (Article 17):	**H1130 Estuaries** Overall assessment of conservation status: Unfavourable - bad (range: favourable, area: unknown, structure and function: unfavourable - bad, future prospects: unfavourable - bad). Overall trend in conservation status: Unknown Main pressures and threats: Fish and Shellfish Aquaculture; professional fishing; fixed location fishing; leisure fishing; bait digging; taking / removal of fauna, general; taking / removal of flora, general; hunting, fishing or collecting activities not referred to above; sand and gravel extraction; urbanised areas, human habitation; industrial or commercial areas; discharges; port areas; energy transport; pipe lines; shipping; nautical sports; motorised vehicles; pollution; water pollution; trampling, overuse; landfill, land reclamation and drying out, general; polderisation; reclamation of land from sea, estuary or marsh; infilling of ditches, dykes, ponds, pools, marshes or pits; removal of sediments (mud...); canalisation; flooding; modification of hydrographic functioning, general; modification of marine currents; management of water levels; dumping, depositing of dredged deposits; dykes, embankments, artificial beaches, general; sea defence or coast protection works; erosion; drying out / accumulation of organic material; eutrophication; acidification; invasion by a species; interspecific faunal relations; interspecific floral relations; genetic pollution. **H1140 Mudflats and sandflats not covered by seawater at low tide** Overall assessment of conservation status: Unfavourable - bad (range: favourable, area: unknown, structure and function: unfavourable - bad, future prospects: unfavourable - bad). Overall assessment of conservation trend: Unknown Main pressures and threats: fish and shellfish aquaculture; professional fishing; fixed location fishing; leisure fishing; bait digging; urbanised areas, human habitation; industrial or commercial areas; discharges; port areas; sport and leisure structures; nautical sports; motorised vehicles; pollution; water pollution; trampling, overuse; dykes, embankments, artificial beaches, general; erosion; eutrophication; invasion by a species; interspecific faunal relations; interspecific floral relations; genetic pollution. **H1110 Sandbanks which are slightly covered by sea water all the time** Overall assessment of conservation status: Unfavourable - bad (range: favourable, area: unknown, structure and function: unfavourable - bad, future prospects: unfavourable - bad). Overall trend in conservation status: Unknown Main pressures and threats: fish and shellfish aquaculture; professional fishing; trawling; drift-net fishing; leisure fishing; sand and gravel extraction; exploration and extraction of oil or gas; urbanised areas, human habitation; industrial or commercial areas; discharges; port areas; energy transport; pipe lines; shipping; pollution; water pollution; Modification of hydrographic functioning, general; modification of marine currents; dumping, depositing of dredged deposits; sea defence or coast protection works; erosion; eutrophication; invasion by a species; interspecific faunal relations; other forms or mixed forms of interspecific faunal competition; introduction of disease; genetic pollution. **H1150 Coastal lagoons:** Overall assessment of conservation status: Unfavourable - Inadequate (range: favourable, area: favourable, structure and function: unfavourable – Inadequate, future prospects: unknown) Overall trend in conservation status: Stable Main pressures and threats: agricultural activities generating marine pollution, modification of coastline, estuary and coastal conditions for development, use and protection of residential, commercial, industrial and recreational infrastructure and areas, modification of flooding regimes, other invasive alien species, mixed source marine water pollution, modification of hydrological flow, temperature changes, increases or changes in precipitation due to climate change, sea-level and wave exposure changes due to climate change and change of habitat location, size, and/or quality due to climate change. **H1310 Salicornia and other annual colonising mud and sand** Overall assessment of conservation status: unfavourable – bad (range: favourable, area: unfavourable – inadequate, structure and function: unfavourable - bad, future prospects: unfavourable – bad) Overall trend in conservation status: Unknown Main pressures and threats: wind, wave and tidal power, including infrastructure, shipping lanes, ferry lanes and anchorage infrastructure, modification of coastline, estuary and coastal conditions for development, use and protection of residential, commercial, industrial and recreational infrastructure and areas, harvesting or collecting of other wild plants and animals, other invasive alien species, mixed source air pollution, air-borne pollutants and sea-level and wave exposure changes due to climate change. **H1130 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)** Overall assessment of conservation status: Unfavourable - bad (range: favourable, area: unfavourable – inadequate; structure and function: unfavourable - bad, future prospects: unfavourable - bad). Overall trend in conservation status: Deteriorating Main pressures and threats: grazing; abandonment of pastoral systems; discharges; water pollution; soil pollution; military manoeuvres; reclamation of land from sea, estuary or marsh; drainage; flooding; modification of marine currents; sea defence or coast protection works; erosion; submersion; invasion by a species; competition. **H2110 Embryonic shifting dunes** Overall assessment of conservation status: unfavourable – bad (range: favourable, area: unfavourable – inadequate, structure and function: unfavourable - bad, future prospects: unfavourable – bad) Overall trend in conservation status: Deteriorating. Main pressures and threats: development and maintenance of beach areas for tourism and recreation, sports, tourism and leisure activities, modification of coastline, estuary and coastal conditions for development use and protection of residential, commercial, industrial and recreational infrastructure and areas, other invasive alien species, mixed source air pollution, air-borne pollutants, abiotic natural processes and sea-level and wave exposure changes due to climate change. **H21210 "Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")**	

	Overall assessment of conservation status: unfavourable – bad (range: favourable, area: unfavourable – inadequate, structure and function: unfavourable - bad, future prospects: unfavourable – bad) Overall trend in conservation status: Deteriorating. Main pressures and threats: development and maintenance of beach areas for tourism and recreation, sports, tourism and leisure activities, modification of coastline, estuary and coastal conditions for development use and protection of residential, commercial, industrial and recreational infrastructure and areas, other invasive alien species, problematic native species, mixed source air pollution, air-borne pollutants, abiotic natural processes and sea-level and wave exposure changes due to climate change. **H2130 "Fixed coastal dunes with herbaceous vegetation ("grey dunes")" * Priority feature** Overall assessment of conservation status: unfavourable – bad (range: favourable, area: unfavourable – inadequate, structure and function: unfavourable - bad, future prospects: unfavourable – bad) Overall trend in conservation status: Deteriorating. Main pressures and threats: extensive grazing or undergrazing by livestock, conversion to forest from other land uses or afforestation, sports, tourism and leisure activities, modification of coastline, estuary and coastal conditions for development use and protection of residential, commercial, industrial and recreational infrastructure and areas, other invasive alien species, problematic native species, mixed source air pollution, air-borne pollutants, natural succession resulting in species composition change. **H2160 Dunes with *Hippopha rhamnoides*** Overall assessment of conservation status: unfavourable – bad (range: favourable, area: unfavourable – inadequate, structure and function: unfavourable - bad, future prospects: unfavourable – bad) Overall trend in conservation status: Deteriorating. Main pressures and threats: mowing or cutting of grasslands, mixed source air pollution, air-borne pollutants, natural succession resulting in species composition change, modification of hydrological flow. **S1095 Sea lamprey *Petromyzon marinus*** Overall assessment of conservation status: Unknown (range: favourable, population: unknown, habitat for the species: unknown, future prospects: unknown). Overall trend in conservation status: Unknown. Main pressure and threats: Modification of hydrological flow; physical alteration of water bodies; drought and decrease in precipitation due to climate change; change of habitat location/size/quality due to climate change; point source and diffuse pollution generated by agricultural and forestry activities; hydropower; discharge of urban waste water. **S1099 River lamprey *Lampetra fluviatilis*** Overall assessment of conservation status: Favourable (range: favourable, population: favourable, habitat for the species: unknown, future prospects: favourable). Overall trend in conservation status: Unknown. Main pressure and threats: point source and diffuse pollution generated by agricultural activities; hydropower; discharge of urban waste water; mixed source pollution to surface and ground waters; drainage; development and operation of dams; modification of hydrological flow; physical alteration of water bodies; change of habitat location/size/quality due to climate change; invasive alien species. **S1364 Grey seal *Halichoerus grypus*** Overall assessment of conservation status: Favourable (range: favourable, population: favourable, habitat for species: favourable, future prospects: favourable) Overall trend in conservation status: Improving Main pressure and threats: management of fishing stocks and game, bycatch and incidental killing, interspecific relations, wind, wave and tidal power, including infrastructure and decline or extinction of related species due to climate change (prey, predator, parasite etc).		
Conservation objectives:	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; • The extent and distribution of the habitats of the qualifying features • The structure and function of the habitats of the qualifying features • The supporting processes on which the habitats of the qualifying features rely • The population of each of the qualifying features, and, • The distribution of the qualifying features within the site		
SSSI condition assessment:	Humber Estuary SSSI: Favourable 7.54%, Unfavourable – recovering 91.21%, Unfavourable – no change 0.17%, Unfavourable – declining 1.09%		
Site Improvement Plan (only threats and actions relevant to the Drought Plan):	1. Water pollution: Control and reduce invasive species: H1130 Estuaries, H1140 Intertidal mudflats and sandflats, S1095 Sea lamprey, S1099 River lamprey. 2. Changes in species distribution: S1095 Sea lamprey, S1099 River lamprey. 3. Invasive species: H1130 Estuaries, H1330 Atlantic salt meadows.		
Potential Effects:			
Element:		Risk of Likely Significant Effects Alone?	Risk of Likely Significant Effects In-combination with other elements?
Minworth / GUC (100Ml/d)			
Minworth / STT (115 Ml/d)	The Humber Estuary SAC is approximately 200 km downstream via hydrological connectivity from two outfall locations, where currently final treated wastewater is discharged into the River Tame. The westernmost discharge is located to the south of the site at Water Orton and the easternmost discharge is located approximately 3 km downstream between Coleshill and the confluence of the Rivers Cole, Tame and Blythe. The proposed element will result in the diversion of 115 Ml/d of final treated wastewater through a new pipeline, to the River Avon. The reduction in final treated wastewater discharge could cause an increase in nutrient concentrations (ammonia, phosphorus), pH and water temperature, as the dilution capacity around the outfall site declines. This could also impact on dissolved oxygen saturation, biochemical oxygen demand and saline intrusion, with a reduction in freshwater inputs into the estuary. A desk study reviewing water quality changes in the River Tame due to reductions in final treated wastewater against moderate Water Framework Directive limits, concluded that impacts were unlikely in relation to physiochemical pollutants. Increased sedimentation at the locality of the reduced flows is also expected. This could impact on the availability of suitable spawning sites for river lamprey and sea lamprey. However, due to the local nature of the impact, likely significant effects are not anticipated.	**No**	**No**

	Due to the distance between the Humber Estuary SAC and proposed works at WwTW and the pipeline installation, no likely significant effects during construction are anticipated. During operation, the lack of final treated wastewater release on the River Tame would cause reductions in flow and water level, reducing the extent of wetted habitat at the periphery of the River Tame. Previous assessments have estimated <5% change in wetted habitat between Q50 and Q95 flow conditions[31]. An assessment of WFD compliance[32] also concluded that hydrological impacts are limited to the reaches downstream of Minworth and are expected to be minor. In addition, flow rates are anticipated to reduce by 0.67 m³/s from upstream of the first discharge point to downstream of the second discharge point[33]. Due to the distance between the designated site and outfall locations and the anticipated localised impact on flow, geomorphology and water quality, no likely significant effects on qualifying habitats and species have been identified. However, it is recommended that detailed flow monitoring and sampling data is undertaken, to further understand the hydrological and geomorphological dynamics along the River Tame and River Trent and to determine if the expected reductions in flow (alone and in-combination with other plans and projects) could impact on qualifying habitats and species and to what extent. This assessment should focus on Atlantic salt meadows, mudflats and *Salicornia* (if present) along the lower reaches of the River Trent, in addition to river lamprey and sea lamprey spawning habitat.		
Minworth Combined (215 Ml/d)	The Humber Estuary SAC is approximately 200 km downstream via hydrological connectivity from two outfall locations, where currently final treated wastewater is discharged into the River Tame. The westernmost discharge is located to the south of the site at Water Orton and the easternmost discharge is located approximately 3km downstream between Coleshill and the confluence of the Rivers Cole, Tame and Blythe. The proposed element will result in the diversion of 215 Ml/d of final treated wastewater through a new pipeline, to the River Avon and Grand Union Canal. The reduction in final treated wastewater discharge could cause an increase in nutrient concentrations (ammonia, phosphorus), pH and water temperature, as the dilution capacity around the outfall site declines. This could also impact on dissolved oxygen saturation, biochemical oxygen demand and saline intrusion, with a reduction in freshwater inputs into the estuary. A desk study reviewing water quality changes in the River Tame due to reductions in final treated wastewater against moderate Water Framework Directive limits, concluded that impacts were unlikely in relation to physiochemical pollutants. Increased sedimentation at the locality of the reduced flows is also expected. This could impact on the availability of suitable spawning sites for river lamprey and sea lamprey. However, due to the local nature of the impact, likely significant effects are not anticipated. Due to the distance between the Humber Estuary SAC and proposed works at Minworth WwTW and the pipeline installation, no likely significant effects during construction are anticipated. During operation, the lack of final treated wastewater release on the River Tame would cause reductions in flow and water level, reducing the extent of wetted habitat at the periphery of the River Tame and potentially River Trent. An assessment of WFD compliance[34] concluded that hydrological impacts associated with the wastewater diversion would effect the River Tame from downstream of wastewater discharger location to the confluence with the River Trent and the River Trent from the confluence with the River Tame to the confluence with the River Derwent. The hydrological assessment is based on an outline operating regime for transfer to GUC SRO and an indicative assessment based on current understanding of operating rules for STT SRO. As such the operating regimes, overlaid on the reference condition flow regimes of the rivers using gauged data identify routine, extended duration significant reduction in late spring, summer and autumn river flows and particularly in low river flows. Previous assessments have estimated <5% change in wetted habitat between Q50 and Q95 flow conditions[35]. Flow rates are anticipated to reduce by 1.24 m³/s from upstream of the first discharge point to downstream of the second discharge point[33]. Due to the distance between the designated site and outfall locations and the anticipated localised impact on flow, geomorphology and water quality, no likely significant effects on qualifying habitats and species have been identified. There is some uncertainty with regards on the potential impact on the movement of migratory species (sea and river lamprey) in the River Trent and the River Tame, especially where river reaches potentially provide off-site functional habitat for these qualifying features. As such, likely significant effects could be anticipated and further assessment is required. This is based on the precautionary principal. It is also recommended that detailed flow monitoring and sampling data is undertaken, to further understand the hydrological and geomorphological dynamics along the River Tame and River Trent and to determine if the expected reductions in flow (alone and in-combination with other plans and projects) could impact on qualifying habitats and species and to what extent. This assessment should focus on Atlantic salt meadows, mudflats and *Salicornia* (if present) along the lower reaches of the River Trent, in addition to river lamprey and sea lamprey spawning habitat.	**Yes**	**No**

European Site name:	**Humber Estuary (UK9006111)**	
Designation type: (SAC, SPA, Ramsar):	SPA	
Qualifying features:	A132 Pied avocet, *Recurvirostra avosetta* (breeding and non-breeding) A157 Bar-tailed godwit, *Limosa lapponica* (non-breeding) A021 Great bittern, *Botaurus stellaris* (breeding and non-breeding) A616 Black-tailed godwit, *Limosa limosa islandica* (breeding and non-breeding) A672 Dunlin, *Calidris alpina alpina* (non-breeding) A140 Golden plover, *Pluvialis apricaria* (non-breeding) A082 Hen harrier, *Circus cyaneus* (non-breeding) A143 Red knot *Calidris canutus* (non-breeding) A195 Little tern, *Sterna albifrons* (breeding) A081 Marsh harrier, *Circus aeruginosus* (breeding) A162 Redshank, *Tringa totanus* (non-breeding)	**Water Dependent?** Yes – all the qualifying features are classified as being water dependent.

[31] AECOM Ltd (2021). Tame, Trent and Humber HEE (Hydrology, Ecology and Environment), Summary Report. Report for Affinity Water, 1 – 48.
[32] Ricardo Energy & Environment (2021). Severn Trent Minworth SRO Environmental Assessment Report: Appendix B.4.3 Water Framework Directive Regulations Compliance Assessment Report. Report for Severn Trent Water. 26April 2021
[33] AECOM Ltd (2021). Consultancy Services for the Provision of Data Gathering and Option Selection: Severn Trent Minworth. Concept Design Report for Severn Trent Water Limited, 1 – 119.
[34] Ricardo Energy & Environment (2021). Severn Trent Minworth SRO Environmental Assessment Report: Appendix B.4.3 Water Framework Directive Regulations Compliance Assessment Report. Report for Severn Trent Water. 26April 2021
[35] AECOM Ltd (2021). Tame, Trent and Humber HEE (Hydrology, Ecology and Environment), Summary Report. Report for Affinity Water, 1 – 48.

	A151 Ruff, *Philomachus pugnax* (non-breeding) A048 Shelduck, *Tadorna tadorna* (non-breeding) Waterbird assemblages	
Current conservation status (Article 12):	**A132 Pied avocet, *Recurvirostra avosetta* (breeding and non-breeding)** Short term population trend: increasing, long term population trend: increasing, non-breeding size (minimum and maximum): 59, breeding size: 64 (8.6% of the population in Great Britain 1998-2002) unit: individuals, data quality: good, population: <2%, isolation: population not isolated, but no margins of area of distribution. **A157 Bar-tailed godwit, *Limosa lapponica* (non-breeding)** Short term population trend: stable, long term population trend: stable, non-breeding size (minimum and maximum): 2752 (4.4% of the population in Great Britain 1996/7 to 2000/1), unit: individuals, data quality: good, population: 2 – 15%, isolation: population not isolated within extended distribution range. **A021 Great bittern, *Botaurus stellaris* (breeding and non-breeding)** Short term population trend: increasing, long term population trend: increasing, non-breeding size (minimum and maximum): 4 (4% of the population in Great Britain 1998/9 to 2002/3), breeding size: 2 (10.5% of the population in Great Britain2000-2002), unit: individuals or calling males, data quality: good, population: 2% - 15%, isolation: population not-isolated within extended distribution range. **A616 Black-tailed godwit, *Limosa limosa islandica* (non-breeding)** Short term population trend: increasing, long term population trend: increasing, non-breeding size (minimum and maximum): 1113 (3.2% of the population 1996/7 to 2000/1), breeding size: 915, unit: individuals, data quality: good, population: 2% - 15%, isolation: population not-isolated within extended distribution range. **A672 Dunlin, *Calidris alpina alpina* (non-breeding)** Short term population size trend: stable, long term population size trend: increasing, non-breeding size (minimum and maximum): 22,222 (1.7% of the population 1996/7 to 2000/1), unit: individuals: data quality: good, population: 2% - 15%, isolation: population not-isolated within extended distribution range. **A140 Golden plover, *Pluvialis apricaria* (non-breeding)** Short term population size trend: decreasing, long term population size trend: increasing, non-breeding size (minimum and maximum): 30,709 (12.3% of the population in Great Britain 1996/7 to 2000/1), unit: individuals: data quality: good, population: 2% - 15%, isolation: population not-isolated within extended distribution range. **A082 Hen harrier, *Circus cyaneus* (non-breeding)** Unknown population trends – insufficient information to report, non-breeding size (minimum and maximum): 8 (1.1% of the population in Great Britain 1997/8 to 2001/2), unit: individuals, population: <2%, isolation: population not-isolated within extended distribution range. **A143 Red knot *Calidris canutus* (non-breeding)** Short term population size trend: stable, long term population size trend: increasing, non-breeding size (minimum and maximum): 28,165 (6.3% of the population1996/7 to 2000/1), unit: individuals, population: 2% - 15%, isolation: population not-isolated within extended distribution range. **A195 Little tern, *Sterna albifrons* (breeding)** Short term population size tend: decreasing, long term population size trend: decreasing, breeding size (minimum and maximum): 51 (2.1% of the population in Great Britain 1998-2002), unit: pairs, population: 2% - 15%, isolation: population not-isolated within extended distribution range. **A081 Marsh harrier, *Circus aeruginosus* (breeding)** Short term population size trend: increasing, long term population size trend: increasing, breeding size (minimum and maximum): 10 (6.3% of the population in Great Britain 1998-2002), units: breeding females, population: 2% - 15%, isolation: population not isolated, but on margins of area of distribution. **A162 Redshank, *Tringa totanus* (non-breeding)** Short term population size trend: decreasing, long term population size trend: stable, non-breeding size: 4,632 (3.6% of the population1996/7 to 2000/1), unit: individuals, population: 2% - 15%, isolation: population not-isolated within extended distribution range. **A151 Ruff, *Philomachus pugnax* (non-breeding)** Short term population size trend: decreasing, long term population size trend: increasing, non-breeding size: 128 (1.4% of the population in Great Britain1996-2000), unit: individuals, population: <2%, isolation: population not-isolated within extended distribution range. **A048 Shelduck, *Tadorna tadorna* (non-breeding)** Short term population size trend: decreasing, long term population size trend: stable, non-breeding size: 4,464 (1.5% of the population1996/7 to 2000/1), unit: individuals, population 2% - 15%, isolation: population not-isolated within extended distribution range. **Waterbird assemblages** Population size (minimum and maximum): 153,934, units: individuals	
Conservation objectives:	The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring: • the extent and distribution of the habitats of the qualifying features • the structure and function of the habitats of the qualifying features • the supporting processes on which the habitats of the qualifying features rely • the populations of each of the qualifying features • the distribution of qualifying features within the site	
SSSI condition assessment:	Humber Estuary SSSI: Favourable 7.54%, Unfavourable – recovering 91.21%, Unfavourable – no change 0.17%, Unfavourable – declining 1.09%	
Site Improvement Plan (only threats and actions relevant to the Drought Plan):	1. Water pollution: Control and reduce invasive species: A021(B) Bittern, A021(NB) Bittern, A048(NB) Common shelduck, A081(B) Marsh harrier, A082(NB) Hen harrier, A132(B) Avocet, A132(NB) Avocet, A140(NB) Golden plover, A143(NB) Red knot, A149(NB) Dunlin, A151(NB) Ruff, A156(NB) Black-tailed godwit, A157(NB) Bar-tailed godwit, A162(NB) Common redshank, A195(B) Little tern and Waterbird assemblage. H9130 Beech forests on neutral to rich soils, H9180 Mixed woodland on base-rich soils associated with rocky slopes, H91J0 Yew-dominated woodland. 2. Changes in species distribution: A021(B) Bittern, A021(NB) Bittern, A048(NB) Common shelduck, A081(B) Marsh harrier, A082(NB) Hen harrier, A132(B) Avocet, A132(NB) Avocet, A140(NB) Golden plover, A143(NB) Red knot, A149(NB) Dunlin, A151(NB) Ruff, A156(NB) Black-tailed godwit, A157(NB) Bar-tailed godwit, A162(NB) Common redshank, A195(B) Little tern and Waterbird assemblage. 3. Invasive species: A021(B) Bittern, A021(NB) Bittern, A048(NB) Common, shelduck, A081(B) Marsh harrier, A082(NB) Hen harrier, A132(B) Avocet, A132(NB) Avocet, A140(NB) Golden plover, A143(NB) Red knot, A149(NB) Dunlin, A151(NB), Ruff, A156(NB) Black-tailed godwit, A157(NB) Bar-tailed godwit, A162(NB) Common redshank, A195(B) Little tern and Waterbird assemblage.	
Potential Effects:		

Element:	Screening Assessment	Risk of Likely Significant Effects Alone?	Risk of Likely Significant Effects In-combination with other elements?
Minworth / GUC (100 Ml/d))			
Minworth / STT (115 Ml/d)	The Humber Estuary SAC is approximately 200 km downstream via hydrological connectivity from two outfall locations, where currently final treated wastewater is discharged into the River Tame. The westernmost discharge is located to the south of the site at Water Orton and the easternmost discharge is located approximately 3 km downstream between Coleshill and the confluence of the Rivers Cole, Tame and Blythe. The proposed element will result in the diversion of 115 Ml/d of final treated wastewater through a new pipeline, to the River Avon. The reduction in final treated wastewater discharge could cause an increase in nutrient concentrations (ammonia, phosphorus), pH and water temperature, as the dilution capacity around the outfall site declines. This could also impact on dissolved oxygen saturation, biochemical oxygen demand and saline intrusion, with a reduction in freshwater inputs into the estuary. A desk study reviewing water quality changes in the River Tame due to reductions in final treated wastewater against moderate Water Framework Directive limits, concluded that impacts were unlikely in relation to physiochemical pollutants. Due to the distance between the Humber Estuary SAC and proposed works at WwTW and the pipeline installation, no likely significant effects during construction are anticipated. During operation, the lack of final treated wastewater release on the River Tame would cause reductions in flow and water level, reducing the extent of wetted habitat at the periphery of the River Tame. Previous assessments have estimated <5% change in wetted habitat between Q50 and Q95 flow conditions[36]. An assessment of WFD compliance[37] also concluded that hydrological impacts are limited to the reaches downstream of Minworth and are expected to be minor. In addition, flow rates are anticipated to reduce by 0.67 m³/s from upstream of the first discharge point to downstream of the second discharge point[38]. Due to the distance between the designated site and outfall locations and the anticipated localised impact on flow, geomorphology and water quality, no likely significant effects on qualifying habitats and species have been identified. However, it is recommended that detailed flow monitoring and sampling data is undertaken, to further understand the hydrological and geomorphological dynamics along the River Tame and River Trent and to determine if the expected reductions in flow (alone and in-combination with other plans and projects) could impact on qualifying habitats and species and to what extent. This assessment should focus on Atlantic salt meadows, mudflats and ***Salicornia*** (if present) along the lower reaches of the River Trent, as these form key supporting habitats for the qualifying bird populations.	**No**	**No**
Minworth Combined (215 Ml/d)	The Humber Estuary SPA is approximately 200 km downstream via hydrological connectivity from two outfall locations, where currently final treated wastewater is discharged into the River Tame. The westernmost discharge is located to the south of the site at Water Orton and the easternmost discharge is located approximately 3km downstream between Coleshill and the confluence of the Rivers Cole, Tame and Blythe. The proposed element will result in the diversion of 215 Ml/d of final treated wastewater through a new pipeline, to the River Avon and Grand Union Canal. Due to the distance between the Humber Estuary SPA and proposed works at Minworth WwTW and the pipeline installation, no likely significant effects during construction are anticipated. During operation, the lack of final treated wastewater release on the River Tame will cause reductions in flow and water level, reducing the extent of wetted habitat at the periphery of the River Tame and potentially River Trent, impacting on macrophyte communities and functionally linked habitat. Previous assessments have estimated <5% change in wetted habitat between Q50 and Q95 flow conditions[39]. Increased sedimentation at the locality of the reduced flows is also expected. In addition, the reduction in final treated wastewater discharge could cause an increase in nutrient concentrations (ammonia, phosphorus), pH and water temperature, as the dilution capacity around the outfall site declines. This could also impact on dissolved oxygen saturation, biochemical oxygen demand and saline intrusion, with a reduction in freshwater inputs into the estuary. A desk study reviewing water quality changes in the River Tame due to reductions in final treated wastewater against moderate Water Framework Directive limits, concluded that impacts were unlikely in relation to physiochemical pollutants. Flow rates are anticipated to reduce by 1.24 m³/s from upstream of the first discharge point to downstream of the second discharge point[40]. Due to the distance between the designated site and outfall locations and the anticipated localised impact from final treated wastewater diversion, no likely significant effects on qualifying species are anticipated. However, it is recommended that detailed flow monitoring undertaken, to further understand the hydrological and geomorphological dynamics along the River Tame and River Trent and to determine if the expected reductions in flow (alone and in-combination with other plans and projects) could impact on qualifying species and to what extent. This assessment should focus on Atlantic salt meadows, mudflats and *Salicornia* (if present) along the lower reaches of the River Trent, as these form key supporting habitats for the qualifying bird populations.	**No**	**No**

European Site name:	**Humber Estuary (UK11031)**	
Designation type: (SAC, SPA, Ramsar):	Ramsar	
Qualifying features:	**Ramsar Criterion 1** The site is representative of a near-natural estuary with important component habitats: dunes systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons. **Ramsar Criterion 3** The site supports a breeding colony of grey seals *Halichoerus grypus* which is the second largest in England and furthest south regular breeding site. The site is also the most north-easterly breeding site in GB for natterjack toad *Bufo calamita*. **Ramsar Criterion 5** The site supports an internationally important assemblage of waterfowl with 153,934 during the non-breeding season. **Ramsar Criterion 6** The site supports golden plover *Pluvialis apricaria altifrons*, knot *Calidris canutus islandica*, dunlin *Calidris alpina alpina*, black-tailed godwit *Limosa limosa islandica* and redshank *Tringa totanus brittanica* at levels of international importance on passage. The site supports common shelduck *Tadorna tadorna*, golden plover, knot, dunlin, black-tailed godwit, bar-tailed godwit *Limosa lapponica lapponica* and common redshank at levels of international importance over winter.	**Water Dependent?** Yes – all the qualifying features are classified as being water dependent.

[36] AECOM Ltd (2021). Tame, Trent and Humber HEE (Hydrology, Ecology and Environment), Summary Report. Report for Affinity Water, 1 – 48.
[37] Ricardo Energy & Environment (2021). Severn Trent Minworth SRO Environmental Assessment Report: Appendix B.4.3 Water Framework Directive Regulations Compliance Assessment Report. Report for Severn Trent Water. 26April 2021
[38] AECOM Ltd (2021). Consultancy Services for the Provision of Data Gathering and Option Selection: Severn Trent Minworth. Concept Design Report for Severn Trent Water Limited, 1 – 119.
[39] AECOM Ltd (2021). Tame, Trent and Humber HEE (Hydrology, Ecology and Environment), Summary Report. Report for Affinity Water, 1 – 48.
[40] AECOM Ltd (2021). Consultancy Services for the Provision of Data Gathering and Option Selection: Severn Trent Minworth. Concept Design Report for Severn Trent Water Limited, 1 – 119.

	Ramsar Criterion 8 The site acts as an important migration route for both river lamprey Lampetra fluviatilis and sea lamprey Petromyzon marinus between coastal waters and their spawning area.		
Current conservation status	**N/A**		
Conservation objectives:	Not available.		
SSSI condition assessment:	Humber Estuary SSSI: Favourable 7.54%, Unfavourable – recovering 91.21%, Unfavourable – no change 0.17%, Unfavourable – declining 1.09%		
Site Improvement Plan (only threats and actions relevant to the Drought Plan):	See threats and pressures listed in Humber Estuary SAC and SPA screening table.		
Potential Effects:			
Element:	Screening Assessment	Risk of Likely Significant Effects Alone?	Risk of Likely Significant Effects In-combination with other elements?
Minworth / GUC (100Ml/d)			
Minworth / STT (115 Ml/d)	The Humber Estuary SAC is approximately 200 km downstream via hydrological connectivity from two outfall locations, where currently final treated wastewater is discharged into the River Tame. The westernmost discharge is located to the south of the site at Water Orton and the easternmost discharge is located approximately 3 km downstream between Coleshill and the confluence of the Rivers Cole, Tame and Blythe. The proposed element will result in the diversion of 115 Ml/d of final treated wastewater through a new pipeline, to the River Avon. The reduction in final treated wastewater discharge could cause an increase in nutrient concentrations (ammonia, phosphorus), pH and water temperature, as the dilution capacity around the outfall site declines. This could also impact on dissolved oxygen saturation, biochemical oxygen demand and saline intrusion, with a reduction in freshwater inputs into the estuary. A desk study reviewing water quality changes in the River Tame due to reductions in final treated wastewater against moderate Water Framework Directive limits, concluded that impacts were unlikely in relation to physiochemical pollutants. Increased sedimentation at the locality of the reduced flows is also expected. This could impact on the availability of suitable spawning sites for river lamprey and sea lamprey. However, due to the local nature of the impact, likely significant effects are not anticipated. Due to the distance between the Humber Estuary SAC and proposed works at WwTW and the pipeline installation, no likely significant effects during construction are anticipated. During operation, the lack of final treated wastewater release on the River Tame would cause reductions in flow and water level, reducing the extent of wetted habitat at the periphery of the River Tame. Previous assessments have estimated <5% change in wetted habitat between Q50 and Q95 flow conditions[41]. An assessment of WFD compliance[42] also concluded that hydrological impacts are limited to the reaches downstream of Minworth and are expected to be minor. In addition, flow rates are anticipated to reduce by 0.67 m³/s from upstream of the first discharge point to downstream of the second discharge point[43]. Due to the distance between the designated site and outfall locations and the anticipated localised impact on flow, geomorphology and water quality, no likely significant effects on qualifying habitats and species have been identified. However, it is recommended that detailed flow monitoring and sampling data is undertaken, to further understand the hydrological and geomorphological dynamics along the River Tame and River Trent and to determine if the expected reductions in flow (alone and in-combination with other plans and projects) could impact on qualifying habitats and species and to what extent. This assessment should focus on Atlantic salt meadows, mudflats and *Salicornia* (if present) along the lower reaches of the River Trent, in addition to river lamprey and sea lamprey spawning habitat.	**No**	**No**
Minworth Combined (215 Ml/d)	The Humber Estuary SAC is approximately 200 km downstream via hydrological connectivity from two outfall locations, where currently final treated wastewater is discharged into the River Tame. The westernmost discharge is located to the south of the site at Water Orton and the easternmost discharge is located approximately 3km downstream between Coleshill and the confluence of the Rivers Cole, Tame and Blythe. The proposed element will result in the diversion of 215 Ml/d of final treated wastewater through a new pipeline, to the River Avon and Grand Union Canal. The reduction in final treated wastewater discharge could cause an increase in nutrient concentrations (ammonia, phosphorus), pH and water temperature, as the dilution capacity around the outfall site declines. This could also impact on dissolved oxygen saturation, biochemical oxygen demand and saline intrusion, with a reduction in freshwater inputs into the estuary. A desk study reviewing water quality changes in the River Tame due to reductions in final treated wastewater against moderate Water Framework Directive limits, concluded that impacts were unlikely in relation to physiochemical pollutants. Increased sedimentation at the locality of the reduced flows is also expected. This could impact on the availability of suitable spawning sites for river lamprey and sea lamprey. However, due to the local nature of the impact, likely significant effects are not anticipated. Due to the distance between the Humber Estuary SAC and proposed works at Minworth WwTW and the pipeline installation, no likely significant effects during construction are anticipated. During operation, the lack of final treated wastewater release on the River Tame would cause reductions in flow and water level, reducing the extent of wetted habitat at the periphery of the River Tame and potentially River Trent. An assessment of WFD compliance[44] concluded that hydrological impacts associated with the wastewater	**Yes**	**No**

[41] AECOM Ltd (2021). Tame, Trent and Humber HEE (Hydrology, Ecology and Environment), Summary Report. Report for Affinity Water, 1 – 48.
[42] Ricardo Energy & Environment (2021). Severn Trent Minworth SRO Environmental Assessment Report: Appendix B.4.3 Water Framework Directive Regulations Compliance Assessment Report. Report for Severn Trent Water. 26April 2021
[43] AECOM Ltd (2021). Consultancy Services for the Provision of Data Gathering and Option Selection: Severn Trent Minworth. Concept Design Report for Severn Trent Water Limited, 1 – 119.
[44] Ricardo Energy & Environment (2021). Severn Trent Minworth SRO Environmental Assessment Report: Appendix B.4.3 Water Framework Directive Regulations Compliance Assessment Report. Report for Severn Trent Water. 26April 2021

	diversion would effect the River Tame from downstream of wastewater discharger location to the confluence with the River Trent and the River Trent from the confluence with the River Tame to the confluence with the River Derwent. The hydrological assessment is based on an outline operating regime for transfer to GUC SRO and an indicative assessment based on current understanding of operating rules for STT SRO. As such the operating regimes, overlaid on the reference condition flow regimes of the rivers using gauged data identify routine, extended duration significant reduction in late spring, summer and autumn river flows and particularly in low river flows. Previous assessments have estimated <5% change in wetted habitat between Q50 and Q95 flow conditions[45]. Flow rates are anticipated to reduce by 1.24 m³/s from upstream of the first discharge point to downstream of the second discharge point[33]. Due to the distance between the designated site and outfall locations and the anticipated localised impact on flow, geomorphology and water quality, no likely significant effects on qualifying habitats and species have been identified. There is some uncertainty with regards on the potential impact on the movement of migratory species (sea and river lamprey) in the River Trent and the River Tame, especially where river reaches potentially provide off-site functional habitat for these qualifying features. As such, likely significant effects could be anticipated and further assessment is required. This is based on the precautionary principal. It is also recommended that detailed flow monitoring and sampling data is undertaken, to further understand the hydrological and geomorphological dynamics along the River Tame and River Trent and to determine if the expected reductions in flow (alone and in-combination with other plans and projects) could impact on qualifying habitats and species and to what extent. This assessment should focus on Atlantic salt meadows, mudflats and *Salicornia* (if present) along the lower reaches of the River Trent, in addition to river lamprey and sea lamprey spawning habitat.		

European Site name:	**River Mease SAC (UK0030258)**	
Designation type: (SAC, SPA, Ramsar):	SAC	
Qualifying features:	H3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation S1149 Spined loach *Cobitis taenia* S1163 Bullhead *Cottus gobio* S1092 White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes* S1355 Otter *Lutra lutra*	**Water Dependent?** Yes, all features are classified as water dependent
Current conservation status (Article 17):	**H3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation** Overall assessment of conservation status: Unfavourable – Bad: (range: favourable, area: unfavourable - inadequate, specific structure and functions: unfavourable – bad, future prospects: unfavourable – inadequate). Overall trend in conservation status: Improving. Main pressures and threats: forestry activities generating pollution to surface or ground waters; hydropower; invasive alien species; mixed source pollution to surface and ground waters; modification of hydrological flow; physical alteration of water bodies; temperature changes due to climate change; drought and decrease in precipitation due to climate change; increases or changes in precipitation due to climate change. **S1149 Spined loach *Cobitis taenia*** Overall assessment of conservation status: Favourable (range: favourable, population: unknown, habitat for the species: favourable, future prospects: favourable) Overall trend in conservation status: Stable Main pressures and threats: alteration of waterbodies, modification of hydrological flow, mixed source pollution to surface and ground waters, invasive species, freshwater fish and shellfish harvesting, abstraction of ground and surface waters for public water supply, recreational use and energy supply (excluding hydropower), other climate related changes in abiotic conditions. **S1163 Bullhead *Cottus gobio*** Overall assessment of conservation status: Favourable (range: favourable, population: favourable, habitat for the species: unknown, future prospects: favourable). Overall trend in conservation status: Stable. Main pressure and threats: physical alteration of water bodies; climate related changes in abiotic conditions; hydropower; freshwater fish and shellfish harvesting; problematic native species; invasive species; mixed source pollution to surface and ground waters; modification of hydrological flow. **1092 White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes*** Overall assessment of conservation status: Unfavourable – Bad: (range: unfavourable – bad, population: unfavourable – bad, habitat for the species: favourable, future prospects: unfavourable – bad). Overall trend in conservation status: Deteriorating. Main pressures and threats: freshwater fish and shellfish harvesting; introduction and spread of species in freshwater aquaculture; invasive alien species; drainage; modification of hydrological flow; physical alteration of water bodies; interspecific relations; change of habitat location/size/quality due to climate change. **S1355 Otter *Lutra lutra*** Overall assessment of conservation status: Favourable (range: favourable, population: favourable, habitat for the species: favourable, future prospects: favourable). Overall trend in conservation status: Stable. Main pressure and threats: modification of hydrological flow; roads, paths, railroads and related infrastructure; illegal shooting/killing; bycatch and incidental killing; mixed source pollution to surface and ground waters, and to marine water; use of plant protection chemical in agriculture; abstraction from groundwater, surface water and mixed water.	
Conservation objectives:	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; • The extent and distribution of qualifying natural habitats and habitats of qualifying species • The structure and function (including typical species) of qualifying natural habitats • The structure and function of the habitats of qualifying species • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely • The populations of qualifying species, and, • The distribution of qualifying species within the site.	
SSSI condition assessment:	River Mease SSSI: 100% unfavourable no change	

[45] AECOM Ltd (2021). Tame, Trent and Humber HEE (Hydrology, Ecology and Environment), Summary Report. Report for Affinity Water, 1 – 48.

Site Improvement Plan (only threats and actions relevant to the Drought Plan):	1. Water abstraction: H3260 Rivers with floating vegetation often dominated by water-crowfoot, S1092 White-clawed (or Atlantic stream) crayfish, S1149 Spined loach, S1163 Bullhead, S1355 Otter - Improve the understanding of the ecological implications of the current water inputs and abstractions.		
Potential Effects:			
Elements:	Screening assessment:	Risk of Likely Significant Effects Alone?	Risk of Likely Significant Effects In-combination with other elements?
Minworth / GUC (100 Ml/d)	The River Mease SAC is approximately 19.4 km north-east of the proposed development site at Minworth Wastewater Treatment Works (WwTW), at its closest point. Due to the distance between the River Mease SAC and proposed works at WwTP and the pipeline installation, no likely significant effects during construction are anticipated on qualifying habitats and species of the designated site.	**No**	**No**
Minworth / STT (115 Ml/d)	The River Mease SAC is approximately 35 km downstream via hydrological connectivity from two outfall locations, where currently final treated wastewater is discharged into the River Tame. The westernmost discharge is located to the south of the site at Water Orton and the easternmost discharge is located approximately 3km downstream between Coleshill and the confluence of the Rivers Cole, Tame and Blythe. The proposed element will result in the diversion of 115 Ml/d of final treated wastewater through a new pipeline, to the River Avon. Due to the distance between the River Mease SAC and proposed works at WwTW and the pipeline installation, no likely significant effects during construction are anticipated. During operation, the lack of final treated wastewater release on the River Tame will cause localised reductions in flow and water level, reducing the extent of wetted habitat at the periphery of the river. In addition, the reduction in final treated wastewater discharge could cause an increase in nutrient concentrations (ammonia, phosphorus), pH and water temperature, as the dilution capacity around the outfall site would decline. This could also impact on dissolved oxygen saturation and biochemical oxygen demand. However, as the River Tame does not drain directly into the River Mease (hydrological connectivity is via the confluence of the River Trent), there is no mechanism for reduced flows to impact on the SAC. Therefore, no likely significant effects on qualifying habitats and species are anticipated.	**No**	**No**
Minworth Combined (215 Ml/d)	The River Mease SAC is approximately 35 km downstream via hydrological connectivity from two outfall locations, where currently final treated wastewater is discharged into the River Tame. The westernmost discharge is located to the south of the site at Water Orton and the easternmost discharge is located approximately 3km downstream between Coleshill and the confluence of the Rivers Cole, Tame and Blythe. The proposed element will result in the diversion of 215 Ml/d of final treated wastewater through a new pipeline, to the River Avon and Grand Union Canal. Due to the distance between the River Mease SAC and proposed works at WwTW and the pipeline installation, no likely significant effects during construction are anticipated. During operation, the lack of final treated wastewater release on the River Tame will cause localised reductions in flow and water level, reducing the extent of wetted habitat at the periphery of the river. In addition, the reduction in final treated wastewater discharge could cause an increase in nutrient concentrations (ammonia, phosphorus), pH and water temperature, as the dilution capacity around the outfall site would decline. This could also impact on dissolved oxygen saturation and biochemical oxygen demand. However, as the River Tame does not drain directly into the River Mease (hydrological connectivity is via the confluence of the River Trent), there is no mechanism for reduced flows to impact on the SAC. Therefore, no likely significant effects on qualifying habitats and species are anticipated.	**No**	**No**

4.2 HRA Screening conclusions

A summary of the outcomes of the HRA screening process for elements is presented in **Table 4.3.**

Table 4.3: Summary of the outcomes of HRA Screening Assessment of the Elements for Minworth SRO

European designated site	Elements	Risk of Likely significant effect alone?	Risk of Likely Significant Effects In-combination with other elements?
Humber Estuary SAC	Minworth / GUC (100 Ml/d) Minworth / STT (115 Ml/d) Minworth combined (215 Ml/d)	Yes	No
Humber Estuary SPA	Minworth / GUC (100 Ml/d) Minworth / STT (115 Ml/d) Minworth combined (215 Ml/d)	No	No
Humber Estuary Ramsar	Minworth / GUC (100 Ml/d) Minworth / STT (115 Ml/d) Minworth combined (215 Ml/d)	Yes	No
River Mease SAC	Minworth / GUC (100 Ml/d) Minworth / STT (115 Ml/d) Minworth combined (215 Ml/d)	No	No

The HRA screening has indicated that a risk of LSE has been identified for the Minworth combined (215 Ml/d) element. As such, further assessment will be required subject to the principles of the Stage 2 Appropriate Assessment to identify if the element can meet the requirements of the integrity test and if further survey, assessment and mitigation development is required to provide greater certainty to any conclusions. A summary of the qualifying features and associated elements being screened in for Stage 2 Appropriate Assessment is presented in **Table 4.4.**

Table 4.4: Summary of the outcome of the HRA Screening Assessment of the elements for Minworth SRO, indicating individual qualifying features which require Stage 2 Appropriate Assessment due to potential likely significant effects on European designated sites.

Element	Qualifying features	Likely significant effect anticipated?
Humber Estuary SAC and Ramsar		
Minworth combined (215 Ml/d)	Estuaries	**No**
	Mudflats and sandflats not covered by seawater at low tide	**No**
	Sandbanks which are slightly covered by sea water all the time	**No**
	Coastal lagoons *Priority feature	**No**
	Salicornia and other annuals colonizing mud and sand	**No**
	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	**No**
	Embryonic shifting dunes	**No**
	"Shifting dunes along the shoreline with Ammophila arenaria ("white dunes")"	**No**
	Fixed coastal dunes with herbaceous vegetation ("grey dunes")" * Priority feature	**No**
	Dunes with *Hippopha rhamnoides*	**No**
	Sea lamprey	**Yes (operation only)**
	River lamprey	**Yes (operation only)**
	Grey seal	**No**
	Ramsar Criterion 8	**Yes (operation only)**

5 Information to Inform Stage 2 Appropriate Assessment

5.1 Humber Estuary SAC and Ramsar

5.1.1 Baseline

The Humber Estuary separates the historic counties of Yorkshire and Lincolnshire. The Special Area of Conservation (SAC) extends about 70km from the mouth of the Humber, past the ports of Grimsby, Immingham, Hull and Goole and up to the limit of saline intrusion on the rivers Ouse and Trent. The Humber Estuary is a large estuary with a high tidal range (macro-tidal). The high suspended sediment loads in the estuary feed a dynamic and rapidly changing system of accreting and eroding intertidal and sub-tidal mudflats and sandflats as well as saltmarsh and reedbeds. Other notable habitats include a range of sand dune types in the outer estuary, together with sub-tidal sandbanks and coastal lagoons. A number of developing managed realignment sites on the estuary also contribute to the wide variety of estuarine and wetland habitats. The estuary supports a full range of saline conditions from the open coast to the limit of saline intrusion. As salinity declines upstream tidal reedbeds and brackish saltmarsh communities fringe the estuary.

Significant fish species include river lamprey and sea lamprey which migrate through the estuary to breed in the rivers of the Humber catchment. Grey seals come ashore in autumn to form large breeding colonies on the sandy shores of the south bank around Donna Nook.

In addition to hosting an impressive array of habitats and species, the Humber Estuary is also an important industrial area and busy commercial waterway, and is a major contributor to the local and national economy. The estuary houses the largest shipping complex in the UK, with the ports of the estuary accounting for 13-15% of the UK seaborne trade. Industries along the estuary include chemical works, oil refinery complexes and power stations, with most of this activity located on the south bank of the middle estuary and around Hull on the north bank.

5.1.2 River lamprey

River lamprey occupy a large region from southern Norway to the western Mediterranean in coastal, transitional and freshwater waterbodies[46]. They are a primitive species that is widespread in the UK, occurring in many rivers from the Great Glen in Scotland at the northern extent and continuing southwards. Tiver lamprey migrate upstream from October – December and spawn from March - April. Access to these functional habitats is vital for the species to complete its lifecycle. A study in 2008 which looked at lamprey populations in the Yorkshire Ouse catchment concluded that the five main rivers in the catchment (Derwent, Swale, Wharfe, Nidd and Ure) all supported healthy populations of river lamprey ammocoetes, with two or more age classes usually present.[47] The age of the study limits its reliability and basis on which to make an accurate judgment of condition of river lamprey in the catchment. Distribution of river lamprey in the River Trent is severely limited by Cromwell weir, which is considered as impassable to river lamprey.

5.1.3 Sea lamprey

Sea lamprey is the largest species present in the UK and it also occupies a larger region than river lamprey; from northern Norway to the western Mediterranean and eastern North America[48]. However, unlike river lamprey, it is absent from many northern and southern rivers in the UK due to pollution incidents and the construction of migratory barriers. Adult sea lamprey migrate upstream from April – May and spawn from late May – June. Access to these functional habitats is vital for the species to complete its lifecycle. Sea lamprey presence is very low compared to river lamprey. A spawning survey carried out in 2011 recorded only 1 sea lamprey on the river Ure with no sightings or redds identified

[46] Maitland, P. S (2003). *Ecology of the River, Brook and Sea Lamprey*. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough, 1 - 54.
[47] Nunn, A. D., Harvey, J. P., Noble, R. A. A. and Cowx, I. G. 2008. Condition assessment of lamprey populations in the Yorkshire Ouse catchment, north-east England, and the potential influence of physical migration barriers. Aquatic Conservation: Marine and Freshwater Ecosystems, 18, 175-189.
[48] Maitland, P. S (2003). *Ecology of the River, Brook and Sea Lamprey*. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough, 1 - 54.

on any of the other major rivers[49]. Spawning surveys in 2015[50] recorded no adults, although had been tagged below Naburn weir, and only 5 redds were observed at Boroughbridge on the River Ure. This is amongst the lowest numbers of spawning sea lamprey recorded in recent years and together with the 2011 data raises further concerns as to the status of sea lamprey within the Humber catchment. Distribution of sea lamprey in the River Trent is unknown however it is thought that distribution of the species is severely limited by Cromwell weir, which is considered as impassable.

5.1.4 Conservation Objectives and Favourable Condition Targets

Specific attributes and targets associated with the conservation objectives for each qualifying feature of the SAC are provided in **Table 4.5** and current conservation status, SSSI condition assessment and site improvement plan are provided in **Table 4.2**.

[49] The Bellflask Ecological Survey Team. 2011. Survey of adult spawning in the Rivers Ure, Swale, Wharfe, Nidd and Derwent 2011 AND Summary of distribution and numbers of sea lamprey in the Rivers Ure, Swale, Wharfe, Nidd and Derwent 2003 to 2011 inclusive: The Bellflask Ecological Survey Team
[50] Bubb, D. 2015. Humber Sea Lamprey Monitoring Project: Paragon Ecology report to Natural England.

Table 4.5: Assessment of adverse effects of the Minworth combined (215Ml/d) element on the relevant Humber Estuary SAC and Ramsar site

Qualifying Feature	Attribute	Target	Potential Effects	Mitigation & Monitoring	Adverse Effects Predicted
River lamprey Sea lamprey	Population: Estuarine population	Maintain the unrestricted usage of the estuary by adult and juvenile river lamprey including for migratory passage and juvenile development.	The abundance of individuals using the Humber Estuary may vary spatially and temporarily but overall will be reflective of the population status and trends in any upstream designated river systems and systems that are considered off-site functional habitat. A reduction in the availability of individuals able to successfully reproduce, and survival rates, may impact the overall size and age-structure of the population and could result in adverse effect on site integrity. The reproduction and recruitment of lampreys is dependent, to a large degree, on processes that occur outside the site. The hydrological assessment[51] identified that flows are likely to be reduced in late spring, summer and autumn river flows and particularly in low river flows. Flow changes during these periods could impact on early spawning migration, migration from spawning sites to nursery habitats, the downstream migration of post metamorphic individuals and on ammocoetes in nursery habitats. The reduction in flow in the River Tame and subsequently the River Trent could impact the natural flow regime of areas that are potentially considered off-site functional habitat. The natural flow regime and suitable water quality is critical to all aspects of lamprey life cycle. It shapes the characteristic biotope mosaic, maintains water in critical biotopes (including marginal siltbeds), and provides adequate flows for migratory passage. A reduction in flow and wetted habitat could result in indirect impacts on the reproductive and recruitment capability of the species. Physical obstructions, in particular are becoming increasingly recognised as major factors influencing the migrations, distributions and population structures of lamprey[52]. Gross freshwater flows are important in maintaining the salinity gradient and water circulation in an estuary. However, the hydrological impacts are considered to be limited to the reaches of the River Trent upstream of the confluence with the River Derwent and freshwater inflows and connectivity will not be impacted. The main upstream migration period for river lamprey is October to March. The spawning season of this species in British rivers starts when the water temperatures reach 10–11ºC. The upstream spawning migration for sea lamprey in Europe usually takes place in April and May when the adults start to migrate back into fresh water. A reduction in flow could also impact on the migration to spawning habitats, should these be present upstream of the confluence with the River Trent and River Derwent (near Derby). After spawning the larvae (ammocoetes) live in freshwater for about 5 years before undergoing metamorphosis, taking on the adult characteristics and migrating to the sea where they feed on fish[53]. A decrease in wetted width is of particular importance for juvenile (ammocoetes and transformer) lamprey habitat which tends to consist of silt in shallow, marginal areas. Adverse effects can also be anticipated should upstream and downstream migration of lamprey species from upstream of the confluence of the River Trent and Tame to the confluence with the River Derwent be effected. A study in 2008 which looked at lamprey populations in the Yorkshire Ouse catchment concluded that the five main rivers in the catchment ((Yorkshire) Derwent, Swale, Wharfe, Nidd and Ure) all supported healthy populations of river lamprey ammocoetes, with two or more age classes usually present[54]. Sea lamprey presence is very low compared to river lamprey. A spawning survey carried out in 2011 recorded only 1 sea lamprey on the river Ure with no sightings or redds identified on any of the other major rivers. There is limited data that suggests that the impacted reaches of the River Trent and River Tame does not provide off-site functional habitat for sea or river lamprey. Distribution of river and sea lamprey in the River Trent is severely limited by Cromwell weir, which is considered as impassable to river and sea lamprey.	Targeted lamprey surveys to understand the distribution of lamprey species in the associated waterbodies and an assessment of the potential contribution to the Humber Estuary populations. Identification and mapping of optimal and sub-optimal lamprey ammocoete habitat is required within the impacted reaches. A review of available information is required to identified key spawning location in the River Trent catchment. Review and identification of potential barriers and the passability of these barriers under low flow conditions. Changes to water depths, velocities, geomorphology and habitat distribution, quantity and quality is required to understand the significance of the flow changes	No adverse effects predicted
River lamprey	Population: recruitment and reproductive capability	Restore the reproductive and recruitment capability of the species.			
Sea lamprey		Maintain the reproductive and recruitment capability of the species.			
River lamprey Sea lamprey	Presence and spatial distribution of the species	Maintain the presence and spatial distribution of the species and their ability to undertake key life cycle stages and behaviours.			
River lamprey Sea lamprey	Structure and function: biological connectivity	Restore connectivity of estuarine features to surrounding rivers, freshwater, marine and coastal habitats, to ensure larval dispersal and recruitment, maintain nursery grounds for mobile species, and to allow movement of migratory			
River lamprey Sea lamprey	Supporting processes: sediment movement and hydrodynamic regime (species)	Maintain all hydrodynamic and physical conditions such that natural water flow is not significantly altered or constrained.			
River lamprey Sea lamprey	Supporting processes: sediment movement and hydrodynamic regime (species)	Maintain all hydrodynamic and physical conditions such that natural water flow is not significantly altered or constrained			

[51] Ricardo Energy & Environment (2021). Severn Trent Minworth SRO Environmental Assessment Report: Appendix B.4.3 Water Framework Directive Regulations Compliance Assessment Report. Report for Severn Trent Water. 26April 2021
[52] Lucas, M. C., Bubb, D. H., Jang, M.-H., Ha, K. and Masters, J. E. G. 2009. Availability of and access to critical habitats in regulated rivers: effects of low-head barriers on threatened lampreys. Freshwater Biology, 54, 621-634.
[53] Henderson, P. A. 2003. Background information on species of shad and lamprey.,Bangor, Countryside Commission for Wales.
[54] Nunn, A. D., Harvey, J. P., Noble, R. A. A. and Cowx, I. G. 2008. Condition assessment of lamprey populations in the Yorkshire Ouse catchment, north-east England, and the potential influence of physical migration barriers. Aquatic Conservation: Marine and Freshwater Ecosystems, 18, 175-189.

			A review of available data between 2005 and 2015[55] identified a total of 97 surveys sites that have been subject to surveys over this period including locations on the River Trent, upstream of the River Tame, The River Trent between the River Tame and the River Derwent, The River Derwent and the River Mease. Lamprey have only been surveyed at 14 sites in this period with the majority of records in the River Derwent and the individuals were identified as brook lamprey (*Lampetra planeri*). Lamprey ammocoetes (possibly river and sea lamprey) were only recorded at six other locations with no records of lamprey on the lower reaches of lamprey on the River Mease, River Tame and only three records on the River Trent upstream of the River Derwent confluence. It should be note that the lamprey records from these surveys do not represent a targeted survey methodology that is required to inform the density of ammocoetes and further monitoring will be required to improve the current understanding of the extent to which the impacted reaches provides supporting habitat to the qualifying features of the Humber Estuary. Previous assessments have estimated <5% change in wetted habitat between Q50 and Q95 flow conditions[56]. Flow rates are anticipated to reduce by 1.24 m^3/s from upstream of the first discharge point to downstream of the second discharge point33. Due to the distance between the designated site and outfall locations and the anticipated localised impact on flow, geomorphology and water quality, the estuary will remain unaffected. As long as a minimum low flow remains available, any juvenile lamprey that may be present are likely to be able to relocate to areas of suitable habitat as river levels decrease. Adverse effects are therefore not anticipated. However, further monitoring is required to confirm the potential extent of flow changes (wetted width, depth, velocity, connectivity and habitat quality) to inform the gate-2 assessments). The gate-2 assessment should also consider in more detail the potential spawning locations (and relevant migration routes) associated with the River Trent, upstream of the River Derwent and the location and passability of potential migration barriers. Further monitoring is also required to understand the extent to which the impacted reaches provide supporting habitats through a combination of habitat walkovers and targeted lamprey surveys. An in-combination assessment with other plans/projects will also be required in gate-2.		
River lamprey Sea lamprey	Supporting processes: physico-chemical properties (species)	Maintain the natural physico-chemical properties of the water.	The physico-chemical properties that influence the species include salinity, pH and temperature. Temperature and flow appear to be the main triggers influencing timing of upstream migration in river and sea lampreys and may affect the timing, duration and consistency of spawning runs[57]. The first conspicuous influx of river lampreys into estuaries generally occurs when the temperature is 12–16 °C[58]. The upper limit for temperature, when migration into rivers normally occurs, is probably 8–12 °C. Lamprey migration has also been found to increase with increasing water temperature[59]. Dissolved Oxygen affects the condition and health of species. Excessive nutrients and / or high turbidity can lead to a drop in DO, especially in warmer months. Barriers to migration can also be created as a result of poor water quality, in particular low levels of dissolved oxygen and can also impact downstream migrants. M,Both river lamprey and sea lamprey are known to require well-oxygenated gravels for spawning. There is a dissolved oxygen (DO) sag that occurs annually in the tidal Ouse during the summer months. The key migration periods for river lamprey are from October to April and therefore the current understanding is that this does not impact upstream migrating river lamprey. As noted above, the main upstream migration period for river lamprey is October to March. The spawning season of this species in British rivers starts when the water temperatures reach 10–11ºC. The upstream spawning migration for sea lamprey in Europe usually takes place in April and May when the adults start to migrate back into fresh water. After spawning	Targeted lamprey surveys to understand the distribution of lamprey species in the associated waterbodies and an assessment of the potential contribution to the Humber Estuary populations. Identification and mapping of optimal and sub-optimal lamprey ammocoete habitat is required within the impacted reaches. A review of available information is required to identified key spawning location in the River Trent catchment. Review and identification of potential barriers and the passability of these barriers under low flow conditions.	No adverse effects predicted
River lamprey Sea lamprey	Supporting processes: water quality - contaminants (species)	Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels.			
River lamprey	Supporting processes: water quality - dissolved oxygen (species)	Maintain the dissolved oxygen (DO) concentration at levels equating to Good Ecological Status (specifically ≥ 5.7 mg per litre (at 35 salinity) for 95 % of the year), avoiding deterioration from existing levels.			
Sea lamprey		Restore the dissolved oxygen (DO) concentration [at] levels equating to [Good] Ecological Status [(specifically ≥ 5.7 mg per litre (at 35 salinity) for 95 % of the			

[55] https://environment.data.gov.uk/ecology/explorer/
[56] AECOM Ltd (2021). Tame, Trent and Humber HEE (Hydrology, Ecology and Environment), Summary Report. Report for Affinity Water, 1 – 48.
[57] Docker, M. F. (ed.) 2014. Lampreys: Biology, Conservation and Control: Springer.
[58] Abou-Seedo, F. S. and Potter, I. C. 1979. The estuarine phase in the spawning run of the River lamprey Lampetra fluviatilis. Journal of Zoology, 188, 5-25.
[59] Russon, I. J., Kemp, P. S. and Lucas, M. C. 2011. Gauging weirs impede the upstream migration of adult river lamprey Lampetra fluviatilis. Fisheries Management and Ecology 18, 201-210.

		year)], avoiding deterioration from existing levels.	the larvae (ammocoetes) live in freshwater for about 5 years before undergoing metamorphosis, taking on the adult characteristics and migrating to the sea where they feed on fish[60]. Changes in water quality could, therefore, impact on all life-stages where the impacted reaches provide supporting habitat. The seasonality, duration and extent of hydrological regime changes are considered in gate-1 to have the potential to change in-river physico-chemical processing, due to potential changes in velocity, time of travel, water depth, surface and feature re-aeration. The prolonged reduction in river flow, particularly at times of low river flow, has been considered at gate-1 to associate with a reduction in buffering capacity for downstream continuous and intermittent water quality pressures. Such changes could impact on the quality of ammocoetes and spawning habitat and could, could result in chemical barriers to migration and result in in mortality of adult and juvenile individuals and effect spawning success through changes in egg incubation rates. A desk study reviewing water quality changes in the River Tame due to reductions in final wastewater against moderate Water Framework Directive limits, concluded that impacts were unlikely in relation to physiochemical pollutants. Impacts are likely to be limited to the reaches of the River Tame to the confluence with the River Trent and the River Trent form the confluence with the River Tame to the Confluence with the River Derwent. As noted above, there is limited data that suggests that the impacted reaches of the River Trent and River Tame does not provide off-site functional habitat for sea or river lamprey. Distribution of river and sea lamprey in the River Trent is severely limited by Cromwell weir, which is considered as impassable to river and sea lamprey. Adverse effects are therefore not anticipated. However, further monitoring is required to confirm the potential extent of water quality changes as a result of the reduction of wastewater through both monitoring and more detailed modelling. The gate-2 assessment should also consider in more detail the potential spawning locations (and relevant migration routes) associated with the River Trent, upstream of the River Derwent and the location and passability of potential migration barriers. Further monitoring is also required to understand the extent to which the impacted reaches provide supporting habitats through a combination of habitat walkovers and targeted lamprey surveys. An in-combination assessment with other plans/projects will also be required in gate-2.		
River lamprey Sea lamprey	Supporting processes: water quality - nutrients (species)	Maintain water quality at mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features			
River lamprey Sea lamprey	Supporting processes: water quality - turbidity (species)	Maintain natural levels of turbidity (eg concentrations of suspended sediment, plankton and other material) in areas where this species is, or could be, present.		Water quality monitoring and modelling to understand the risk associated with reduced wastewater inputs	

[60] Henderson, P. A. 2003. Background information on species of shad and lamprey.,Bangor, Countryside Commission for Wales.

6 Conclusions and Recommendations

The ACWG methodology states that the HRA for each SRO should be undertaken in accordance with available guidance for England and Wales and should be based on a precautionary approach as required under the HRA process. The requirement for a HRA is established through the Conservation of Habitats and Species Regulations 2017 (as amended), commonly referred to as the Habitats Regulations.

As the gate-1 submission does not form a statutory plan or project, STW and AW has undertaken an assessment of the implications of the individual elements of the Minworth SRO by adopting the *principles* of the HRA process to help identify risks to feasibility and deliverability of the elements.

The HRA screening has indicated that a risk of LSE has been identified for the Minworth combined (215 Ml/d) element. As such, further assessment was required subject to the principles of the Stage 2 Appropriate Assessment to identify if the element can meet the requirements of the integrity test and if further survey, assessment and mitigation development is required to provide greater certainty to any conclusions.

The Appropriate Assessment concluded that adverse effects on the site integrity of the Humber Estuary SAC and Ramsar site was not predicted. Available data suggest that associated waterbodies do not provide off-site functional habitat. In addition, NE has identified that distribution of river and sea lamprey in the River Trent is severely limited by Cromwell weir, which is considered as impassable to river lamprey.

Flows and water quality impacts will be limited to the reaches upstream of the confluence of the River Trent and the River Derwent and freshwater inflows, water quality and other estuarine process will be unaffected.

However, it is recommended that detailed monitoring is undertaken, to further understand the hydrological, water quality and geomorphological dynamics along the River Tame and River Trent and to determine if the expected reductions in flow (alone and in-combination with other plans and projects) could impact on qualifying habitats and species and to what extent.

Surveys (including targeted surveys) are also required to confirm that the associated waterbodies do not provide supporting habitat for river and sea lamprey.

The conclusion on the risk of LSE and adverse effects will need to be reviewed and updated (where required) as more information becomes available during completion of the gate-2 assessments, including any bespoke hydrological, habitat and/or water quality modelling.

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RICARDO

Minworth SRO

Biodiversity Net Gain and Natural Capital

The content of this document is draft and relates to material [or data] which is still in the course of completion in travel to Gate 2 and should not be relied upon at this early stage of development. We continue to develop our thinking and our approach to the issues raised in the document in preparation for Gate 2.

Report for GUC PMB

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Table of Contents

1 Introduction

1.1 Background and purpose of report

Ofwat, through the PR19 Final Determination, has identified the potential for companies to jointly deliver strategic regional water resources solutions to secure long-term resilience on behalf of customers while protecting the environment and benefiting wider society. As part of the assessment of companies' PR19 business plans, Ofwat introduced proposals to support the delivery of Strategic Regional Water Resource Options over the next 5 to 15 years with solutions required to be 'construction ready' for the 2025-2030 period. Ofwat's Final Determination[1] in December 2019 set out a gated process for development of Strategic Resource Options (SROs) for the co-ordination and development of a consistent set of SROs.

This gated process provides a mechanism for the industry, regulators, stakeholders and customers to input into the development and scheduling of these strategic solutions, through a combined set of statutory and regulatory processes. These include the National Framework, Drinking Water Safety Plans, Business Plans and Water Resource Management Plans (WRMPs). The strategic regional working group (consisting of Affinity Water, Anglian Water, Severn Trent Water, Southern Water, South West Water, Thames Water, United Utilities and Wessex Water) published a joint company statement reiterating a commitment to continue working with the Regulators' Alliance for Progressing Infrastructure Development (RAPID), the Environment Agency (EA), Natural Resources Wales (NRW), Ofwat and the Drinking Water Inspectorate (DWI) to make all of the planning processes and statutory timetables a success.

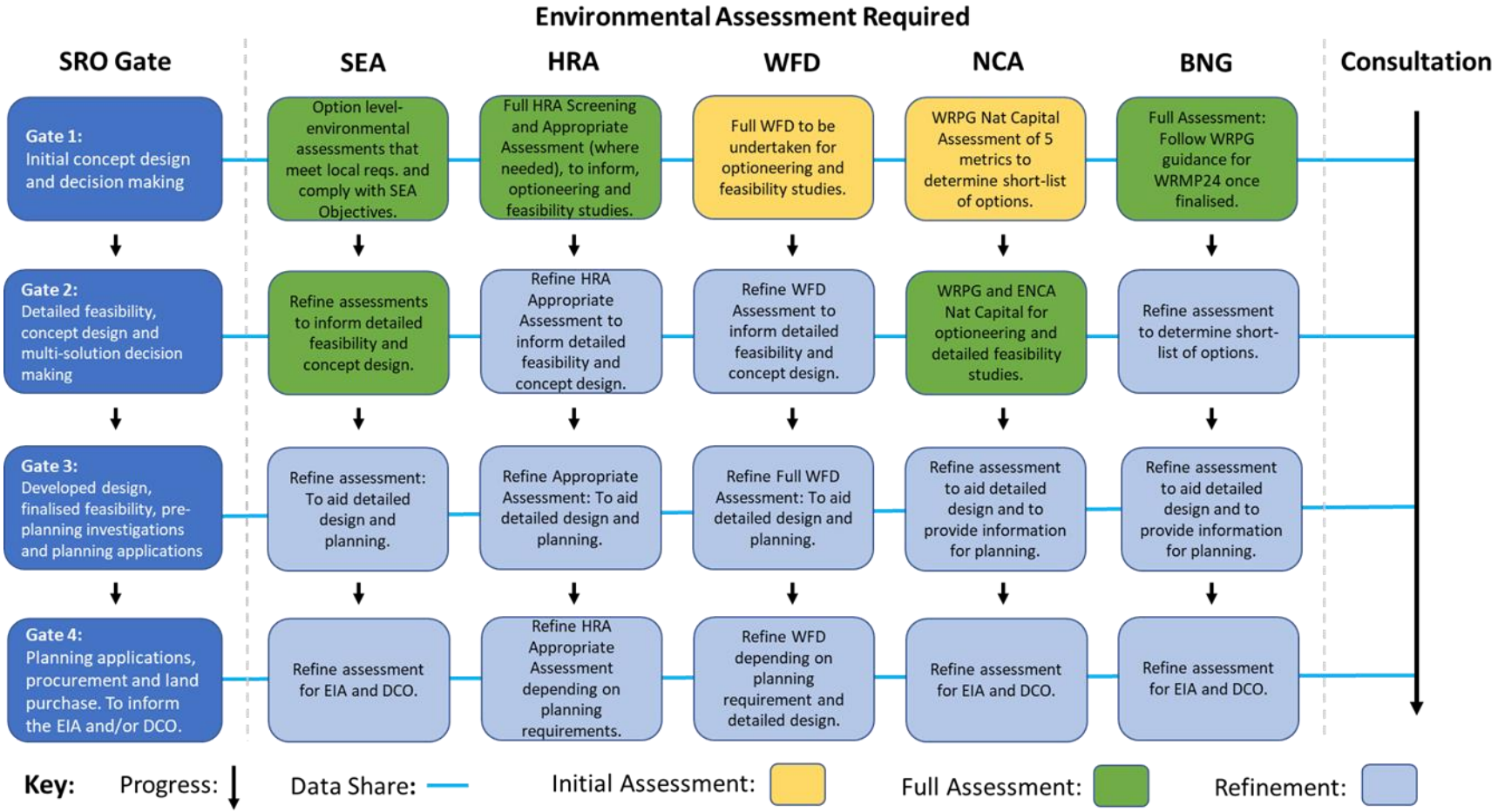
The Severn Trent Water (STW) – Minworth Source has been identified as an SRO in the PR19 Final Determination, with funding provided to STW and Affinity Water (AW). The Minworth SRO is a wastewater augmentation option that will provide treated wastewater from the wastewater treatment works which can be discharged into the River Avon to support the River Severn to River Thames Transfer, or discharged into the canal network to support the Grand Union Canal. Therefore, its delivery will benefit from development funding and RAPID facilitation.

In October 2020, the group of Water Companies involved in developing SROs (known as the All Company Working Group - ACWG), published guidance[2] for environmental assessment methods for SROs which is aligned to the draft Water Resources Planning Guideline (WRPG): Working Version for Water Resource Management Plan 2024 (WRMP24) to increase the consistency of environmental assessment and the evaluation of impacts on environmental water quality in particular.

The ACWG guidelines indicate that the process requires Water Companies to provide the following information related to each SRO at the stage outlined (**see Figure 1.1**).

[1] Ofwat (2019), PR19 Final Determinations, Strategic regional water resource solutions appendix
[2] Mott MacDonald Limited (2020). All Companies Working Group WRMP environmental assessment guidance and applicability with SROs. Published October 2020

Figure 1.1 Environmental Assessment Integration with SRO Gates



In line with Ofwat's PR19 Final Determination the following is required at gate-1 in the context of a Natural Capital Assessment (NCA) and associated Biodiversity Net Gain (BNG):

- *"Initial environmental, social and economic valuations (or metric benefits) consistent with principles in the National Planning Statement and Water Resources Planning Guidelines"*

Therefore, at gate-1, a high level assessment of NC and BNG opportunities and benefits has been applied to the Minworth Source SRO to inform an overall assessment of the environmental feasibility and deliverability of the solution. Neither NCA nor BNG is required at this stage as a statutory requirement but is built into the ACWG and other associated Water Resource Management Planning guidance

This report provides this initial option-level Natural Capital and associated BNG assessment of the Minworth SRO The report sets out the objectives and methodologies used to support and inform an overall assessment of the feasibility of the schemes, from an environmental perspective.

The environmental assessment of the Minworth SRO schemes has been undertaken in the context of the ACWG guidance. This approach has been adopted to assess the various schemes within the Minworth SRO thus determining the environmental impacts, and potential NC opportunities where BNG opportunities have been potentially identified as part of the Minworth SRO. This has been provided in a manner consistent with the assessments that will be undertaken for the regional and individual water company WRMPs This report, the data, and the assessments made, have been shared with Thames Water Ltd and Affinity Water Ltd.

1.2 Structure of this report

The report is divided into the following sections:

- Section 1: This introduction
- Section 2: Provides a background to the Minworth source SRO
- Section 3: Provides the methodology adopted for the NCA and BNG
- Section 4: Provides the results of the scheme assessments
- Section 5: Conclusions and recommendations to inform gate-2 assessments
- Appendices: Assumptions and associated spreadsheet

2 Minworth Sources SRO

2.1 Introduction

The Minworth SRO sub-options are considered integral to a Severn to Thames Transfer (STT) System. In addition, some of the schemes are also integral in the delivery of the Grand Union Canal (GUC) transfer SRO.

A STT conveying raw water from the lower River Severn into the upper or middle River Thames via an interconnector would increase the catchment area from which water resources can be drawn to the south-east of England. In addition to any flows that may be available to be abstracted under licence from the River Severn, a range of raw water Source Support Elements for the STT System are under consideration to provide additional resource.

The STT SRO comprises 2 principal aspects:

1. Severn to Thames Conveyance – Deerhurst to Culham pipeline or Cotswold canal conveyance, including piping to Culham – to convey the water from the River Severn to the River Thames; and
2. STT Source Support Elements which comprise water resources that can be added, or not abstracted (redeployed), from the rivers Vyrnwy, Severn and Avon.

These SROs include the Minworth SRO, STW Sources SRO, UU Sources SRO and UU Lake Vyrnwy SRO. The STT System, therefore, comprises the STT SRO and the source SROs which would be required to work as a combined system to deliver the required outputs into the River Thames.

Minworth SRO can support GUC (up to 100Ml/d), it could support STT (up to 115Ml/d) or it could potentially support both transfer SROs (up to 215Ml/d). The SEA, WFD, HRA, BNG and Nat Cap assessments should consider the options in their entirety. For Minworth/GUC, this involves the site upon which treatment process upgrades are required, and any impacts on the River Tame system regarding the diversion of up to 100Ml/d of treated wastewater discharge from Minworth.

For Minworth/STT (115Ml/d), this also involves the site upon which treatment process upgrades are required, although the process upgrades for this sub-option will have a larger footprint than those for Minworth/GUC. This assessment covering the 115Ml/d sub-option to support STT will involve a pipeline from the Minworth site to the River Avon, but the discharge will not be covered within this assessment to avoid ‘double counting’ with the STT SRO assessments. It will also assess any impacts on the River Tame system regarding the diversion of up to 115Ml/d of treated wastewater discharge from Minworth.

For Minworth/both (215Ml/d), this sub-option is an amalgamation of the two previous sub-options. It involves Minworth supporting STT and GUC. Although both options are unlikely to be required at the same time period (to be determined by the regional planning process), this assessment will consider the potential effects of diverting up to 215Ml/d of treated wastewater from reaching the River Tame. It will also cover the treatment process upgrades required to ‘upgrade’ the existing Minworth WwTWs

As noted above, the Minworth Sources SRO is also critical in the delivery of the GUC Transfer SRO which will comprise of the transfer of treated effluent down the GUC to supply Affinity Water. This comprises a direct discharge into the canal network, canal transfer to a new abstraction near Hemel Hempstead, and the onward transfer of raw water to a new water treatment works and expanded reservoir. It is expected that this work is jointly managed in partnership between the water companies and Canal & River Trust. This solution ranges from 50 to 100 Ml/d in capacity.

Minworth SRO includes three schemes:

1. Minworth / STT (115Ml/d): The development at the Minworth Wastewater Treatment Works (WwTW) and a pipeline to the River Avon for the transfer of treated effluent of up to 115 Ml/d.
2. Minworth Combined (215Ml/d): The development at the Minworth WwTW and a pipeline to the River Avon for the transfer of treated effluent of up to 215 Ml/d.
3. Minworth / GUC (100Ml/d): The development at the Minworth WwTW for the further treatment of effluent of up to 100 Ml/d.

A more detailed description of each scheme is provided in the sections below.

2.2 Minworth / STT (115 Ml/d)

Currently treated wastewater from the Minworth Wastewater Treatment Works (WwTW) is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 115 Ml/d portion of this treated wastewater to a new outfall on the River Avon and hence into the River Severn catchment to support STT abstraction from the River Severn at Deerhurst or Gloucester Docks.

There would be an upgrade to the existing Minworth WwTW to improve the existing quality of wastewater to an acceptable standard for discharge to the River Avon. The discharge into the River Avon will require additional treatment technologies. The upgrades for this option will include the installation of a Ballasted Magnetite Coagulation (CoMagTM, Evoqua) Technology, UV disinfection units and Granular Activated Carbon units. All construction will be within the existing boundaries of the Minworth WwTW site.

In addition, this element comprises a pumping station at the Minworth WwTW site and pipeline from the Minworth WwTW site to a new outfall on the River Avon. The pipeline from Minworth WwTW to the River Avon outfall would be some 37.6km in length. The outfall location has been identified, during studies undertaken a gate-1, and would be located on the River Avon to the south of Warwick.

This assessment relates to the upgrade of the WwTW site associated with the discharge into the River Avon, and the pipeline to the River Avon. This assessment also considers any impacts on the River Tame system regarding the diversion of up to 115Ml/d of treated wastewater discharge from Minworth.

The assessment of the discharge of some 115 Mld to the River Avon is considered as part of the STT SRO and does not form part of this assessment.

2.3 Minworth Combined (215 Ml/d)

Currently treated wastewater from the Minworth WwTW is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 215 Ml/d portion of this treated wastewater. With a 115 Ml/d portion being diverted to a new outfall on the River Avon and hence into the River Severn catchment to support STT abstraction from the River Severn at Deerhurst or Gloucester Docks and 100 Ml/d being diverted to the GUC.

There would be upgrades to the existing Minworth WwTW site necessary to improve the existing quality of wastewater to an acceptable standard for each discharge location (as noted below). As a result of the analysis of the receiving water quality (canal and river) and the location of the potential wastewater discharges, different levels of treatment would be required for each option.

The discharge into the GUC will require upgrades to ensure discharges of a maximum of 0.2mg/l Total Phosphorous. This will consist of the installation of Ballasted Magnetite Coagulation (CoMag™, Evoqua) Technology.

The discharge into the River Avon will require additional treatment technologies. The upgrades for this option will include the installation of a Ballasted Magnetite Coagulation (CoMagTM, Evoqua) Technology, UV disinfection units and Granular Activated Carbon units.

The upgrade works in both cases will be located in the same area of the existing WwTW site. All construction will be within the existing boundaries of the Minworth WwTW site.

In addition, this element comprises a pumping station at the Minworth WwTW site and a pipeline from the Minworth WwTW site to a new outfall on the River Avon. The pipeline from Minworth WwTW to the River Avon outfall would be some 37.6km in length. The outfall location has been identified, during studies undertaken at gate-1, and would be located on the River Avon to the south of Warwick.

This assessment relates to the upgrade of the WwTW site associated with discharges to both the River Avon and the GUC, and the pipeline to the River Avon. This assessment also considers any impacts on the River Tame system regarding the diversion of up to 125Ml/d of treated wastewater discharge from Minworth.

The assessment of the discharge of some 115 Mld to the River Avon is considered as part of the STT SRO and does not form part of this assessment. The pipeline and discharge of 100Ml/d to the GUC is considered under the GUC Transfer SRO and does not form part of this assessment.

2.4 Minworth / GUC (100Ml/d)

Currently treated wastewater from the Minworth WwTW is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 100 Ml/d portion of this treated wastewater to the GUC system.

This assessment relates to the upgrade to the WwTW site associated with the discharge into the GUC and with a capacity of up to 100 Ml/d. The discharge into the GUC will require upgrades to ensure discharges of a maximum of 0.2mg/l Total Phosphorous. This will consist of the installation of Ballasted Magnetite Coagulation (CoMag™, Evoqua) Technology. All construction will be within the existing boundaries of the Minworth WwTW site. This assessment also considers any impacts on the River Tame system regarding the diversion of up to 100Ml/d of treated wastewater discharge from Minworth.

The pipeline and discharge of 100Ml/d to the GUC is considered under the GUC Transfer SRO and does not form part of this assessment.

3 Methodology

3.1 Methodologies for gate-1

3.1.1 Natural Capital Assessment (NCA)

A NCA has been carried out to identify the potential Natural Capital benefits and disbenefits of the Minworth Sources. The primary aim of this work is to assess Natural Capital, related to the BNG opportunities and construction impacts to support decision making. We have accounted for socioeconomic aspects (recreation and amenity) to provide a more holistic view of natural and associated social capital. This socioeconomic element highlights the relationships between people and the affected environments and identifies how these relationships could change as a result of the elements.

Following a high level screen assessment to identify the potential benefits and disbenefits of each Minworth Sources component (based on key data sources and expert judgement to supplement data gaps), the approach taken has been designed to satisfy the requirements of the key regulators (i.e. Environment Agency (EA), Natural England (NE), Rapid) and requirements as stated in the Water Resources Planning Guideline (WRPG)[3]. The expert judgement is underpinned by key open-source data and review of associated environmental and habitat GIS mapped data related to the scheme footprint and surrounding area.

The following provides a summary for key legislation/guidance, country applicability and our summary approach related to each for NCA and also biodiversity net gain since the later underpins the NCA biodiversity outputs as outlined in **Section 2**.

- WRMP24 Supplementary Guidance[4]: Environment and society in decision-making, taking into account the assessment of five minimum ecosystem services (England) namely biodiversity, climate regulation (carbon storage); water purification and natural hazard regulation.
- Environment Bill when announced, is supported by the BNG assessment (see **A.7 for further info**) via the Defra biodiversity metric (England).

As a result the approach follows that outlined by the All Company Working Group (ACWG) environmental assessment guidance for Strategic Resource Options (SROs)[5] (hereafter referred to as ACWG Guidance) whilst taking account of the key requirements above and draws on the WRSE Regional Plan Environmental Assessment guidance[6] and EA[7] and NRW's[8] Water Resources Planning Guideline (WRPG) WRMP24 Supplementary Guidance on Environment and Society in Decision-Making. RAPID gate-1 expectations for Natural Capital Assessment have been incorporated which include:

- Desktop baseline assessment of the five key metrics as included in the WRPG[3] (plus the additional socioeconomic metric);
- List of assumptions made during the assessment including but not limited to: a theory-based Zone of Influence (ZoI); the use of landcover data derived from satellite imagery and;
- The application of a Gross Domestic Product (GDP) inflator for monetised value adjustment (where applicable).

[3] Environment Agency, Ofwat & Natural Resources Wales (2020) Water Resources Planning Guideline. 17th March 2021. Available at https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline. Accessed 29/04/2021.
[4] Water Resources Planning Guideline. Supplementary Guidance Environment and society in decision-making. Available via request: water-company-plan@environmnent-agency.gov.uk
[5] All Company Working Group (2020). WRMP environment assessment guidance and applicability with SROs
[6] Mott MacDonald (2020) WRSE Regional Plan Environmental Assessment Methodology Guidance
[7] Environment Agency (2020) Water resources planning guideline 2024 supplementary guidance- Environment and society in decision-making (England).
[8] Natural Resources Wales (2020) Water resources planning guideline 2024 supplementary guidance- Environment and society in decision-making (Wales).

The NCA output at gate-1 is high-level and intrinsically linked to the BNG (i.e. provides the Natural Capital biodiversity assessment). Where feasible, valuations (both spatially quantitative and monetised) have been provided, noting key assumptions/limitations especially in the context of outline design related limitations as detailed in **A1.1** At gate-1 the required focus is to provide a Natural Capital baseline. The assessment has therefore focused on construction related losses and potential gain related to a 10% BNG uplift based on open source data currently available.

3.1.1.1 Data sources and gaps

The Natural Capital assessment has been completed using the following data sources, as recommended by the ACWG Guidance[5] and the EA and NRW's Natural Capital Assessment Guidance[3] (including Annex 1 of the WRPG Supplementary Guidance[3]).

3.1.1.2 Natural Capital stocks

The ACWG Guidance for a Natural Capital Approach advises that land use should be grouped into eight distinct types of broad habitat (urban; enclosed farmland; mountains, moors and heath; freshwater; woodland; marine; and semi-natural grassland), from which ecosystem services and benefits to society can be attributed and then monetised. The Copernicus CORINE Land Cover 2018 dataset was used to identify land cover types. This dataset is derived from satellite imagery, predominantly Sentinel-2 but additionally Landsar-8 for gap filling[9]. CORINE Land Cover 2018 identifies 44 different types of land cover and spans the entirety of Europe. These 44 land use types were initially grouped into the eight broad habitat types as recommended in the ACWG Environmental Assessment Guidance to give the total area of each broad habitat within each element's ZoI. The marine habitat was then removed from this assessment as not applicable within the boundaries of the Minworth Sources area.

The conversion from Corine Land Cover to broad habitat was undertaken and outlined in

[9] Copernicus (2020) Evolution of CORINE Land Cover. Accessed: https://land.copernicus.eu/pan-european/corine-land-cover

Table .

Table 3-1: Conversion from Corine Land Cover to seven broad habitat types

Corine Land Cover	Broad habitat type
Airports	Urban
Construction site	Urban
Continuous urban fabric	Urban
Discontinuous urban fabric	Urban
Dump sites	Urban
Green urban areas	Urban
Industrial or commercial units	Urban
Mineral extraction sites	Urban
Road and rail networks and associated land	Urban
Sport and leisure facilities	Urban
Complex cultivation patterns	Enclosed farmland
Land occupied by agriculture with significant areas of natural vegetation	Enclosed farmland
Non-irrigated arable land	Enclosed farmland
Pastures	Enclosed farmland
Moors and heathland	Mountains, moors and heath
Natural grasslands	Semi-natural grassland
Coniferous forest	Woodland
Mixed forest	Woodland
Transitional woodland-scrub	Woodland
Water bodies	Freshwater
Estuaries	Coastal margins

3.1.1.3 Ecosystem Services

Stocks of Natural Capital underpin the provision of ecosystem services, i.e. the goods and services provided by nature that benefit humans and society. Some ecosystem services can be valued in monetary terms based on the benefits they provide. The data sources used to value ecosystem services are described below, these have been taken from the WRPG[3], ACWG Guidance[5] and Defra's Enabling a Natural Capital Approach (ENCA) Guidance[10].

3.1.1.4 Biodiversity and Habitat

Assessment of biodiversity has been based on the habitat data used in the BNG assessments. The lengths of river within the ZoI of each element have also been calculated using WFD Waterbody data. Further incorporation of these into the Natural Capital Assessment will be included at gate-2 (see **Section 5).**

3.1.1.5 Climate Regulations (carbon sequestration)

The carbon sequestration rates for Natural Capital stocks have been taken from the EA WRPG Supplementary Guidance (from JBA Consulting)[11] as shown in **Table 3-2**:. Carbon sequestration rates of the relevant Natural Capital assets have been converted into monetary values using the Department for Business, Energy, and Industrial Strategy (BEIS) Interim Non-Traded Carbon Values. Non-traded carbon values have been applied to carbon sequestered as these emissions are not captured by the EU Emissions Trading Scheme. As the prices published by BEIS are in £2018, GDP deflators were used to adjust them to the 2019 base year of modelling.

[10] Defra, Enabling a Natural Capital Approach (2020). https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca
[11] Table 7 of the EA Supplementary Guidance: Environment and Society in Decision-Making (2020).

Table 3-2: Carbon sequestration of land use from EA WRPG Supplementary Guidance

Land use type	C seq rate (t/CO2e/ha/yr)
Woodland (deciduous)	4.97
Woodland (coniferous)	12.66
Arable land	0.10
Pastoral land	0.39
Peatland – Undamaged	4.11
Peatland – Overgrazed	-0.1
Peatland – Rotationally burnt	-3.66
Peatland – Extracted	-4.87
Grassland	0.39
Heathland	0.7
Shrub	0.7
Saltmarsh	5.19
Urban	0
Green urban	0.40

3.1.1.6 Natural Hazard Regulation

For the purposes of this assessment at this gate-1 stage, flooding was determined to be the most significant natural hazard risk noting that air quality has been considered separately and that the focus has been related to water transfer. noting that air quality has been considered separately and that the focus has been related to water transfer. noting that air quality has been considered separately and that the focus has been related to water transfer. Key flood risk zones from open source EA data was used to identify these areas. At this stage and the given the level of detail regarding option design any flood risk impacts of benefit opportunities have been assessed as being related to operational effects during drought periods. The physical changes to Natural Capital stocks for example, may impact the capacity of habitats to slow the flow of flood water year-round: equally high level opportunities for natural flood management were considered related to habitat type. Monetary values were sourced per broad habitat type from existing studies conducted in the UK. Values for woodland and wetlands/ floodplains broad habitat types were identified using the ENCA Services Databook[12] where the associated studies were evaluated to ensure their suitability for benefit transfer. A value for semi-natural grasslands was not available. Additional studies were identified with the final best estimate for semi-natural grasslands derived from a benefit function from an existing ecosystem services assessment (Christie et al, 2011[14]) noting however, that this value is mainly applicable to lowland meadows (Holzinger & Haysom, 2017[15]) and hence at this state is likely to impact values: further more detailed data assessment should be undertaken as part of gate-2 to review any more new information.

An annual monetary value was only derived for the flood regulating services of woodland, semi-natural grassland, and wetland/ floodplain assets (see **Table 3-2:**). Robust monetary values for the urban and enclosed farmland broad habitat types are not currently available and hence it was not possible to

[12] https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca#enca-services-databook

provide a monetised estimate of these services at gate-1. As a result, the overall value of the NCA is likely to be understated at this stage.

Table 3-3: Benefit Transfer Values: Natural Hazard Regulation

Broad habitat type	Annual Value	Reference	Additional Comments
Woodland	115 (£2018/ha)	Forest Research (2018)[13] & ENCA Services Databook	These results are experimental noting no semi-grassland value.
Semi-natural grasslands	197 (£2015/ha)	Christie et al (2011)[14] & Holzinger & Haysom (2017)[15]	Appear applicable to lowland meadow only. Based on an ecosystem services assessment of Chimney Meadows Reserve (UK).
Freshwater (Open waters/ wetlands/ floodplains)	407 (£2011/ha)	Morris & Camino (2011)[16] & ENCA Services Databook	No additional comments.

3.1.1.7 Water Purification

The WRPG[3] does not require the monetisation of Water Purification Services (p. 36) as these services are highly dependent on local factors. There are limited tools available to provide accurate monetised assessment and as such, at this stage, the assessment has been undertaken as qualitative and quantitative rather than a monetised. The assessment of this service is based on habitat data, WFD status information from the EA's Catchment Explorer[17] and outputs at the river basin scale from the Natural Environment Valuation Online (NEVO) tool.[18]

3.1.1.8 Water Regulation

The WRPG[3] does not require the monetisation of Water Regulation Services (p. 42). The main benefit of the Minworth sources is the deployable output, therefore this is not considered as an additional Natural Capital benefit to avoid double counting, and Water Regulation has been screened out of the assessment.

3.1.1.9 Recreation and Tourism

The Outdoor Recreation Valuation Tool (ORVal)[19] was used to estimate recreation demand from existing or new greenspace as a proxy for recreation value. The values derived from the ORVal[19] tool are estimated using a Random Utility Model of travel cost estimates[20]. The values represent the total welfare lost if the site in question were to be removed. In cases where elements consist of more than one site, the marginal values of each site are aggregated based on the assumption that other sites that exist outside of the element scope, are substitutes[21].

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[13] Forest Research (2018). Valuing flood regulation services of existing forest cover to inform natural capital accounts. Accessed via: file:///C:/Users/se17/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/Final_report_valuing_flood_regulation_services_051218%20(3).pdf

[14] Christie, Mike, Tony Hyde, Rob Cooper, Ioan Fazey, Petter Dennis, John Warren, Sergio Colombo, and Nick Hanley. 2011. Economic Valuation of the Benefits of Ecosystem Services delivered by the UK Biodiversity Action Plan. Report to Defra, London: Aberystwyth University.

[15] Holzinger, Oliver, and Karen Haysom. 2017. Chimney Meadows Ecosystem Services Assessment: An Assessment of how the new management of Chimney Meadows Nature Reserve by Bers, Bucks and Oxon Wildlife Trust impacts on the value of ecosystem services. Oxford: Berks, Bucks and Oxon Wildlife Trust.

[16] Morris & Camino (2011) UK National Ecosystem Assessment Economic Analysis Report, School of Applied Sciences, Cranfield University.

[17] https://environment.data.gov.uk/catchment-planning/

[18] https://sweep.ac.uk/portfolios/natural-environment-valuation-online-tool-nevo/

[19] https://www.leep.exeter.ac.uk/orval/

[20] Day & Smith (2017) The ORVal Recreation Demand Model: Extension Project. Accessed via: https://www.leep.exeter.ac.uk/orval/pdf-reports/ORValII_Modelling_Report.pdf

[21] https://www.leep.exeter.ac.uk/orval/pdf-reports/ORVal2_User_Guide.pdf

3.1.1.10 Air quality

Air Quality is a required assessment within the WRSE guidance and hence has been included in this Natural Capital Assessment. Airborne pollutants represent a serious threat to human health and wellbeing: assessment of air quality regulation services is therefore also relevant to the well-being goals set out by the Welsh Government[Error! Bookmark not defined.]. Natural habitats are able to reduce these harmful effects by absorbing air pollution providing ecosystem service benefit to society. To quantify this benefit, values provided by Jones et al. (2019)[22] have been used to convert land cover types into estimates of monetary value for pollutant absorption per hectare per year. This has been used to assess the baseline value of the habitats within Air Quality Management Areas that fall within a defined ZoI surrounding each element. Where habitats do not fall within an Air Quality Management Area they have not been included in the assessment of this Natural Capital metric. Monetary values are provided in **Table .**

Table 3-4: Air pollutant value by habitat type

Habitat group	Value (£2019 per hectare per year)
Urban Woodland	871
Rural Woodland	277
Urban grassland	168
Enclosed farmland	16
Coastal margins	29

3.1.2 Biodiversity Net Gain (BNG)

Whilst currently BNG is not yet mandatory it is likely to become a legal requirement for development once the Environment Bill has become an Act of Parliament. Delivering net gain for the environment has become a policy requirement and the **25-Year Environment Plan** speaks of embedding an environmental net gain principle for development, including infrastructure.

The Biodiversity Net Gain (BNG) assessment required for gate-1 is carried out in line with the All Company Working Groups (ACWG) current guidance to SRO Environmental Assessment. The requirements and outputs of the assessment are also consistent with WRPG guidance for WRMP24.

The outputs provide both an assessment of losses and potential net gain opportunities and the data upon which the NCA is compiled related to habitat type (both losses and Net Gain uplift opportunities) for the NC biodiversity metric.

The guidance states that BNG should be demonstrated for each element/option to "**look to maximise biodiversity net gain**" and that "**supply options should incorporate BNG into design and therefore provides a biodiversity optimised programme"**. If significant BNG can be achieved but at significant additional cost this should be included as a separate option. Therefore, BNG calculations should be carried out at long-list stage, gate-1, and that early identification of opportunities and constraints is essential to design and consideration of any requirement for additional options. Identified opportunities and constraints for BNG have been detailed below in the results section, noting at gate-1 this constitutes a high-level assessment based on limited open-source data and consideration given for the need for any additional options to address constraints.

In accordance with the guidance, our approach has been to use a **GIS-based system** to allow for rapid assessment of multiple elements and the application of **Defra's Biodiversity tool 'The Biodiversity Metric 2.0' (Defra BNG Metric)** as a means of scoring the biodiversity gain or loss of each element. Therefore, the baseline will be developed from spatial data sets of habitat inventories and scored through the Defra BNG Metric.

[22] Laurence Jones, Massimo Vieno, Alice Fitch, Edward Carnell, Claudia Steadman, Philip Cryle, Mike Holland, Eiko Nemitz, Dan Morton, Jane Hall, Gina Mills, Ian Dickie & Stefan Reis (2019) Urban natural capital accounts: developing a novel approach to quantify air pollution removal by vegetation, Journal of Environmental Economics and Policy, 8:4, 413-428

3.1.2.1 Achieving Biodiversity Commitments

Our approach assesses whether the ST Sources meet with the 25 Year Environment Plan commitments and statutory environmental duties for biodiversity through taking into account the **biodiversity commitments** (listed below).

The assessment applies the principles of Net Gain, by taking a hierarchical approach to mitigation seeking to avoid loss of key habitats, and therefore species, and strategic identification of opportunities for biodiversity benefits to protect, enhance and provide resilience:

1. Conserving and enhancing SSSIs (Wildlife and countryside Act as amended):
2. Furthering the purposing of the Habitats Directive (and regulations) Conservation of Habitats and Species Regulations 2017 as amended.
3. Achieving the conservation objectives for marine protected areas (marine and Coastal Access Act)
4. Biodiversity net gain for habitats and species of principle importance for the conservation of biodiversity – (Natural environment and rural communities Act).

Key to this, is timely identification of the possible requirement for compensation for likely impacts, such as those to 'irreplaceable habitats' and identify lower impact alternatives.

For gate-1, the BNG assessment comprised a full assessment for each element. Gate-2 will be a refined assessment to determine the short list of options. Further details of our approach are provided below.

3.1.2.2 Data collection and review

The first stage is collection of data and review of relevant, available information to inform of key BNG constraints and opportunities. All the data sets use open source data that is readily available and can be uploaded to a centralised GIS database.

3.1.2.3 Identifying the biodiversity baseline conditions

The Defra BNG metric is a habitats-based assessment. To demonstrate best outcome (% BNG) will require a **baseline calculation** of current biodiversity value/score. This tool quantifies each habitat type into 'units' based on a number of factors, including habitat distinctiveness, area (or linear equivalent), condition, ecological connectivity and strategic significance. At gate-1, the assessment of BNG options is a high-level assessment based on available open source data. For this, a range of open source and assessable data will be used to gain a good understanding of habitats present within the ZoI that can provide a robust baseline.

Firstly, the habitat data has been provided by using existing habitat inventories, such as Corine Land Cover and areas measured in GIS. Secondly, the identification of habitat distinctiveness, condition and baseline extent for habitats, including priority habitats and designated and non-designated sites, has been determined through mapping on the Priority Habitat Inventory and open data on designated sites noting that where data on habitat quality is not available for a habitat, 'moderate' condition will be assumed to avoid an over precautionary assessment. Any assumptions where a 'moderate' habitat condition has been defined, these will be reviewed via field surveys to ground truth and reassess the habitat condition. Such assumptions will be defined and addressed at gate-2 noting that field surveys to ground-truth need to commence early on as part of the gate-2 process or between gates to ensure that data can been used to assess opportunities in more detail as part of the overall gate process related to BNG and mitigation measures.

The baseline scores are adjusted for the associated habitat impacts (gains or losses) related to the construction of each element as area of habitat loss. The adjustments take into account the assumption of good practice construction methods and re-instatement. This part of the assessment identifies high risk areas where the proposals will result in a significant loss of biodiversity and offsetting will be more onerous or may identify an 'irreplaceable habitats' that should be avoided, such as certain priority habitats. There are no operational impacts on terrestrial habitats and there is insufficient open source data to assess operational impacts to rivers at gate-1. The Biodiversity Metric 2.0 is also not designed to assess degradation from operational effects, which may be resolved within the next release of 3.0.

The output is the BNG tool spreadsheet, a table of baseline unit scores for each element (Appendix 3, 7, 8.1, 8.1 and 9). The criteria definitions will align with those for SEA and NC within the WRSE for designated sites. The results will feedback into engineering design of elements to identify opportunities to reduce their impact. The BNG tool spreadsheets for the pipeline route and the Grand Union Canal element are located in **Appendices 8.1 and 8.2** respectively.

3.1.2.4 Identifying BNG opportunities and calculating the benefit score

Enhancement measures can include the provision of new habitats, provision of new habitat features and the improved management of existing habitats which will result in a net benefit to biodiversity, over and above the measures required to mitigate and compensate for the impacts of a proposed scheme. Enhancement opportunities are added to the Metric as a habitat area and the Metric re-calculates the quantity or balance of (units) of BNG provided, which is also given as a % change from the baseline.

Opportunities for biodiversity gain will be linked with those within SEA, WFD, HRA mitigation measures where applicable and NC approaches and will require working in parallel to identify solutions to provide best outcomes across these assessments.

The output of this stage is the tool spreadsheet and a table of the habitats and areas required for enhancement/creation to offset the impacts of each element and provide a minimum 10% BNG (both found in **Appendix A6**). Representation of the BNG opportunities, habitat enhancements or creation, would be represented in GIS with areas shown within possible suitable locations based on habitat type only. The purpose is to represent the area of enhancement /creation required for a rapid assessment of achievability and flag any unmitigable impacts.

3.1.2.5 Strategic assessment of opportunity areas

The metric takes into account habitat distinctiveness and risk parameters associated with habitat creation and restoration. This means that a 1:1 replacement will not score 0 in terms of gains and losses but a negative number of units, as additional enhancements will be required, for example, to take account of time lag of the establishment of created/restored habitat. Therefore, if additional habitat area is required to offset losses and provide BNG, it is possible that insufficient land may be available on site. A strategic assessment of off-site opportunity areas has been undertaken to identity suitable parcels of land where the best biodiversity gain could be achieved. These opportunity areas will interface with the Natural Capital approach to identify where benefits can be achieved and are described further below.

3.1.2.6 Identifying BNG opportunity areas

Our approach follows the mitigation hierarchy of avoiding, minimising and mitigating the habitat lost/deteriorated and local compensation. Maximum credits can be achieved through identifying opportunities for enhancing the habitat that is lost/degraded rather than replacement. However, where insufficient habitat lies on site to deliver what's required for net gain, alternative locations will be sought. A review has been undertaken of Biodiversity Opportunity Areas.

Using the principles of Biodiversity Opportunity Areas, core areas for biodiversity have been identified, such as designated and non-designated sites and priority habitats. The opportunities will be assessed for their suitability for specific net gain features, connectivity opportunities and achievability. Values will then be assigned against areas of mitigation opportunity with potential condition improvement for each feature and opportunity including specific mitigations recommendations.

4 Assessments Results

4.1 Introduction

The Minworth Source SRO options are presented in **Table 4-1.**

Table 4-1: Minworth Sources SRO

Scheme Name and Description*
Minworth / STT (115Mld): Minworth 115Ml/d to include development of site at Minworth, Pipe to Avon, No discharge to Avon†, 115Ml/d not going to the River Thame.
Minworth Combined (215Mld): Minworth 215Ml/d to include development of site at Minworth, Pipe to Avon, No discharge to Avon†, 215Ml/d not going to the River Thame.
Minworth / GUC (100Mld): Minworth Site for the GUC development only.

**For gate-1 the BNG and NCA has focused on the terrestrial habitats, as insufficient information currently available to assess any effects related flow changes for example in the River Avon to be adequately considered: hence Minworth 115Ml/d and 215Ml/d have been grouped as one assessment at this stage.*

†The assessment of the discharge of some 115 Mld to the River Avon is considered as part of the STT SRO and does not form part of this assessment.

In order to measure the Natural Capital benefits and disbenefits of each element, the assessment first requires knowledge of the likely changes in habitat extent and quality. This is the basis of the BNG assessment. The Natural Capital Assessment relies on the BNG outputs to understand extent of change. The data sources used to carry out monetary valuation of the baseline Natural Capital stock (see **Section 3)** can then be applied to the future change scenario, to provide an ecosystem service valuation (in monetary terms)) for the future Natural Capital stock. The difference between the baseline and future scenarios is then been used as the Natural Capital valuation for each element. For those elements that are only assessed qualitatively, a description of the future change scenario is necessary which outlines the likely changes in ecosystem service provision following Minworth source implementation for each element.

Calculation of the overall impact on Natural Capital and ecosystem service provision need to consider the mitigation and enhancement opportunities that will be incorporated in scheme design, particularly the biodiversity uplift requirements outlined in the BNG assessment. To account for this, a further assessment needs to be carried out of the Minworth sources to provide a high level BNG uplift. At gate-1 BNG enhancement opportunities have not been agreed so an estimated uplift of 10% for each impacted habitat is included in the Natural Capital Assessment. This is critical as BNG is expected to become a requirement of planning permission, and therefore the Minworth sources selected for development will be required to include a BNG uplift in the final design.

The assessment at gate-1 focusses primarily on the terrestrial habitats and impacts with commentary only related to aquatic environments: more detail will be necessary at gate-2 once there is more information regarding Minworth sources and associated groupings design including agreed Ml/d variant taken forward. At gate-2 understanding flow dynamic change on all key Natural Capital aquatic-related metrics should be feasible but this is not expected at gate-1.

The habitats within the ZoIs for each Minworth source have been mapped and a high-level analysis of likely effects following each element's implementation has been performed. An assessment of the likely risks posed to the Natural Capital metrics is provided in **Table 4-2** below. This provides that basis for the assessment work to be completed for gate-1.

Note:

- Each 'element' associated with the Minworth sources is split out for the assessment below and for the baseline (see section 4.2 and 4.4)
- Groupings as shown in table 4-1 areas completed as part of the full assessments (see sections (4-3 and 4-5)

Table 4-2: Risks posed to Natural Capital/Net Gain metrics per element

Reference	Metric	Risk	Impacts
Minworth / STT (115Ml/d) and Minworth Combined (215Ml/d)	Biodiversity	Medium	Stocks lost mainly arable agriculture with some from urban areas. Will lead to carbon sequestration and air quality disbenefits. Biodiversity disbenefits related mainly to hedgerow loss: mitigation options through BNG uplift which can have offsetting opportunities for carbon and air quality. *Further investigation required at gate-2.*
	Water regulation	Low	
	Carbon	Medium	
	Air quality	Medium	
	Water purification	Low	
	Natural hazard regulation	Low	
	Recreation & tourism	Low	
Minworth / GUC (100Ml/d)	Biodiversity	Low	Construction site is located almost entirely on urban land. Risks to natural capital stocks are therefore negligible.
	Water regulation	Low	
	Carbon	Low	
	Air quality	Low	
	Water purification	Low	
	Natural hazard regulation	Low	
	Recreation & tourism	Low	

4.2 Baseline assessment results - NCA

The NCA tables for the Minworth Sources are provided in associated appendices as outlined below. A breakdown of the qualitative and quantitative baseline assessment results are detailed in the Excel workbooks accompanying the Environmental Assessment report (**A4.1, A4.2, A6, and A7**). The workbooks also include a series of figures for each element depicting the ZoI and the distribution of land cover and other features of relevance to ecosystem service assessment. A baseline assessment of Natural Capital stocks and ecosystem service provision has been carried out to inform the assessment of each option. This has been based on a 1km ZoI using habitat data as a proxy for Natural Capital stocks. The flow of ecosystem services under baseline conditions has been assessed using the data outlined in **Section 3.**

4.2.1 Biodiversity and habitat

Table summarises the areas of each broad habitat within the 1km ZoI for each element. Only habitats that are present within the ZoI are included. The lengths of river that lie within this zone have also been calculated so that qualitative assessments can be conducted regarding effects to nearby waterways, but as discussed in Section 4.1, only the terrestrial impacts are being assessed quantitatively at this stage. Changes to habitats due to changes in flow cannot therefore be taken into account at gate-1.

The baseline indicates that the majority of land use for the Minworth Sources is urban or enclosed farmland with relatively low biodiversity value, noting more detailed analysis of local biodiversity features will be required at gate-2.

The pipeline elements have significant areas of higher biodiversity value habitat, such as woodland and semi-natural grassland, which support a range of wider ecosystem services, whereas the ZoI surrounding the proposed GUC development consists only of urban and agricultural habitats.

Table 4-3: Summary of broad habitat types for elements

Reference	Based on 1km radius = Total zone of influence (ha)	Habitat type	Ha per habitat: based on 1km radius ZoI	Length of river within buffer zone* (km)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	7536.71	Urban	2038.08	8.75
		Enclosed farmland	5428.55	
		Freshwater	13.04	
		Woodland	57.04	
Minworth / GUC (100Mld)	454.80	Urban	331.81	2.32
		Enclosed farmland	122.98	

**This includes rivers flowing within the 1km buffer zone that may not be directly related with the scheme. These are not identified by the Corine dataset but may still be affected by construction/operation and have also been included at this state as may related to BNG opportunity areas.*

4.2.2 Climate regulation

Table summarises the baseline land use types within the 1km ZoI of each Minworth sources and the monetary value of the climate regulation ecosystem services they provide. The Minworth/STT and Minworth Combined (115Mld and 215Mld) pipeline provides the greatest carbon sequestration value under baseline conditions; this is related to the considerably larger ZoI as well as the presence of high value habitats within the that ZoI (e.g. woodland) – see **Table**).

Table 4-4: Summary of baseline non-traded carbon sequestration values per element

Reference	Baseline non-traded carbon sequestration value (£2019)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	80,512
Minworth / GUC (100Ml/d)	735

4.2.3 Natural hazard regulation

Table presents the baseline assessment of natural hazard regulation. Only areas located within flood plain and close to urban areas (where impacts of flooding are likely to be more costly) have been scoped into the assessment. The areas susceptible to flooding were identified using Flood Zone 2 and 3 definitions outlined in National Planning Policy[23]. A shown in **Table 4.3** there is no direct link between the Minworth/GUC construction area and freshwater habitat within a flood zone. As a result the baseline natural hazard value has been identified as £0 in this context.

Baseline land cover was converted to monetary value based on data outlined in **Section 3.** A benefit transfer value has not been identified at this stage for farmland, therefore this has not been accounted for in the baseline assessment.

Table 4-5: Summary of the Natural Capital baseline for natural hazard regulation

Reference	Baseline value of natural hazard regulation (£2019)
Minworth / STT and Minworth Combined (115Mld and 215Mld) pipeline	11,867

[23] https://www.gov.uk/government/publications/national-planning-policy-framework--2

Minworth / GUC (100Ml/d)	0

4.2.4 Water purification

Baseline provision of water purification services is dependent on the following:

- Land cover (habitat)
- Proximity to receptor (i.e. a water body)
- Current water quality of receptors

Baseline water purification provision has not been fully quantified at gate-1 given the limited data available. A brief summary of the baseline is included below in **Table .**

Table 4-6: Summary of baseline water purification service provision per element

Reference	Baseline water purification ecosystem service provision
Minworth / STT and Minworth Combined (115Mld and 215Mld)	Water purification services are currently provided by arable, pasture, woodland and coastal and floodplain grazing marsh habitats. The element involves construction of an approximately 35km pipeline which crosses or runs within 100m of several waterbodies, including the Cole from Hatchford-Kinghurst Brook to R Blythe (status Moderate), the Blythe from Patrick Bridge to R Tame (status Poor) and the Grand Union Canal, Warwick to Solihull (status Moderate).
Minworth / GUC (100Ml/d)	The Tame – R Rea to R Blythe waterbody is currently achieving Moderate status and therefore has potential to improve or decline if water purification services are affected.

Table depicts baseline values to support limited quantification for water purification, extracted from the NEVO[18] tool. This is broken down on a river basin basis and provides a high-level view of baseline water quality in the potentially impacted rivers. Where 2 river basins are affected an average assessment is included. This provides the baseline for the key water quality parameters.

Table 4-7: NEVO outputs
**Note: Severn basin included as part of the pipeline is in this basin district*

Reference	Basin	Dissolved Oxygen Conc. (mg/l)	Nitrogen Conc. (mg/l)	Phosphorus Conc. (mg/l)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	*Humber*	*11.55*	*9.10*	*0.38*
	Severn	*9.94*	*9.88*	*0.40*
	Average	10.74	9.52	0.39
Minworth / GUC (100Ml/d)	Humber	11.55	9.10	0.38

4.2.5 Tourism and recreation

Table depicts the baseline welfare value for each element, as well as the estimated visitation on a given year and the total area designated for recreational use. This data is derived from the ORVal[19] tool as described in **Section 2**.

Table 4-8: ORVal outputs

Reference	Estimated Welfare Value (£ per year)[24]	Estimated visits (per year)	Total Recreation Land Cover (m^2)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	4,326,922	1,453,447	4,711,781
Minworth / GUC (100Ml/d)	985,339	302,156	149

The following two **sections 4.2.6** and **4.2.7** provide a high level summary related to the key sites for each of the Minworth group sources that contribute to the values provided in **Table.**

4.2.6 Minworth / STT and Minworth combined (115Mld and 215Mld)

The pipeline route crosses through multiple welfare sites, notably four golf courses (Stonebridge, North Warwickshire, West Midlands and Warwick) and several parks. There are also a number of churches and cemeteries that have been included in the baseline valuation for welfare and recreation services for this scheme. There are also a number of paths that fall within the ZoI and contribute towards the estimated total welfare value. The element crosses through some densely populated areas, parts of North Birmingham and the neighbouring suburbs, this is reflected in the high visitor numbers modelled by ORVal.

4.2.7 Minworth / GUC (100Mld)

Much of the land within the ZoI is industrial urban or agricultural, with only a small number of recreation sites falling within. These are mainly areas of nature improvement, with one cemetery and one area of managed grass but proximity to large urban areas is reflected in relatively high visitor numbers and value modelled by ORVal.

4.2.8 Air quality

Only sites with Air Quality Management Areas present within the 1km ZoI have been considered. The results from the baseline Natural Capital assessment of air quality are presented in **Table** with only habitats featuring habitats with air pollutant removal value shown.

Table 4-9: Air pollutant Natural Capital values of relevant elements

Element	Habitat type	Area (ha)	Value of area (£ per year)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	Enclosed farmland	69.76	£1116
Minworth / GUC (100Mld)	Enclosed farmland	85.09	£1361

4.3 Assessment NCA

The following tables present the natural capital and ecosystem service losses and gains resulting from each of the proposed Minworth sources through construction and estimated (at this gate) biodiversity enhancement and habitat creation opportunity areas for each proposed grouping (i.e. Biodiversity Net Gain (BNG)). These are shown in **Table 1-2.**

Ecosystem service loss is calculated based on the area of natural capital stock lost through implementation of each Minworth Sources grouping compared to the baseline.

The tables below present:

1. Change related to construction of the options without any BNG mitigation in place.

[24] Typically, the monetary value attributed to a recreation site is high. This might lead to overrepresentation of these sites in assessment of natural capital. An awareness of this area of bias will be important when interpreting the results of the assessment.

2. Change related to construction of the options assuming incorporation of BNG mitigation (i.e. habitat creation) within option design.

Note: this comparison, i.e. with and without BNG mitigation, is not the same as comparing construction and operational effects. At this stage it is not possible to determine all of the effects of the operation of the scheme as there is insufficient detail. This information will be generated as the development of the scheme progresses, and it will be used in a subsequent consideration of the impact of the scheme upon natural capital stocks.

These **Tables 4-10 - 4-15** together with **sections 4.3.1 – 4.3.6** provide overall assessment of the Minworth group sources for each of the key ecosystem services (i.e. Biodiversity and habitats; climate regulation; natural habitat regulation; tourism and recreation and; air quality). **Table 4-16** and **section 4.3.7** then provides the final overall natural capital account for each group.

Only habitat creation BNG mitigation measures are included in the Natural Capital Assessment as these represent a permanent change in extent of natural capital stock. Other BNG mitigation measures include habitat improvement (e.g. from poor to moderate status). It should be noted that it has not been possible to monetise the benefits of habitat condition improvement as there is not enough information available on how ecosystem service provision is affected by changes to habitat quality.

4.3.1 Biodiversity and Habitat

The change in biodiversity and habitat ecosystem services resulting from the Minworth sources with and without mitigation, is presented in **Table 4-10**. The assessment shows that there is some loss to urban and farmland habitats that will not be mitigated through the currently proposed BNG uplift. This is reflective of the Defra Biodiversity Metric which requires a net gain in overall habitat units rather than a net gain for each habitat type.

Within the current version of the Defra River Metric mitigation/compensation for 10% BNG cannot to be calculated for river habitat loss due to errors in the multipliers of the River Metric 2.0 and therefore are not included within the BNG assessment. Therefore, a bespoke solution would need to be agreed with the regulators to mitigate for freshwater habitat losses; however, version 3.0 is due for release in 2021 and is likely to resolve this issue and will need to be considered at gate-2.

Table 5-10: Summary of biodiversity and habitat ecosystem service changes with and without BNG uplift for each Minworth Sources group*

Group	Summary	Habitat change (without BNG uplift)	Habitat change (with BNG uplift)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	Majority of habitat lost is farmland, which provides relatively little biodiversity, urban has even less. Potential habitat creation areas consist of farmland (traditional orchards) and deciduous woodland to compensate losses in biodiversity.	-28.74 Ha urban -64.93 Ha farmland†	-28.74 Ha urban 1 Ha farmland 10.5 Ha woodland
Minworth / GUC (100Mld)	Majority of habitat lost is urban, with a very small amount of farmland. This is likely to support little biodiversity. Potential habitat creation areas consist deciduous woodland to compensate losses in biodiversity.	-8.84 Ha urban -0.013 Ha farmland†	-8.84 Ha urban -0.013 Ha farmland 0.5 Ha woodland

**Note: Habitats that make up the 10% minimum uplift are based on the BNG assessment. These have been assessed via the Defra Biodiversity metric 2.0 which provides for an assessment of which combination of habitats (and condition improvement) will result in the greatest BNG uplift.*

†The proposed site for the WWTP is based within the STW boundary on urban land, however the Corine dataset identified a small amount of farmland habitat within this area. This has been including in the analysis for accuracy.

4.3.2 Climate regulation

Table 4-11: Summary of climate regulation ecosystem service changes with and without BNG uplift for each Minworth source group

Group	Summary	Carbon value (£/year) (without BNG)	Carbon value (£/year) (with BNG)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	Proposed uplift considerably outweighs the stocks lost through construction.	-£711	£3123
Minworth / GUC (100Mld)	Habitats lost through construction provided negligible benefit to climate regulation.	-£0	£148

4.3.3 Natural hazard regulation

Table 4-12: Summary of floor regulation ecosystem service changes with and without BNG uplift for each Minworth source group

Group	Summary	Flood regulation value (£/year) (without BNG uplift)	Flood regulation value (£/year) (with BNG uplift)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	Habitats lost through construction do not offer benefits to natural hazard regulation. Uplift is mainly provided by habitat creation associated with pipeline.	-£0	£1208
Minworth / GUC (100Mld)	Habitats lost through construction do not offer benefits to natural hazard regulation.	-£0	£58

4.3.4 Water purification

Table 4-13: Summary of water purification ecosystem service changes with and without BNG uplift for each Minworth source group*

Group	Summary	Impact without BNG	Impact with BNG
Minworth / STT and Minworth Combined (115Mld and 215Mld)	Reduced flow of effluent into Humber may improve water quality status. Proposed woodland creation may reduce agricultural runoff into waterways.	+ve	+ve
Minworth / GUC (100Mld)	Proposed woodland creation may reduce agricultural runoff into waterways.	Neutral	+ve

*Water purification impacts are described in **Section 4.2.4**

4.3.5 Tourism and Recreation

Table 4-14: Summary of tourism and recreation ecosystem service changes with and without BNG uplift for each Minworth source group.

Group	Summary	Recreation (without BNG, during construction)	Recreation (with BNG – qualitative only*)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	Figures represent the worst-case-scenario revenue impact where affected recreation sites close down entirely, with potential resulting impacts on physical health and well-being. In reality the majority will be able to remain operational throughout construction. Impacts on recreation from BNG uplift are not possible to quantify until definitive uplift sites have been selected	-£485,078	Provision of additional woodland habitat as part of required BNG uplift may improve tourism and recreation if visitor facilities are included in woodland scheme design (e.g. footpaths, information boards).
Minworth / GUC (100Mld)	No recreational areas are included within the construction zone	-£0	Provision of additional woodland habitat as part of required BNG uplift may improve tourism and recreation if visitor facilities are included in woodland scheme design (e.g. footpaths, information boards).

4.3.6 Air quality regulation

Table 4-15: Summary of air quality regulation ecosystem service changes with and without BNG uplift for each Minworth source group.

Group	Summary	Air quality regulation value (£/year) (without BNG uplift)	Air quality regulation value (£/year) (with BNG uplift)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	No stocks are lost from valued habitats within Air Quality Management Areas. Locations for uplift have yet to be finalised so impacts on these areas are as of yet unknown.	£0	£0
Minworth / GUC (100Mld)	No stocks are lost from valued habitats within Air Quality Management Areas. Locations for uplift have yet to be finalised so impacts on these areas are as of yet unknown.	£0	£0

4.3.7 Summary

Table 4.16 summarises the total change in ecosystem service benefits for each of the four Minworth sources group. This does not include recreation and tourism impacts as these are applicable during the construction period only, and there is a high level of uncertainty around the impacts of construction on access to local recreation sites.

Table 4-16: Summary of overall natural capital impacts of each Minworth source group

Group	Summary	Overall ecosystem service change (without BNG) (£/year[25])	Overall ecosystem service change (with BNG) (£/year)
Minworth / STT and Minworth Combined (115Mld and 215Mld)	Ecosystem service greatly increased through proposed habitat creation.	-£711	£4331
Minworth / GUC (100Mld)	Habitats lost through construction provided negligible ecosystem services. Proposed habitat creation therefore easily increases natural capital value of the area.	£0	£206

Table 4-16 indicates a significant overall all benefit related to the Minworth/STT and Minworth combined option compared to the Minworth GUC. At this stage (Gate-1) this needs to be considered with caution. The main difference related to ecosystem change is accrued through the significant difference in potential areas of woodland habitat (i.e. 10.5Ha versus a 0.5 Ha opportunity for Minworth). This in turn provides significant benefits for carbon sequestration and to a lesser extent natural flood management benefit. However, at this stage recreation opportunities have not been monetised due to the construction design limitation of each scheme. This therefore, will need to be reviewed at Gate-2.

4.4 BNG Baseline

A Biodiversity Net Gain (BNG) assessment has been carried out to identify the potential biodiversity loss of the elements and what replacement habitat could be required to achieve a 10% biodiversity net gain. For this high-level assessment, certain assumptions have been made to quantify the potential net loss and therefore net gain opportunities, which are based on a worst-case scenario, assuming all habitat within the working easement will be lost during construction and re-instated. For net gain, we have also considered spatially where mitigation and offsetting opportunities exist in relation to each element. The assessment identifies the quantity of each habitat type required to make this improvement elsewhere (off-site) to provide this and identifies strategic locations of where these opportunities may lie at a county level.

Section 4.4 addresses the gate-1 expectations for BNG in providing:

- the data sources and how they have been used to assess BNG;
- data gaps and assumptions; and
- baseline conditions for each element;

Section 4.5 provides:

- the assessment results; and
- a scope for further work on BNG to gate-2.

The assessment (Section 4.5) highlights which elements present the greatest biodiversity loss and elements which can achieve mitigation and/or offsetting with the least amount of required land. This information will feed into the design process to ensure that net gain requirements are met and opportunities for enhancement are maximised. At this conceptual design stage, the metric calculations are based on certain assumptions. Gate-1 is focused on providing the foundations for more detailed quantitative calculations at gate-2

The methodology for this assessment has been developed to accommodate the current uncertainty surrounding the elements (design/precise location etc). It is a high-level assessment that is proportional

[25] This includes a temporary loss of recreation benefit during the construction period only.

to scale and data availability. As certainty surrounding the schemes increases, the assessment will be updated accordingly with latest available data. A full list if assumptions is given in **Section 4.4.8**. At gate-1, the assessment of BNG is a high-level assessment based on open-source data, uploaded to a centralised GIS database. To provide a more robust baseline, habitat surveys will be required at gate-2. Specific detail is given in **A2** where data from these reports have been used to fill data gaps due to lack of survey data.

The BNG requirement for the ACWG (**section 3.4.2.5** of the guidance[26]) stipulates that each option should look to maximise biodiversity net gain and any required mitigation should be included to enable identification of any significant costs. The ACWG requires a full assessment of BNG using the Defra metric and that BNG calculations would take place at Gate 1 and be further refined throughout the gateway process. In accordance with the ACWG guidance, at gate-1 a biodiversity baseline has been developed from spatial data of habitat inventories and assessed in line with the Defra Metric 2.0, to calculate the change in biodiversity score for each element to include agreed mitigation. The open source habitat data can be supplemented with local data sets or Phase I (habitat) site data to increase the accuracy for each option at gate-2. Therefore, where data gaps arose at gate-1, these should be addressed at gate-2 through the following actions, as set out within **section 2.9** below. At gate-2, the BNG assessment would be refined through the inclusion of concept designs into the assessment, in accordance with **section 3.4.3.5** of the ACWG guidance.

The BNG assessment needs to be refined through greater detail on the construction methods and construction easement to provide great clarity on the impact pathways and habitat scores through the Biodiversity Metrics.

Further assessment on the hydrological impacts on ecology will be undertaken within gate-2 by a suitable water professional to be determined as part of the gate-2 process and procurement. These potential impacts will inform the assessment of operational BNG losses/gains.

Stakeholder consultation is essential to identify opportunities. This will be critical to the opportunity assessment related to mitigation and enhancement. We propose a series of short workshops during gate-2 for key stakeholder to discuss opportunities. This will include key water company representatives and stakeholders (as agreed by the STW steering group). The opportunities which may be discussed include:

- Landowners' land and landownership constraints
- Local wildlife sites
- Whether local councils have allocated land for BNG
- Criteria for prioritisation
- Consideration of specific species targets for net gain options

The improvement of baseline data is required to support gate-1 through site habitat surveys (condition assessment), ground truthing and habitat scoring. Survey locations will be targeted to sensitive areas and to ground truth the variation across the working easements. These assessment should be completed early on in gate-2 to support workshop discussion.

Table 4.1 of the ACWG guidance includes the requirement to include data on Local Wildlife Sites, which would need to be obtained from the Local Records Centre. Priority habitat layers for hedgerows/arable field margins are not open-source information and will be purchased from the Local Records Centre to improve baseline information.

A more detailed review should be undertaken at gate-2 of National and Local plans and policies, such as River Basin Management Plans, catchment or WFD objectives to identify any specific objectives for BNG that can be delivered. Using the principles of Nature Recovery Networks, core areas for biodiversity have been identified within BOAs. Opportunities for connecting these through habitat restoration/creation should be explored in gate-2 in line with ACWG guidance (see also **Figure 1.1**) which requires more detailed assessment of the options. This more detailed opportunity assessment will include those already identified with local plans, including those already identified within Local

[26] All Companies Working Group WRMP Environmental Assessment Guidance and Applicability with SROs, October 2020

Plans/LBAPs/strategies. The opportunities should be assessed for their suitability for specific net gain features, connectivity opportunities and achievability. Values will then need to be assigned against areas of mitigation opportunity with potential condition improvement for each feature and opportunity using the principles of the scoring of the River Biodiversity Metric tool.

The current Biodiversity Metric tool (2.0) has calculation issues when working out river mitigation and units gained. It is anticipated that a 3.0 version of the tool will be released in summer 2021 in which previous errors within the tool will be updated. If available, the Biodiversity Metric calculations will be re-entered into the 3.0 version at gate-2, and this should also allow river mitigation to be calculated.

Minworth Source SRO options are provided within **Section 4.1**. The BNG assessment was undertaken on the individual elements and combined for the groupings.

The Biodiversity Metric is a habitats-based assessment and is divided into assessments for terrestrial habitats (Habitats), and linear habitats (Hedgerows and Rivers). The baseline has been developed from existing spatial data sets of habitat inventories and identifying impact pathways (Zone of Influence (ZoI)) using data from the SEA, HRA and WFD assessments. The habitat baseline is scored through the tool, which quantifies each habitat type into 'units' (or 'River Biodiversity Unit' (RBU) for rivers and streams) based on a number of factors, including habitat distinctiveness, area (or linear equivalent), condition, ecological connectivity and strategic significance

4.4.1.1 Baseline mapping

The construction area (easement) of the elements were mapped using QGIS so that habitat analysis could be conducted on the construction area and operational impact pathways. To allow full habitat coverage, four data sources were combined in GIS: Priority Habitat Inventory, Corine Land Cover 2018, National Forest Inventory 2017 and OS Zoomstack (surface water). Habitat types were converted into the UK Hab classifications using the conversation table within the Technical Data tab in the Metric. The area (ha) of each habitat type within the buffer was measured in GIS.

4.4.1.2 Working Width Calculations

GIS data provided by AECOM on 01/02/2021 contained descriptions of the working width on different sections of each element. Based on these descriptions a dynamic buffer for each Minworth Sources has been mapped with a variable width between 20m to 40m dependant on location and habitat. Aerial imagery was used to locate sections where the working width changed based on descriptions provided by AECOM, such as along roads and hedgerows. The specific construction zone will be refined in the run up to gate-2 once Minworth Sources designs have been developed further and environmental impacts are better understood; however, this provides a reasonable approximation at this stage.

4.4.1.3 Woodland and trees

Within the working width GIS layer particular sections of pipeline have descriptions listed as '*trees avoided where possible'*. The majority of areas with high tree cover are usually classified as a woodland habitat. Due to the uncertainty associated with the number of trees which may be retained a worst-case scenario will be assumed of total habitat loss in these areas, which will be refined at gate-2.

4.4.1.4 Arable Field Margins

Arable field margin priority habitat is not currently mapped within the Natural England Priority Habitat Inventory dataset. In order to capture all potential habitat loss, assumptions were made on the location of arable field margins to allow the habitat loss to be quantified with the DEFRA Biodiversity Metric. The JNCC UK Biodiversity Action Plan described arable field margins as '*usually sited on the outer 2–12m margin of the arable field, although when planted as blocks they occasionally extend further into the field centre*.' Aerial imagery combined with the CORINE land cover data was used to approximately calculate the number of arable fields each element intersected. A 4m arable field margin was assumed which was then then multiplied by the working width and number of element intersections. This provided an area which could be added into the DEFRA Biodiversity Metric and classified as '*Cropland - Arable field margins pollen & nectar*' within the tool.

4.4.1.5 Rivers and streams

In the Biodiversity Metric 2.0, rivers and streams are defined as those classified as 'Main River' or 'Ordinary Watercourse'. This classification includes all types of watercourses, including canals, canalised rivers and rivers with an ephemeral (temporary) nature, such as Chalk Streams. Coastal, tidal and inter-tidal reaches are not measured within the rivers and streams component of the biodiversity metric. The data to populate the Biodiversity Metric 2.0 tool is normally based on the assessment outputs obtained through a Modular River Survey and the River Condition Assessment Tool[27]. In the absence of field data at gate-1, a bespoke approach was developed to estimate the river type and condition. Certain characteristics were assumed, and open-source data used, such as Priority Habitat mapping for rivers and aerial imagery. **Section 4.4** sets out the data obtained and what assumptions have been made to facilitate a high-level assessment of BNG for gate-1.

The construction baseline usually comprises the river types within the construction (redline) boundary and the principles can be applied for the purpose of this assessment. The construction area is based on GIS data of the element pipeline locations and other structures. In order to calculate approximate temporary river length loss during construction, aerial imagery and WFD waterbody data was used to count the number of watercourses intersected for each element. Number of structures for discharges/abstractions were also counted. Main rivers >2m in width were discounted, as the construction methods would use directional drilling, avoiding habitat loss. Watercourses <2m assumed temporary habitat loss along an 20m easement and re-instatement. Outfalls would result in permanent bank loss along an assumed 15m section. Further detail on land take for these structures will be required at gate-2. The baseline data is provided in the Excel spreadsheet in **A3 Rivers Data and Opportunities** of this report. The total length of river impacted per Minworth Sources elements are broken down by reach and provided in column L of the 'Classifications' tab.

Condition data, required for the Biodiversity Metric, is usually based on data obtained through the River Metric Survey, a sub-reach scale field survey (the Monitoring of River Physical habitat (MoRPh) survey). As this survey is not possible for gate-1, a bespoke approach was developed where a pragmatic assessment of condition was developed based on adopting the Water Framework Directive (WFD) overall condition score as the baseline[28], described in **Section 4.4.4.1**. The Biodiversity Metric for rivers is also not currently designed to account for operational degradation, only direct impacts from construction. Whilst Ricardo has developed bespoke approach to assessing operational impacts for rivers, there is insufficient hydrological data to complete this assessment for Minworth at gate-1. .

4.4.2 Habitats

The Biodiversity Metric requires the assessment of the following characteristics of the habitats for site habitat baseline:

4.4.2.1 Distinctiveness

- Condition
- Ecological connectivity
- Strategic significance

The Biodiversity Metric requires the assessment of the following characteristics of the habitats for habitat creation:

- Distinctiveness
- Condition
- Ecological connectivity
- Strategic significance
- Temporal risk

[27] https://modularriversurvey.org/
[28] Data source: Water watch wales (https://waterwatchwales.naturalresourceswales.gov.uk/en/) and catchment explorer (https://environment.data.gov.uk/catchment-planning/WaterBody/GB109054039800)

- Difficulty risk
- Spatial risk

The data sources and how they are used for the assessment are described in the sections below.

4.4.2.2 Distinctiveness

Each UK Habitat category is automatically assigned a distinctiveness score by the biodiversity Metric tool (see **Table 4-17**) which is based on an assessment of the habitat type's features, including species richness, rarity, percentage of habitat protected within Sites of Special Scientific Interest (SSSIs) (the less protected the higher the distinctiveness) and the capability of the habitat to support rare species which may not be found in other habitat types.

Table 4-17 Distinctiveness categories (Natural England, 2019[29])

Category	Score	Example of habitat type
Very High	8	Priority habitats as defined in Section 41 of the Natural Environment and Rural Communities (NERC) Act that are highly threatened, internationally scarce and require conservation action e.g. blanket bog
High	6	Priority habitats as defined in Section 41 of the NERC Act requiring conservation action e.g. lowland fens
Medium	4	Semi-natural vegetation not classed as a priority habitat e.g. hazel scrub
Low	2	Semi-natural or modified vegetation not classed as a priority habitat and of lower relative value to most wildlife e.g. temporary grass and clover ley; intensive orchard; rhododendron scrub
Very Low	0	Habitats and land cover or little or no value to wildlife e.g. hardstanding or sealed surface

4.4.2.3 Condition

Normally, the condition of each habitat type is assessed against specific requirements listed within the guidance documents from field survey data. For the purpose of gate-1, open-source data has been used, which is described in Section 2.8.2. These requirements are specific to each habitat type and relate to physical characteristics, structural attributes, typical species present and positive and negative indicators, such as the presence of invasive species. See **Table 4-18** below.

Table 4-18 Condition categories (Natural England, 2019)

Category	Multiplier
Good	3
Fairly good	2.5
Moderate	2
Fairly poor	1.5
Poor	1
N/A - Agriculture	1
N/A - Other	0

For the high-level assessment at gate-1, the lack of survey data on baseline habitat condition means that habitat condition is assumed to be 'moderate' in all cases. This provides a multiplier of 2 which

[29] http://publications.naturalengland.org.uk/publication/5850908674228224

equates to the average condition score between poor and good and therefore is the best estimate thus holding this variable constant and allowing comparison between elements.

4.4.2.4 Ecological connectivity

Each habitat type is assessed for its connectivity to other surrounding similar semi-natural habitats, which could enable the movement of species throughout the wider environment (see **Table 4-19**). Connectivity is automatically assigned in the Biodiversity Metric tool based on distinctiveness. Low and Medium distinctiveness habitats are always low connectivity. High or very high distinctiveness are medium connectivity.

Table 4-19 Connectivity categories (Natural England, 2019)

Category	Multiplier
Medium connectivity	1.1
Low connectivity	1

4.4.2.5 Strategic significance

Strategic significance is measured at a landscape scale, taking into consideration local plans for green infrastructure and biodiversity, national character areas and national objectives. This category gives value to habitats that are situated within optimal locations which could enable biodiversity objectives to be met (see **Table 4-20**). For the purposes of this gate-1 strategic significance is assumed to be 'medium' in all cases where habitat is lost, thus holding this variable constant. Where mitigation is required Biodiversity Opportunity Areas were identified and therefore assessed as 'high'.

Table 4-20 Strategic significance categories (Natural England, 2019)

Category	Multiplier	Point applied to calculation	
		Pre-impact	Post-impact
High strategic significance Within an area formally identified as being of good environmental potential in local policy	1.15	Yes	Yes
Medium strategic significance Good environmental potential but not in an area formally identified as being of good environmental potential in local policy	1.1	Yes	Yes
Low strategic significance Low environmental potential and not in an area formally identified as being of good environmental potential in local policy	1	Yes	Yes

4.4.2.6 Temporal risk

Temporal and difficulty multipliers are automatically applied to the biodiversity unit calculation in the case of habitat creation, restoration, or enhancement in order to consider the time it will likely take to achieve the target condition and how difficult it will be to achieve the desired result. This gives some weighting to the level of uncertainty that these factors create (see **Table 4-21**).

There can be a negative impact on biodiversity for a period of time whilst newly created or enhanced habitat is establishing to its required level of maturity. The temporal risk accounts for this time lag.

Table 4-21 Temporal risk multipliers (Natural England, 2019b)

Time to Target Condition (years)	Time to Target Multiplier
30	0.343
20	0.49
10	0.7
5	0.837
1	0.965
0	1

4.4.2.7 Difficulty risk

The Biodiversity Metric considers how difficult (**Table 4-22**) it is to create or restore different habitat types and applies a multiplier to account for the uncertainty of achieving the target state.

Table 4-22 Difficulty Categories (Natural England, 2019)

Difficulty of Creation Category	Difficulty of Creation Multiplier
Very High	0.1
High	0.33
Medium	0.67
Low	1

4.4.2.8 Spatial risk

Compensatory habitat created at a greater distance from the site of habitat loss will deplete a local area of natural habitat, risking reduced habitat connectivity and limiting available food sources for a variety of wildlife. As all compensatory habitat discussed is within the Local Planning Authority (LPA), a multiplier of 1 is used in all cases (see **Table 4-23**).

Table 4-23 Spatial risk categories (Natural England, 2019)

Local Risk Category	Spatial Risk Multiplier
Compensation inside LPA, or deemed to be sufficiently local to site of biodiversity loss	1
Compensation outside LPA of impact site but in neighbouring LPA	0.75
Compensation outside LPA of impact site and beyond neighbouring LPA	0.5

4.4.3 Hedgerows

Habitat loss and hedgerow loss are two separate assessments within the DEFRA Biodiversity Metric. In order to calculate approximate hedgerow loss aerial imagery was used to count the number of hedgerows intersected by each Minworth element. The number of hedgerow intersections was then multiplied by the working width to give an overall length of hedgerow loss. This was then entered into the DEFRA Biodiversity Metric and classified as '*Native species rich hedgerow*' which then quantified the hedgerow loss.

The current working width for all elements is reduced to 20m where hedgerows are impacted based on the information provided by Jacobs; however, as the detail of the Minworth evolves, this width and number of hedgerows that may be avoided may change as a result of the use of direction drilling techniques during Minworth construction.

4.4.4 Rivers

The Biodiversity Metric requires the assessment of the following characteristics of rivers/streams and canals.

- River type and condition
- Distinctiveness
- Strategic significance
- Risk multipliers
- Time to target condition
- Difficulty of creation

The data sources and how they are used for the assessment are described in the sections below. The baseline data for river type, condition and strategic significance is provided for each element in the Excel spreadsheet in **A3 Rivers Data and Opportunities**.

4.4.4.1 River Type and Condition

The rivers and streams condition (**Table 4-24**) assessment for the Biodiversity Metric is usually based on the extent and diversity of observed physical features in the river channel and riparian zone (including the physical structure of vegetation) as well as the extent and types of any human modifications. The rivers and streams condition assessment, called the River Metric Survey, is based on geomorphic principles and comprises a largely desk-based reach-scale assessment, which indicates the current hydro-geomorphological river type, and a sub-reach scale field survey to inform the river type and assess its baseline condition (the Monitoring of River Physical habitat (MoRPh) survey).

The survey is not possible for gate-1 given the timing constraints and would also be too onerous for high level assessment. Instead, a bespoke approach was used where river type has been based solely on open-source data and a pragmatic assessment of condition was developed based on adopting the Water Framework Directive (WFD) overall condition score as the baseline[30]. WFD condition is based on a larger reach than is assessed for the River Metric Survey. As such, survey and more detailed assessment will be required at gate-2.

Table 4-24 Condition categories (Natural England, 2019)

Category	Multiplier
Good	5
Fairly good	4
Moderate	3
Fairly poor	2
Poor	1

The river type is based on two classifications: Priority Habitats, as defined under section 41 of the Natural Environmental and Rural Communities Act 2006, and 'River Naturalness'. The data sources for river type are provided in **A3 Rivers Data and Opportunities**. Priority River Habitat mapping focuses on naturalness as the principal criterion in recognition of the vital importance of natural processes in delivering sustainable riverine habitats and supporting characteristic biodiversity.

[30] Data source: Water watch wales (https://waterwatchwales.naturalresourceswales.gov.uk/en/) and catchment explorer (https://environment.data.gov.uk/catchment-planning/WaterBody/GB109054039800)

4.4.4.2 Distinctiveness

By nature, rivers have a high biological diversity. Their distinctiveness is assessed within the Biodiversity Metric tool by entering the river type, which is automatically assigned a distinctiveness score (see **Table 4-25**).

Table 4-25 Distinctiveness categories (Natural England, 2019)

Category	Score	River type
Very High	8	On Priority Rivers Map Class I River Naturalness Assessment
High	6	Class 2 or 3 River Naturalness Assessment Is a Priority River Habitat sub-type: • Headwater Streams • Chalk Rivers • River – Abundance of Water crowfoot • Active Shingle Rivers
Medium	4	Class 4 or 5 river Naturalness Assessment Rivers and Streams (other) Canals

4.4.4.3 Strategic significance

Strategic significance of each river/stream/canal within the ZoI considers whether it is present within local and catchment plans, Catchment Planning Systems, River Basin Management Plans and Priority Habitats for Restoration. This category gives value to watercourses that are identified for action, which could enable biodiversity objectives to be met (see **Table 4-26**). A review was undertaken of these plans for each watercourse within the ZoI and the data sources provided in provided for each element in the Excel spreadsheet in **A3 Rivers Data and Opportunities** in column M of the 'Classifications' tab.

Table 4-26 Strategic significance categories (Natural England, 2019)

Category	Multiplier	Point applied to calculation	
		Pre-impact	Post-impact
High strategic significance Within local and catchment plans, Catchment Planning Systems, River Basin Management Plans and Priority Habitats for Restoration	1.15	Yes	Yes
Low strategic significance Low environmental potential and not formally identified in any local plan	1	Yes	Yes

4.4.4.4 Risk multipliers

The Biodiversity Metric for rivers includes risk multipliers to take account of uncertainty and difficulty of restoration/enhancement and creation of offsets.

A temporal multiplier (**Table 4-27**) accounts for the time to target condition follow re-instatement or creation and a difficulty of creation multiplier for all rivers and streams. However, there are errors in this multiplier within the metric, which have been recognised by Defra and will be addressed for version 3.0, whereby the multipliers are reversed. Therefore, assessing the units delivered through enhancements and habitat creation is not possible with version 2.0.

Table 4-27 Temporal multiplier (Natural England, 2019)

Condition	Time to target condition (years)	Multiplier
Good	10	0.7
Fairly good	8	0.752
Moderate	5	0.837
Fairly poor	2	0.931
Poor	1	0.965

4.4.5 Net gains/Losses

4.4.5.1 Construction

The calculation of net loss/gain within the Biodiversity Metric 2.0 only considers direct impacts resulting in habitat loss, whether permanent or temporary. The baseline habitat scores are then adjusted for the associated habitat impacts (gains or losses) related to the construction of each element. This is assessed following construction and prior to habitat re-instatement and assumes typical good practice construction methods and mitigation will be used, such that potential for downstream effects of construction will be fully mitigated. This part of the assessment identifies high risk areas where the proposals will result in a significant loss of biodiversity and offsetting will be more onerous or may identify an 'irreplaceable habitat' that should be avoided, such as certain priority habitats. These irreplaceable habitats are flagged by the Metric as 'unacceptable loss 'and require a bespoke mitigation strategy if unable to be avoided. These habitats are then removed from the mitigation calculations which can account for a difference between onsite area lost and onsite habitat creation.

The gains and losses are calculated assuming all habitat within the ZoI from construction impacts will be lost and reinstated with the same habitat. This is assessed as on-site habitat creation within the Biodiversity Metric. Due to the risk factors in habitat creation, such as time lags and difficulty in creation, the habitat units for reinstatement will not equally compensate for the units lost. The results of the deficit 'net loss' for each habitat type per element are provided in **Section 4.5** in table format in habitat units and hectares or linear meters of river/hedgerow. The number of units/hectares to provide 10% net gain are also given. The outputs are presented as:

- Summary data tables of habitat gains/losses
- Maps of constraint areas and impact areas

4.4.6 Strategic assessment of Biodiversity Opportunity Areas

Enhancement measures can include the provision of new habitats, provision of new habitat features and the improved management of existing habitats which will result in a net benefit to biodiversity, over and above the measures required to mitigate and compensate for the impacts of a proposed scheme. Enhancement opportunities are added to the Biodiversity Metric as a habitat area and the Metric re-calculates the quantity or balance of (units) of BNG provided, which is also given as a % change from the baseline. This stage will require significant manipulation of habitat restoration/creation options to identify the best outcome at gate-2. For gate-1, the mitigation hierarchy was followed to identify like for like replacement habitat opportunities. Opportunities for biodiversity gain were linked with those within SEA, WFD and Natural Capital approaches provide the outputs that directly feed into the biodiversity ecosystem service for the later of these assessments.

The output of this stage is a summary of the Biodiversity Metric output and a table of the habitats and areas required for enhancement/creation (**Section 4.5**). Due to risk parameters associated with habitat creation and restoration a 1:1 replacement in habitat type and area will not score 0 in terms of gains and losses but a negative number of units. Where additional habitat area is required to offset losses, it is possible that insufficient land may be available on-site.

For rivers, offsetting within the same waterbody is the preferred option. However, this may not be possible and therefore, the mitigation hierarchy would be followed, so the number of units required for three scenarios were assessed:

1. Enhancement within the impacted waterbody (same country).
2. Enhancement within the catchment (same country)
3. Enhancement within the wider area but with a strategically identified area, such as Biodiversity Opportunity Areas (BOAs) in England.

BOA maps are open source and produced from a review of countywide strategies and Local plans. This high-level assessment provides an estimate of the scale (ha/km) of mitigation/offsetting needed to achieve net gain and a tool for comparison of the element's biodiversity impact. A strategic assessment of off-site opportunity was undertaken to identity suitable parcels of land where the best biodiversity gain could be achieved. Specific detail of possible mitigation measures and the identification of specific objectives within National and Local plans and policies within is not assessed for gate-1, as this level is detail is not meaningful given the assumptions in the data. For a high-level assessment, firstly the area/length of habitat required for offsetting/net gain was identified and whether this land take is available within the surrounding area and supported by local plans.

4.4.6.1 Habitats

To identify land parcels with opportunities for habitat creation or enhancement a review of county biodiversity plans and Local Planning Authorities policies was undertaken.

Certain elements cross multiple counties, therefore, plans or policies which focused on landscape scale biodiversity opportunity areas were prioritised. The main sources which provided landscape scale strategies for a variety of habitat types were Local Nature Partnerships. **Table 4-28** below highlights the relevant plan identified for each element which provides a variety of BOAs that could be utilised for mitigation and compensation.

Table 4-28 Minworth elements and Biodiversity Opportunity Areas for terrestrial habitats

Component	Biodiversity Opportunity Areas
Minworth	Warwickshire, Coventry and Solihull Green Infrastructure Map

Each Biodiversity Opportunity plan within **Table 4-28** was reviewed and either the specific GIS shapefiles downloaded for the BOAs if available or individual areas were mapped from maps provided online. BOAs chosen to be mapped were either adjacent to an element or the closest BOA available where there were no adjacent opportunities.

Where data on specific recommendations for habitat creation were provided these were included within the GIS attribute table allowing a total area to be calculated for each habitat and assessed against the area needed for mitigation on each element. This gives an overview of where opportunities exist and whether there is sufficient opportunity within the local area.

The output is a habitat map with core biodiversity features and strategic areas (allocations). The exact location would be subject to consultation at gate-2.

4.4.6.2 Rivers

To ensure no net loss / net gain, riparian improvements and in-channel; enhancements can be considered. A strategic assessment was undertaken to identify the availability of suitable river habitats for restoration within the vicinity of the watercourses.

For river enhancement, quality and risk are considered within the calculator whereby the strategic significance is given a multiplier of 0.15 if the waterbody lies within a local plan, River Basin Management Plan etc and a spatial multiplier accounts for distance of offsets (0.75 for outside the waterbody and 0.5 for outside the catchment) and time taken to reach to the target (restored) condition.

For offsetting/net gain, the closer the restoration is to the impacted area, the greater number of biodiversity units can be obtained.

An example is provided in **Table 4-29** to show the greatest number of units that can be obtained for different river types and locations/distance from the impacted reach.

Table 4-29 Example BNG unit change per river type

River type	Condition (operation)	Condition (proposed following enhancement)	Strategic location of enhancement	Buffer zone (km)*	BNG units achievable
Rivers and streams	Fairly poor	Moderate	On-site enhancement	20	243.48
Rivers - Abundance of Water-Crowfoots	Fairly poor	Moderate	On-site enhancement	20	365.22
Priority river habitat	Fairly poor	Moderate	On-site enhancement	20	486.97
Rivers and streams	Fairly poor	Moderate	Off-site enhancement (within waterbody)	20	178.45
Rivers - Abundance of Water-Crowfoots	Fairly poor	Moderate	Off-site enhancement (within waterbody)	20	267.87
Priority river habitat	Fairly poor	Moderate	Off-site enhancement (within waterbody)	20	356.9
Rivers and streams	Fairly poor	Moderate	Off-site enhancement (outside the waterbody)	20	44.61
Rivers - Abundance of Water-Crowfoots	Fairly poor	Moderate	Off-site enhancement (outside the waterbody)	20	66.92
Priority river habitat	Fairly poor	Moderate	Off-site enhancement	20	89.22

**This buffer width has been chosen to coincide with that specified within the HRA. This will sufficiently incorporate the different local habitats and opportunities*

There are many factors to take into consideration when prioritising rivers for action. Rivers that are of types relevant to the UK BAP definition (chalk rivers and active shingle rivers) but are not sufficiently natural to feature on the priority habitat map should be considered a priority for natural process restoration in England (there is currently no equivalent online data for Wales). Action on these rivers should be considered of equal importance to the protection and enhancement of rivers on the priority habitat map. Data on Priority River Habitats for Restoration[31] was analysed to identify reaches within 1km of the element components. No priority river habitats for restoration were identified within 1km of Minworth component.

For opportunities in England, BOA GIS shape files for habitat BOAs were used to identify river habitats within each county within 1km of each Minworth elements (**Table 4-30**). This provided an overview of the possible lengths of river available for restoration within 1km of each element. Further refinement of these data will be required at gate-2, once the length and location of the impacted habitat is known, to identify whether opportunities lie within the waterbody, within the catchment or outside of the water body.

[31] https://data.gov.uk/dataset/e0165747-8368-4ff7-a644-df9aeb27bb0b/priority-habitat-creation-and-restoration

Table 4-30 Biodiversity Opportunity Areas – Rivers within 1km

Element/Option Component ID	Waterbody (1km of option component)	Length (km)	Counties
Pipeline (Minworth STT and Minworth combined)	Gog Bk - source to conf R Avon	4.35	Warwickshire and Solihull
Pipeline (Minworth STT and Minworth combined)	Avon (Wark) conf R Leam to Tramway Br, Stratford	4.04	Warwickshire and Solihull
Pipeline (Minworth STT and Minworth combined)	Grand Union Canal, Warwick to Solihull	5.81	Warwickshire and Solihull
Pipeline (Minworth STT and Minworth combined)	Blythe from Temple Balsall Brook to Patrick Bridge	6	Warwickshire and Solihull
Pipeline (Minworth STT and Minworth combined)	Blythe from Patrick Bridge to R Tame	4.57	Warwickshire and Solihull
Pipeline (Minworth STT and Minworth combined)	Cole from Hatchford-Kingshurst Brook to R Blythe	4.68	Warwickshire and Solihull
Pipeline (Minworth STT and Minworth combined)	Tame - R Rea to R Blythe	4.5	Warwickshire and Solihull
Pipeline (Minworth STT and Minworth combined)	Birmingham and Fazeley Canal upper section	0.98	Warwickshire and Solihull
TOTAL		**34.93**	

Mitigation for WFD compliance can be used to account for 'no net loss' but not 'net gain'. Net gain needs to be additional to count and not part of a statutory requirement. More detailed assessment will be undertaken at gate-2 to identify:

a. Actions within the river basin /catchment plans can be offsets (to be agreed with the Regulators); and
b. Mitigation for WFD compliance.

4.4.7 Biodiversity Net Gain and Natural Capital

Taking a habitats-based assessment approach, the outputs from the BNG assessment for the Minworth Sources were linked back to the Natural Capital (NC) metrics and the BNG outputs were used to support quantify the Biodiversity and Habitats ecosystem service (**Section 4.2).**

4.4.8 Data Gaps and Assumptions

Due to the high-level nature of the gate-1 assessment and the lack of available detailed design information, several assumptions have been made, which have been described within the above text. The key assumptions, however, are summarised in **A1.**

4.5 BNG Assessment

4.5.1 Biodiversity Loss

The following tables present the biodiversity net gain (BNG) results of the Defra Biodiversity Metric calculations for the elements, summarised by the Minworth sub-option. These groupings are as follows in **Table 4-31**:

Table 4-31 Minworth groupings

	Sub-Options	Elements included
ST Minworth	**Group 1** **(Minworth / STT (115Mld))**	• Minworth / STT 115Ml/d to include development of site at Minworth, Pipe to Avon, No discharge to Avon, 115Ml/d not going to the Thame. Any impacts associated with the increased flows in the River Avon has been considered in the HRA for the STT SRO.
	Group 2 **((Minworth Combined (215Mld))**	• Minworth Combined 215Ml/d to include development of site at Minworth, Pipe to Avon, No discharge to Avon, 215Ml/d not going to the Thame. Any impacts associated with the increased flows in the River Avon has been considered in the HRA for the STT SRO and any impacts on the GUC has been considered in the GUC transfer HRA
	Group 3 **((Minworth / GUC (100Mld)**	• Minworth SRO Site for the GUC development only

Not all elements within each grouping have terrestrial construction impacts. Elements within each group which have terrestrial impacts were combined to provide an overall unit loss, for each grouping, post-mitigation. A detailed breakdown of habitat loss per grouping is provided in **Appendix A7**. There are no operational impacts on terrestrial habitats for group 1 and 2, all habitat loss will be during construction and mitigated through habitat re-instatement (other than for permanent structures). However, group 3 refers to Minworth site for the GUC development which will result in permanent habitat loss during construction (also no operational impacts). Therefore, the calculation of loss within the tables below is post-mitigation, as we already know habitat will be re-instated. This then gives the deficit for offsite compensation and opportunities for BNG. Therefore, the post-mitigation (pre-compensation) calculations provide a more useful calculations of biodiversity loss than pre-mitigation, particularly as habitat loss is temporary.

Although group 3 is being built on heavily urbanised land predominantly covered with concrete, it must be considered that any natural habitat present is of higher ecological local value, and therefore should not be undervalued when lost. This is especially true due to the inability to perform habitat enhancements onsite or directly within the local area.

For rivers, this assessment only includes the construction impacts. The construction impacts take account of open cut methods for pipeline installation.

Tables 4-32 represents the biodiversity deficit for offsite compensation following re-instatement (mitigation) as % loss of biodiversity units and **Table 4-33** of the overall units lost following re-instatement (mitigation).

Table 4-32 Summary of the percentage loss (post re-instatement and pre off-site compensation) for habitats, hedgerow and rivers for each grouping

	Percentage Biodiversity Change					
Group	**Loss of habitat units (construction)**	**Loss of habitat units (operation)**	**Loss of hedgerow units (construction)**	**Loss of hedgerow units (operation)**	**Loss of river units (construction)**	**Loss of river units (operation)**
1	-25.66%	0	-43.93%	0	0.06	0
2	-25.66%	0	-43.93%	0	0.06	0
3	100%	0	100%	0	0	0

The overall percentage loss for each Minworth option was combined to provide the loss for each grouping, see **Appendix A8.1 and A8.2 and A7** for individual Minworth percentage loss.

Certain priority habitats are unable to be assessed within the DEFRA Metric owing to their uniqueness and difficulty of re-creation and compensation. If lost they require a bespoke compensation strategy. The hectarage of this loss is shown in **Table 4-33** and these habitats should be avoided at the design stage where possible. The unacceptable loss habitats and their individual areas are given within the baseline metric data, provided within the Appendices for each element.

Table 4-33 Summary of the overall unit loss (post re-instatement and pre off-site compensation) for habitats, hedgerow and rivers for each grouping

	Net Biodiversity Unit Loss				
Group	**Loss of habitat units (construction and operation)**	**Un-acceptable habitat losses (hectares) (construction)**	**Loss of hedgerow units (construction and operation)**	**River units (construction)**	**River units (operation)**
1	-94.17	-1.04	-2.16	-1	0
2	-94.17	-1.04	-32.16	-1	0
3	-105.27	0	-1.2	0	0

4.5.2 Biodiversity Opportunities

To achieve biodiversity net-gain there are opportunities locally for the following habitat enhancement and creation. Table 4-34 shows for each habitat type impacted by the scheme, the offsite hectarage /km of habitat enhancement or creation required for a minimum 10% net gain in habitats and hedgerows and the metric units that this achieves. As stated in the methodology the majority of habitats were assumed to be in moderate condition. Hectarage required can be halved if habitats are assumed to be in poor condition. The individual requirements per Minworth Sources are provided in **Appendices 8.1 and 8.2** and highlights the specific percentage gain. It is important to also consider the need for bespoke mitigation / compensation or 'unacceptable loss habitats' (refer to **Appendices 8.1 and 8.2 and A7**).

Table 4-34 Summary of the offsetting requirements to achieve an approximate 10% net gain for habitats and hedgerows for each grouping

Offsetting Requirements for 10% BNG				
Habitat	**Enhancement or Creation**	**Group 1**	**Group 2**	**Group 3**
Neutral grassland	Enhancement	26ha	26ha	28ha
Modified grassland	Enhancement	-	-	6ha
Broadleaved woodland	Creation (grassland succession)	10ha	10ha	0.5ha
Traditional Orchard	Creation	1ha	1ha	-
Native species rich hedgerow	Creation	0.52km	0.52km	0.26km
Total (ha)	**Habitat**	**37ha**	**37ha**	**34.5ha**
	Hedgerow	**0.52km**	**0.52km**	**0.26km**

The overall habitat requirement for a 10% net gain is very identical for groups 1 and 2 with regard to hectarage required). As noted in Table 4-33 the Minworth Pipeline option have 1.05ha of habitats which are categorised as 'unacceptable losses' which is a major consideration due to the requirement for a bespoke mitigation strategy.

Within the current version of the Defra River Metric mitigation/compensation for 10% BNG cannot to be calculated for river habitat loss due to errors in the multipliers of the River Metric 2.0 and therefore are not included within our assessment. Therefore, a bespoke solution would need to be agreed with the regulators; however, version 3.0 is due for release in 2021 and is likely to resolve this issue.

Availability of land for offsetting per element has been summarised in **Appendix A9** (rivers) **and A8.1 and A8.2** (terrestrial habitats).

For each element, a desk study was undertaken to review any policies or mapped areas in relation to land that has been identified as providing opportunities for terrestrial habitat enhancement or creation. All terrestrial habitat impacts lie within England, and therefore Welsh strategic opportunities were not considered for terrestrial habitats. If an element crossed multiple counties a review was undertaken in each local authority it fell in along with search engine key word searches. These areas can have varying names and can be summarised as Biodiversity Opportunity Areas (BOAs) in England. Not all county's and local authorities had relevant policies or maps in relation to BOAs, so they are not necessarily found along the entire length of an element. Instead, BOAs were mapped where the fell within the same county as an element and were considered in close proximity to provide offsetting. In most cases this was between 0-5km from the element, however in some cases more than 5km where BOAs were less abundant. The main focus was not on how close the BOAs were to each element but availability within the same county or landscape along with variety of habitat types. The main source of BOA information used for gate-1 came from Local Nature Partnerships as these groups usually map at a landscape scale for habitat creation and connectivity and provide a high-level assessment of availability of land which could be utilised for mitigation. Where the information was available the specific habitat type was also noted, such as area for woodland creation, however in some cases such as in Oxfordshire the specific habitat type was not available. For all groupings there are enough BOAs to provide the required mitigation to achieve a 10% net gain. As the study continues into gate-2 these specific BOAs will be refined and surveyed to identify the optimal areas to focus on.

Opportunities for delivering BNG for rivers was identified from published information on Priority Rivers for Restoration[32] and BOAs for relevant counties within England. The data set for Priority Rivers for Restoration identifies reaches targeted for restoration. The length and location of reaches located within 1km of the elements are given in **Appendix A3** and summarised by their group in **Table 4-35**. The data also provided information on whether the restoration related to physical or hydrological opportunities. Rivers within BOAs also present potential opportunities for restoration and the length of rivers within

[32] https://data.gov.uk/dataset/e0165747-8368-4ff7-a644-df9aeb27bb0b/priority-habitat-creation-and-restoration

1km of the impacted reaches for each element were measured and given in **Appendix A8.1 and A8.2** and summarised by their groupings in **Table 4-35.**

Table 4-35 Summary of the offsetting opportunities for BNG for rivers for each grouping, within 1km

Offsetting Opportunities for BNG			
	Group 1	**Group 2**	**Group 3**
Rivers within BOAs (within 1km)			
Gog Bk - source to conf R Avon	4.35	4.35	-
Avon (Wark) conf R Leam to Tramway Br, Stratford	4.04	4.04	-
Grand Union Canal, Warwick to Solihull	5.81	5.81	-
Blythe from Temple Balsall Brook to Patrick Bridge	6	6	-
Blythe from Patrick Bridge to R Tame	4.57	4.57	-
Cole from Hatchford-Kingshurst Brook to R Blythe	4.68	4.68	-
Tame - R Rea to R Blythe	4.5	4.5	-
Birmingham and Fazeley Canal upper section	0.98	0.98	-
Total	**35.16km**	**35.16km**	**-**

5 Recommendations for Gate -2

5.1 Gate 2 - Natural Capital

The following section outlines key gate-2 requirement and associated next steps. These are based on what has been identified within the overall assessment and delivery of outputs. It also takes account of OFWAT's requirements for gate-2 especially related to multi-solution decision making and improving on gate-1 activities related to detail and breadth of studies for a key decision point for strategic solutions. OFWAT states that the solution (in this case the Minworth) should be developed to a standard suitable for submitting into final regional plans or final water resources management plans based on refined and consistent costs and benefits. The following key gate-2 are identified to support this requirement and to build on any new regulatory guidance that may be developed throughout the gate-2 process.

Much of the ACWG guidance[33] on a natural capital approach at gate-2 has already been addressed (i.e. monetising ecosystem services of the broad habitats featured in **Table 3-1**). With this in mind one of the primary goals moving forward will be to further develop quantification of the biodiversity metrics to enable easier monetisation and ensure the cost-benefit ratios of the scheme elements are as accurate as possible. This will also ensure the detail and breadth of information required for later gates is provided.

The following sections outline key gate-2 requirement and associated next steps.

5.1.1 Refining the zone of influence

The current ZoI for the assessed elements extends to 1 km from any likely construction zones. Whilst acceptable for a high-level approach as required for gate-1, greater detail will be necessary for gate-2. Once the Minworth groupings have been developed further, more in-depth analysis of likely effects on factors such as water quality, bankside habitats or groundwater flow will be possible, and may highlight a necessity to expand or reduce our chosen zones. This will ensure that calculations derived from areas of habitat are more accurate, without over/underestimating the areas that may be affected. It will also allowing for a greater understanding of the impact on the freshwater environment, as rivers and groundwater are likely to have a different zone of interest to terrestrial impacts.

5.1.2 Better representation of recreational areas

ORVal[19], used in this assessment to value recreation and tourism, derives site values from a statistical model. This model does not account for individual characteristics which may determine the site's welfare benefit. In future assessments it would be beneficial to capture site specific features and a less generalised figure for visitor numbers to enable accurate valuation of recreation services. In addition at gate-1 it has not been possible to monetise the recreation and tourism benefits of the scheme with BNG uplift as details of habitat creation opportunities have not been agreed. These will need to be further assessed and monetised at gate-2.

5.1.3 Better natural hazard regulation

The assessment currently takes flooding into account as the primary natural hazard, but further investigation into the impact that drought has on habitats ability to slow-flow and provide natural flood resilience. This would help to more accurately identify any risk to natural habitat regulation. In order to accomplish this will require a greater breadth of data than currently available.

5.1.4 Climate change predictions

Habitat type and land usage may change in the future due to changes in global climate, creating disparity between the predicted changes caused by element implementation and the observed changes in the future. Given the longevity of the Minworth, predicted climate induced change in Natural Capital will provide a more accurate assessment of benefits to support climate change resilience.

[33] All Companies Working Group WRMP Environmental Assessment Guidance and Applicability with SROs, October 2020

5.1.5 Land use predictions

The vast majority of our Natural Capital Assessment is based on land cover. Upcoming changes in land use will therefore introduce discrepancies in our calculations, making it imperative that we account for planned changes such as large-scale building developments.

5.1.6 Confirming element impacts

It will be important in gate-2 to look at how the elements will affect their surrounding habitats in closer detail to confirm our current assessment and develop it further, ultimately giving a more accurate predicted change in Natural Capital values.

5.1.7 Incorporating Net Gain into element design and Natural Capital Assessment

The Biodiversity Net Gain assessment focusses on quantifying disbenefits to biodiversity and providing the guidelines to not only mitigate them but to create a 10% increase in biodiversity with the implementation of the chosen element(s). It will be necessary to incorporate the quantified values and mitigation plans so that changes in Natural Capital can be calculated with them in mind including air quality and carbon assessment.

5.1.8 Accounting for habitat condition improvement

The BNG assessment considers options to increase the biodiversity metric score through both habitat creation and enhancement. It has not been possible to account for the natural capital benefits related to habitat enhancement at gate-1 as habitat extent has been used as a proxy for natural capital stock. For gate-2 it will be important to consider how habitat condition contributes to delivery of ecosystem services and assess how habitat enhancement measures will affect natural capital values.

5.1.9 Inclusion of abiotic features

Whilst our study considers a variety of biotic factors, WRSE guidance also recommends the assessment of abiotic factors (i.e. minerals, fossil fuels and renewable energy). At present, this study has not valued abiotic services in its assessment of Natural Capital due to limited availability of robust data to represent these features for a project of this scale. At gate-2, and following increased certainty of the element routes and the (ZoI) better representation of abiotic factors should be sought. This will require a review on data availability and potential data collection at that stage.

5.1.10 Key partners collaboration

At gate-1 this Natural Capital Assessment has focused on the base line Natural Capital within a 1km ZoI, an assessment of the potential opportunities for uplift related to BNG and predicted Natural Capital loss as a result of construction/operation of the Minworth and groupings. This has been a desked based study using open source data and outputs from the associated SEA, WFD, and HRA assessments as part of this work. At gate-2 there is a need to review this work in light of the wider more locally focused Natural Capital work being completed by local partners to ensure synergy between approaches and avoid any double counting.

5.1.11 Refinement of biodiversity and habitat assessment, including aquatic habitats

For gate-1, the biodiversity and habitats assessment has focussed primarily on high-level broad habitats using CORINE data. The resolution of CORINE data does not allow us to understand local aquatic and terrestrial habitats in detail and what Natural Capital benefits may be related to them. Understanding of impacts will be improved at gate-2 following detailed aquatic and terrestrial field surveys to confirm habitat condition and extent for BNG assessment, as well as hydrological modelling and detailed WFD assessment. This can then feed into a more detailed assessment of biodiversity ecosystem services.

5.1.12 Accounting for Biodiversity and Habitat Ecosystem Services

At gate-1 Natural Capital benefits have been aligned with overall high level BNG opportunity areas which have been based on Priority Habitats etc where information has been gained from online sources. There has been no ground truthing of this information to establish where opportunity is likely to be greatest on-the-ground. Ground-truthed BNG and mitigation options (informed by BNG surveys)

together with stakeholder engagement (to better understand local authorities) will enable a more refined Natural Capital account to be provided at gate-2.

5.2 Gate 2 - Biodiversity Net Gain

The BNG requirement for the ACWG (Section 3.4.2.5 of the guidance[34]) stipulates that each option should look to maximise biodiversity net gain and any required mitigation should be included to enable identification of any significant costs. The ACWG requires a full assessment of BNG using the Defra metric and that BNG calculations would take place at Gate 1 and be further refined throughout the gateway process. In accordance with the ACWG guidance, at gate-1 a biodiversity baseline has been developed from spatial data of habitat inventories and assessed in line with the Defra Metric 2.0, to calculate the change in biodiversity score for each element to include agreed mitigation. The open source habitat data can be supplemented with local data sets or Phase I (habitat) site data to increase the accuracy for each option at gate-2. Therefore, where data gaps arose at gate-1, these should be addressed at gate-2 through the following actions, as set out within section 2.9 below. At gate-2, the BNG assessment would be refined through the inclusion of concept designs into the assessment, in accordance with section 3.4.3.5 of the ACWG guidance.

The BNG assessment needs to be refined through greater detail on the construction methods and construction easement to provide great clarity on the impact pathways and habitat scores through the Biodiversity Metrics.

Further assessment on the hydrological impacts on ecology will be undertaken that will inform the assessment of operational BNG losses/gains.

Stakeholder consultation is essential to identify opportunities. This will be critical to the opportunity assessment related to mitigation and enhancement. We propose a series of short workshops for key stakeholder to discuss opportunities. This will include key water company representatives and stakeholders (as agreed by the STW steering group). The opportunities which may be discussed include:

- Landowners' land and landownership constraints
- Local wildlife sites
- Whether local councils have allocated land for BNG
- Criteria for prioritisation
  Consideration of specific species targets for net gain options

The improvement of baseline data is required to support gate-1 through site habitat surveys (condition assessment), ground truthing and habitat scoring. Survey locations will be targeted to sensitive areas and to ground truth the variation across the working easements

Table 4.1 of the ACWG guidance includes the requirement to include data on Local Wildlife Sites, which would need to be obtained from the Local Records Centre. Priority habitat layers for hedgerows/arable field margins are not open-source information and will be purchased from the Local Records Centre to improve baseline information.

A more detailed review should be undertaken of National and Local plans and policies, such as River Basin Management Plans, catchment or WFD objectives to identify any specific objectives for BNG that can be delivered. Using the principles of Nature Recovery Networks, core areas for biodiversity have been identified within BOAs. Opportunities for connecting these through habitat restoration/creation should be explored in gate-2, including those already identified within Local Plans/LBAPs/strategies. The opportunities should be assessed for their suitability for specific net gain features, connectivity opportunities and achievability. Values will then need to be assigned against areas of mitigation opportunity with potential condition improvement for each feature and opportunity using the principles of the scoring of the River Biodiversity Metric tool.

The current Biodiversity Metric tool (2.0) has calculation issues when working out river mitigation and units gained. It is anticipated that a 3.0 version of the tool will be released in summer 2021 in which

[34] All Companies Working Group WRMP Environmental Assessment Guidance and Applicability with SROs, October 2020

previous errors within the tool will be updated. If available, the Biodiversity Metric calculations will be re-entered into the 3.0 version at gate-2, and this should also allow river mitigation to be calculated.

Appendices

Appendix	Title	
A1	Summary of key issues	See below in this document
A2	Data Sources	See below in this document
A3	Rivers Data and Opportunities	See accompanying spreadsheet
A4	Minworth groups 1 and 2 NCA figures	See accompanying spreadsheet
A5	Minworth group 3 NCA figures	See accompanying spreadsheet
A6	Minworth NCA calculations	See accompanying spreadsheet
A7	BNG assessment	See accompanying document
A8.1	ST Minworth pipeline BNG	See accompanying spreadsheet
A8.2	ST Minworth GUC BNG	See accompanying spreadsheet
A8.3	Minworth Rivers BNG	See accompanying spreadsheet
A9	Rivers BNG Assessment	See accompanying spreadsheet

A1 Summary of Key Issues

A1.1 Key gaps and assumptions

The methodology for this assessment has been developed to accommodate the current uncertainty surrounding the Minworth (design/precise location etc). It has provided a high-level assessment that is proportional to scale and data availability. We have relied on satellite imagery data sets (CORINE) to assess land cover and a statistical model (ORVal[17]) to obtain values. As certainty surrounding the Minworth increases, the assessment will be updated accordingly with latest available data. See **Section 5** for details of further requirements for gate 2. Gate-1 assumptions are outlined below:

A1.2 Corine land cover terrain types as a proxy for broad habitat types

Best judgment has been used to determine how Corine Land Cover types map to the broad habitats types (see

Table) based on the Corine Land Cover description.

A1.3 Zone of influence (ZoI)

At gate-1 it has not been feasible to determine a bespoke ZoI for each element as design details are not confirmed and impact pathways are not fully understood. We have used a one-kilometre ZoI for the baseline assessment, which is consistent with that used to determine biodiversity impacts in the Strategic Environmental Assessment (SEA).

For assessment of habitat change, we have used the construction working widths, as this represents the likely area of physical habitat change. This is consistent with the approach taken in the BNG assessment.

It is unlikely that the ZoI will be affected evenly by environmental changes brought about by the construction/operation of the final Minworth source groupings. At this stage however, we have assumed that the changes will be uniform across the affected areas. To do otherwise at this stage (gate-1) would be infeasible due to the scale of the proposed projects and the lack of detailed design information.

A1.4 Data scale

The Corine Land Cover data used to generate broad habitat area data has too low a resolution to detect individual rivers or streams. Therefore, the freshwater habitat is likely to be underrepresented. In order to compensate for this, the lengths of rivers that lie within the 1 km buffer zone around each Minworth have been calculated and included as a reflection of that habitat type.

A1.5 Monetisation assumptions

All calculations are set up using real 2019 prices[35]. The benefit transfer values have been converted to £2019 by applying a GDP deflator consistent with the ENCA guidance (

[35] 2020 data not currently available

Table). A GDP deflator is considered more appropriate than adjusting for inflation using the Consumer Price Index (CPI) for this assessment, as the GDP deflator only reflects goods and services produced in the UK.

Table A1: GDP Deflators to update historic values to current prices.

Year	Index (2019 = 100)	% Change on previous year
2010	85.30	1.53
2011	87.04	2.04
2012	88.49	1.66
2013	90.16	1.89
2014	91.81	1.83
2015	92.35	0.58
2016	94.32	2.14
2017	96.11	1.89
2018	98.16	2.14
2019	100.00	1.88
2020	-	2.05

Source: ENCA Services Databook July 2020.

A1.6 Designated and non-designated sites

The baseline data is a habitat assessment based on identifying risks to Priority Habitats. Risks to designated sites is dealt with in the Habitats Regulations Assessments. Risks to wildlife sites have not been included in this level of assessment for gate-1, as national datasets are not available and are mapped at a county level with data held by individual record centres.

Classification and condition of rivers and streams has been taken from the Environment Agency Catchment Explorer website, as survey data is not available for gate-1.

A1.7 Baseline data

ACWG guidance recommends the use of the Natural Habitat Atlas for baseline habitat data; however, the data lacks the detail required for this assessment and is better provided by the Priority Habitats Inventory, supplemented with Corine Landcover where there are data gaps.

The Corine Land Cover and Priority Habitat Inventory data does not provide detailed Phase I level of mapping for the whole area and some assumptions have been made on habitat type. The Biodiversity Metric 2.0 uses habitat types as described in the UK Habs. Where the data identifies pasture grassland, this has been translated into the UK Habs type 'Grassland - Other neutral grassland'.

It is assumed the working easement involved total habitat loss and re-instatement and more detailed construction methods and design is required to avoid over estimation of impacts. The Minworth

information provides further detail on land take for certain Minworth; however only those locations mapped within the GIS shapefiles provided were assessed.

Condition data is not available for habitats with no designations. For these we have assumed a 'moderate' condition score for terrestrial habitats and used Catchment Explore data to assume river condition for each reach. This data lacks the level of detail required for assessing each reach and survey data will be required for the gate-2 assessment.

The Minworth source pipe elements cross various minor roads, for which we have assumed open cut construction methods. Roads are classified as 'Urban - built linear features', which scores 0 and therefore they are excluded from the assessment.

A1.8 Habitat loss

All habitats within the construction easement are assumed to be lost and re-instated with the same habitat type and restored to the same condition. There is no information at this stage on whether some of the habitat along the Minworth Sources overall routes will be retained but degraded from vehicle access and restored (temporary degradation).

Priority habitat layers for hedgerows/arable field margins are not open source information. However, the hedgerow intersections have been identified through aerial photography and an estimate made of habitat loss based on a working easement of 20m, as provided by Jacobs. Arable field margins were identified from mapped Countryside Stewardship areas from MAGIC with the assumption that all are Mid-tier (6m wide) and in Higher level Stewardship.

Construction methods are unknown for small watercourses (<2m) and an assumption was made of open cut methods with a 20m easement will be subject to habitat loss. 15m loss of habitat long riverbanks has been assumed for all outfall structures.

A1.9 Application of the Biodiversity Metric

The Biodiversity Metric is not specifically designed to address habitat degradation, rather than loss. However, as our approach to all Minworth Sources elements is the same, it is inconsequential in comparing each of these elements at a strategic level.

A2 Data Sources

Priority River Habitat:

Natural England maps: https://naturalengland-defra.opendata.arcgis.com/datasets/priority-river-habitat-rivers england/data?geometry= 3 756%2C52 469%2C 1 615%2C52 761

River with water crowfoot:

NBN data for records of water crowfoot was used, from data sources for the 3 habitats (stream, river, floating) https://nbn org uk/the-national-biodiversity network/archive-information/nbn-gateway/ JNCC holds data on SACs H3260 - Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation but this cannot be readily linked to watercourses and Defra Open Data holds information on the WFD macrophyte classification UK distribution maps, which lack the detail required for the River Cycle 2 River Macrophyte Classification

Naturalness:

River Naturalness Assessment - this interactive map shows locations of priority river habitats and overall naturalness score on a scale of 1 5 The data for Naturalness classes is provided for a range of attributes, such as hydrological integrity, ecological integrity. For Naturalness classes 1 and 2 the data includes an 'overall naturalness score', which has been used for this assessment. The Naturalness classes 3 and 4, which are for headwater streams, do not have an overall score The data is provided as an urban class and semi-natural class, where the data for the semi-natural class has been used for this assessment, as we are assessing loss of natural habitat:

Class 1 and 2 River Naturalness Assessment within the Priority River Habitat layer: https://environment.data gov uk/dataset/39c267c0-5014 4e34 85f8 2318c4c74787

Class 3 - 5: In attribute table of headwater areas shapefile https://naturalengland defra.opendata.arcgis.com/datasets/priority-river-habitat-headwater-areas-england/data?geometry=-2 987%2C51 802%2C 0 846%2C52 099

Headwater streams:

headwater areas shapefile https://naturalengland-defra opendata arcgis com/datasets/priority-river-habitat headwater-areas-england/data?geometry= 2.987%2C51.802%2C 0.846%2C52.099

Chalk rivers:

Chalk rivers layer on the Defra data portal: https://data gov uk/dataset/f478556e 9eb5-4d4a a0c6 78654860ebda/chalk-rivers .

Shingle rivers:

Active shingle river (Headwater streams). Used the Priority river habitat in England mapping and targeting measures report. Overlaid image onto Google Earth and converted to shapefile for use in QGIS:
http://publications.naturalengland.org.uk/publication/6266338867675136#:~:text=Priority%20river%20habitat%20in%20England%20%E2%80%93%20mapping%20and,naturalness%20and%20natural%20processes%20as%20the%20primary%20criterion .

River and streams (other)

Everything that doesn't qualify for the above

Canals.

WFD classifications and CRT data portal: https://data-canalrivertrust opendata arcgis.com/

A value for semi-natural grasslands was not available Additional studies were identified with the final best estimate for semi natural grasslands derived from a benefit function from an existing ecosystem services assessment (Christie et al, 2011[14]) noting however, that this value is mainly

applicable to lowland meadows (Holzinger & Haysom, 2017[15]) and hence at this state is likely to impact values: further more detailed data assessment should be undertaken as part of gate-2 to review any more new information.

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Minworth SRO

Environmental Assessment Report:
Water Framework Directive Regulations Compliance Assessment Report

The content of this document is draft and relates to material [or data] which is still in the course of completion in travel to Gate 2 and should not be relied upon at this early stage of development. We continue to develop our thinking and our approach to the issues raised in the document in preparation for Gate 2.

Report for Severn Trent Water and Affinity Water

[redacted] | Issue number 3 | Date 10/05/2021

Ricardo Confidential

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1	23/04/2021	Draft for client review	[redacted]			
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3	10/05/2021	Updated following scope change				

Contents

Figures

Tables

Separate Annexes (Excel workbooks)

Filename	Content
WFD_Annex_1_Minworth_100_280421	Completed ACWG WFD compliance worksheet for Minworth SRO scheme: Minworth / GUC (100 Ml/d)
WFD_Annex_2_Minworth_115_280421	Completed ACWG WFD compliance worksheet for Minworth SRO scheme: Minworth / STT (115 Ml/d)
WFD_Annex_3_Minworth_215_280421	Completed ACWG WFD compliance worksheet for Minworth SRO scheme: Minworth / Combined (215 Ml/d)

1 Background and purpose of report

Ofwat, through the PR19 Final Determination, has identified the potential for companies to jointly deliver strategic regional water resources solutions to secure long-term resilience on behalf of customers while protecting the environment and benefiting wider society. As part of the assessment of companies' PR19 business plans, Ofwat introduced proposals to support the delivery of Strategic Regional Water Resource Options over the next 5 to 15 years with solutions required to be 'construction ready' for the 2025-2030 period. Ofwat's Final Determination[1] in December 2019 set out a gated process for development of Strategic Resource Options (SROs) for the co-ordination and development of a consistent set of SROs.

This gated process provides a mechanism for the industry, regulators, stakeholders and customers to input into the development and scheduling of these strategic solutions, through a combined set of statutory and regulatory processes. These include the National Framework, Drinking Water Safety Plans, Business Plans and Water Resource Management Plans (WRMPs). The group of Water Companies involved in developing SROs (known as the All Company Working Group - ACWG), (consisting of Affinity Water, Anglian Water, Severn Trent Water (STW), Southern Water, South West Water, Thames Water (TW), United Utilities (UU) and Wessex Water) published a joint company statement reiterating a commitment to continue working with the Regulators' Alliance for Progressing Infrastructure Development (RAPID), the Environment Agency (EA), Natural Resources Wales (NRW), Ofwat and the Drinking Water Inspectorate (DWI) to make all of the planning processes and statutory timetables a success.

Minworth has been identified as an SRO in the PR19 Final Determination, with funding allocated to STW and Affinity Water.

In October 2020, the ACWG, published a methodology[2] for environmental assessment methods for SROs which is aligned to the draft Water Resources Planning Guideline (WRPG): Working Version for Water Resource Management Plan 2024 (WRMP24) to increase the consistency of environmental assessment of the SROs and the evaluation of impacts on environmental water quality in particular.

The ACWG methodology indicates that the process requires Water Companies to provide the following information related to each SRO at the stage outlined (see **Figure 1**).

This report sets out the Water Framework Directive Regulations[3] (WFD) Compliance Assessment for Severn to Thames Transfer (STT) at gate-1. The Water Framework Directive[4] is an EU Directive which, as of 31/12/2020, is no longer applicable to the United Kingdom. Therefore, the principle legal basis is the national legislation which currently mirrors the EU Directive. The Water Framework Directive has been translated into UK legislation as the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 in England and Wales. From this point forward "WFD" refers to the legislation applicable to England and Wales, not the EU Directive.

The WFD compliance assessment of the STT SRO has been undertaken in the context of the ACWG guidance. This approach has been adopted to assess the various components of the STT System, thus determining the environmental risk of the STT SRO in a manner consistent with the assessments that will be undertaken for the regional and individual water company WRMPs.

[1] Ofwat (2019), PR19 Final Determinations, Strategic regional water resource solutions appendix
[2] Mott MacDonald Limited (2020). All Companies Working Group WRMP environmental assessment guidance and applicability with SROs. Published October 2020
[3] Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. SI 2017 No. 407
[4] European Union (2000) Directive 2000/60/EC of the European Parliament and of the Council

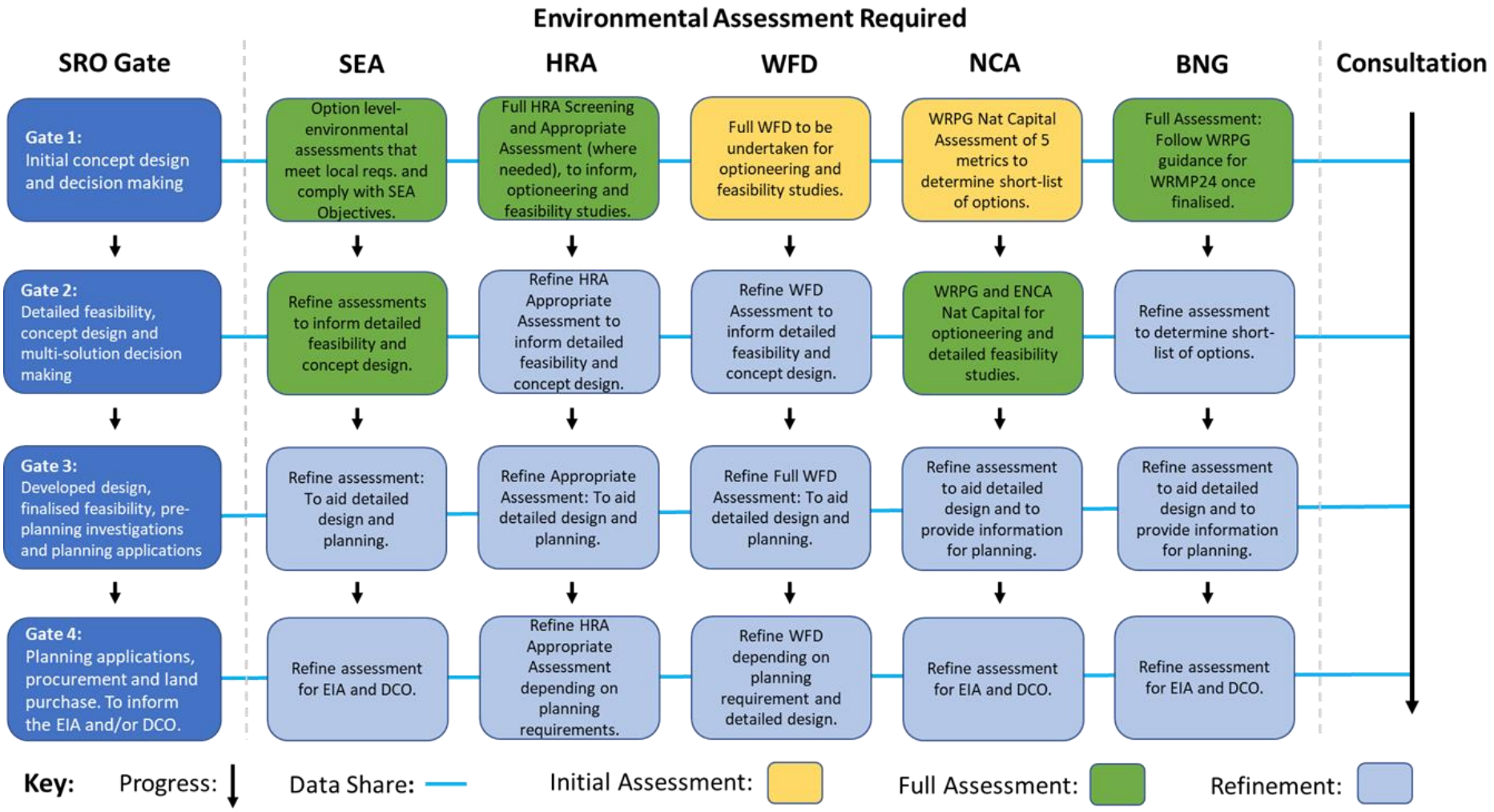


Figure 1 Environmental Assessment Integration with SRO Gates

1.1 Area under consideration

The area under consideration for the assessment reflects the spatial scope of the Minworth SRO schemes which includes specific areas of the River Trent catchment area. This comprises the River Tame corridor, from the existing WwTW discharge outfall at Minworth WwTW to the River Trent confluence and along the River Trent until there is sufficient flow accretion from other tributaries.

1.2 Structure of this report

The report is divided into the following sections:

- Section 1: This introduction
- Section 2: Provides a background to the Minworth SRO
- Section 3: Provides the methodology adopted for the WFD Regulations compliance assessment
- Section 4: Provides the results of the WFD compliance assessment Level 1 screening of Minworth SRO
- Section 5: Provides the results of the WFD compliance assessment Level 2 assessment of Minworth SRO
- Section 6: Conclusions and recommendations to inform gate-2 assessments.

A series of accompanying Excel workbooks have been included as separate annexes. These are the completed ACWG WFD compliance worksheets for the Minworth SRO.

2 Minworth SRO

2.1 Introduction

The Minworth SRO and associated schemes are considered integral to a Severn to Thames Transfer (STT) System. In addition, some of the schemes are also integral in the delivery of the Grand Union Canal (GUC) transfer SRO.

A STT conveying raw water from the lower River Severn into the upper or middle River Thames via an interconnector would increase the catchment area from which water resources can be drawn to the south-east of England. In addition to any flows that may be available to be abstracted under licence from the River Severn, a range of raw water transfer supporting source options for the STT are under consideration to provide additional resource.

The STT SRO comprises 2 principal aspects:

1. Severn to Thames Conveyance – Deerhurst to Culham pipeline or canal conveyance, including piping to Culham.
2. Source rivers used to transport water associated with supported abstractions (rivers Vyrnwy, Severn, Avon and Thames).

In order for all of the STT Support Elements to be able to deliver the water into the STT System there is a requirement for these water supplies to be replaced with other water sources (aspect 2 above). The provision of this additional water is covered under separate SROs that provide the facilities to enable supporting flows for the STT System.

These SROs include the Minworth SRO, STW Sources SRO, UU Sources SRO and UU Lake Vyrnwy SRO. The STT System, therefore, comprises the STT SRO and the source SROs which would be required to work as a combined system to deliver the required outputs into the River Thames.

As noted above, the Minworth SRO is also critical in the delivery of the GUC Transfer SRO which will comprise of the transfer of treated wastewater down the GUC to supply Affinity Water. This comprises a direct discharge into the canal network, canal transfer to a new abstraction near Hemel Hempstead, and the onward transfer of raw water to a new water treatment works and expanded reservoir. It is expected that this work is jointly managed in partnership between the water companies and Canal & River Trust. This solution ranges from 50 to 100 Ml/d in capacity.

Minworth SRO includes three schemes:

1. Minworth / GUC (100 Ml/d) The development at the Minworth WwTW for the further treatment of wastewater to the GUC of up to 100 Ml/d.
2. Minworth / STT (115 Ml/d): The development at the Minworth Wastewater Treatment Works (WwTW) and a pipeline to the River Avon for the transfer of treated wastewater of up to 115 Ml/d.
3. Minworth / Combined (215 Ml/d) The development at the Minworth WwTW and a pipeline to the River Avon for the transfer of treated wastewater of up to 215 Ml/d.

A more detailed description of each element is provided in the sections below. The locations of these three schemes are shown on **Figure 2**.

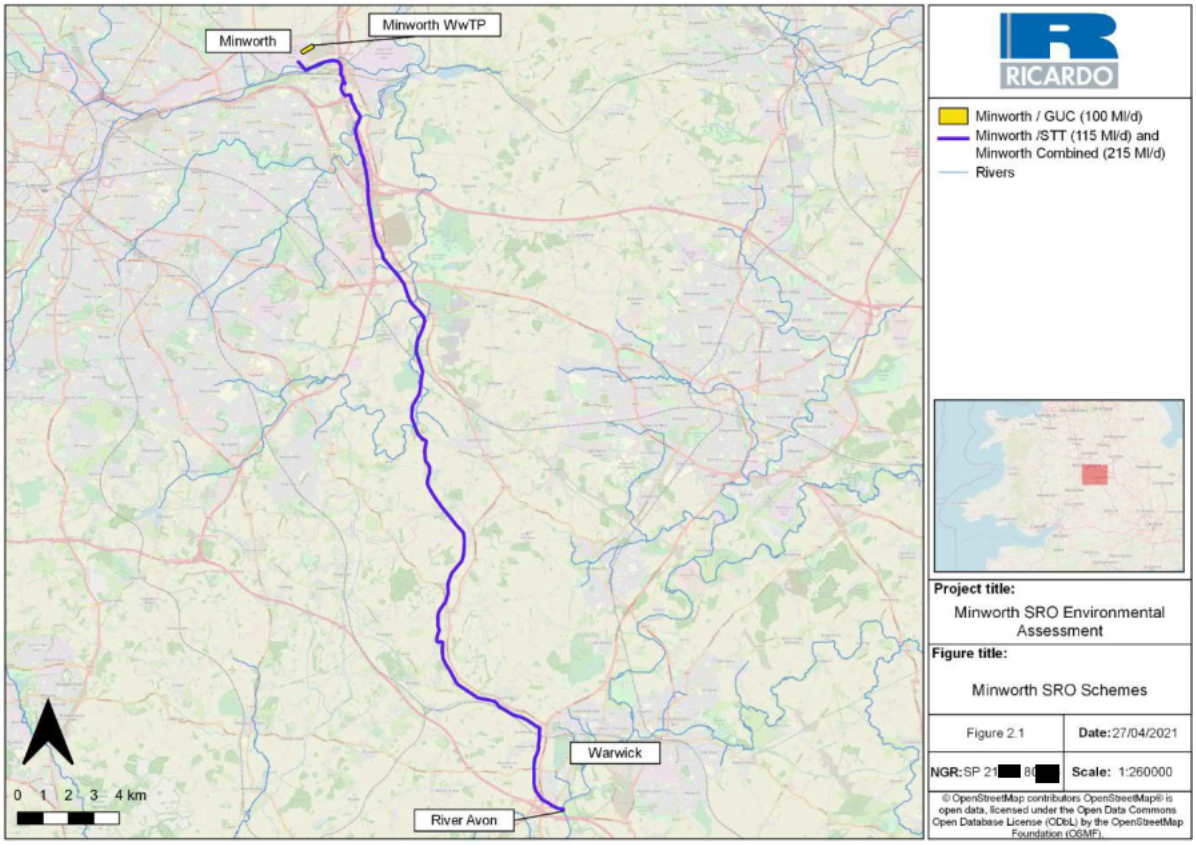


Figure 2 Location of Minworth SRO Schemes

2.2 Minworth / GUC (100 Ml/d) Scheme

Currently treated wastewater from STW's Minworth WwTW is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 100 Ml/d portion of this treated wastewater to the GUC system.

This assessment relates to the upgrade to the WwTW site associated with the discharge into the GUC and with a capacity of up to 100 Ml/d. The discharge into the GUC will require upgrades to ensure discharges of a maximum of 0.2mg/l Total Phosphorous. This will consist of the installation of Ballasted Magnetite Coagulation (CoMag^{TM}, Evoqua) Technology. All construction will be within the existing boundaries of the Minworth WwTW site.

This assessment also considers any impacts on the River Tame system regarding the diversion of up to 100 Ml/d of treated wastewater discharge from Minworth WwTW. The pipeline and discharge of 100Ml/d to the GUC is considered under the GUC Transfer SRO and does not form part of this assessment.

2.3 Minworth / STT (115 Ml/d) Scheme

Currently treated wastewater from STW's Minworth WwTW is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 115 Ml/d portion of this treated wastewater to a new outfall on the River Avon and hence into the River Severn catchment to support STT abstraction from the River Severn at Deerhurst or Gloucester Docks.

There would be an upgrade to the existing Minworth WwTW to improve the existing quality of wastewater to an acceptable standard for discharge to the River Avon. The discharge into the River Avon will require additional treatment technologies. The upgrades for this option will include the installation of a Ballasted Magnetite Coagulation (CoMagTM, Evoqua) Technology, UV disinfection units and Granular Activated Carbon units. All construction will be within the existing boundaries of the Minworth WwTW site.

In addition, this element comprises a pumping station at the Minworth WwTW site and pipeline from the Minworth WwTW site to a new outfall on the River Avon. The pipeline from Minworth WwTW to the River Avon outfall would be some 37.6km in length. The outfall location has been identified, during studies undertaken a gate-1, and would be located on the River Avon to the south of Warwick.

This assessment relates to the upgrade of the WwTW site associated with the discharge into the River Avon, and the pipeline to the River Avon. This assessment also considers any impacts on the River Tame system regarding the diversion of up to 115Ml/d of treated wastewater discharge from Minworth WwTW. The assessment of the intermittent transfer of 115 Mld to the River Avon is considered as part of the STT SRO and does not form part of this assessment.

2.4 Minworth / Combined (215 Ml/d) Scheme

Currently treated wastewater from STW's Minworth WwTW is discharged into the River Tame, a tributary of the River Trent. It is proposed to divert a 215 Ml/d portion of this treated wastewater. With a 115 Ml/d portion being diverted to a new outfall on the River Avon and hence into the River Severn catchment to support STT abstraction from the River Severn at Deerhurst or Gloucester Docks and 100 Ml/d being diverted to the GUC.

There would be upgrades to the existing Minworth WwTW site necessary to improve the existing quality of wastewater to an acceptable standard for each discharge location (as noted below). As a result of the analysis of the receiving water quality (canal and river) and the location of the potential wastewater discharges, different levels of treatment would be required for each option.

The discharge into the GUC will require upgrades to ensure discharges of a maximum of 0.2mg/l Total Phosphorous. This will consist of the installation of Ballasted Magnetite Coagulation (CoMag™, Evoqua) Technology.

The discharge into the River Avon will require additional treatment technologies. The upgrades for this option will include the installation of a Ballasted Magnetite Coagulation (CoMagTM, Evoqua) Technology, UV disinfection units and Granular Activated Carbon units.

The upgrade works in both cases will be located in the same area of the existing WwTW site. All construction will be within the existing boundaries of the Minworth WwTW site.

In addition, this element comprises a pumping station at the Minworth WwTW site and a pipeline from the Minworth WwTW site to a new outfall on the River Avon. The pipeline from Minworth WwTW to the River Avon outfall would be some 37.6km in length. The outfall location has been identified, during studies undertaken a gate-1, and would be located on the River Avon to the south of Warwick.

This assessment relates to the upgrade of the WwTW site associated with discharges to both the River Avon and the GUC, and the pipeline to the River Avon. This assessment also considers any impacts on the River Tame system regarding the diversion of up to 215Ml/d of treated wastewater discharge from Minworth WwTW. The assessment of the intermittent transfer of 115 Mld to the River Avon is considered as part of the STT SRO and does not form part of this assessment. The pipeline and discharge of 100Ml/d to the GUC is considered under the GUC Transfer SRO and does not form part of this assessment.

3 Methodology for Gate-1

3.1 Overall approach

The ACWG guidelines set out an assessment approach and accompanying reporting spreadsheet for undertaking the constraint test of WFD Regulations compliance that is required for SRO. The ACWG guidelines identify three WFD objectives for assessing WFD constraints. These are established from Regulation 13 of the WFD Regulation as follows:

1. To prevent deterioration[5] of any WFD element of any water body.- in line with Regulations 13(2)a and 13(5)a
2. To prevent the introduction of impediments to the attainment of 'Good' WFD status or potential for any water body. It is accepted that for some water bodies achievement of Good status or potential is currently technically infeasible or disproportionately costly. Where this is the case, the test is applied to the currently agreed objectives for that water body rather than against Good status/potential - in line with Regulations 13(2)b and 13(5)c.
3. To ensure that the legally binding planned programme of water body measures in the second cycle of River Basin Management Planning (RBMP2) to protect and enhance the status of water bodies are not compromised.-

These are the WFD compliance objectives that have been tested for constraints for the three Minworth SRO schemes.

Following the ACWG guidelines, each Minworth SRO Schemes has been assessed separately and individually using the Level 1 basic screening to identify potentially affected WFD water bodies and possible impacts based on activities. Using relevant EA guidance[6] most construction activities have been screened out at Level 1 as these would not lead to WFD non-compliance. For each of the WFD water bodies screened into the Level 2 assessment for each Minworth SRO Schemes separately and individually the ACWG reporting spreadsheet has been completed and is available as a separate annex, see **Table 1**.

Table 1 Accompanying ACWG assessment spreadsheets to this report

Filename	Content
WFD_Annex_1_Minworth_100_280421	Completed ACWG WFD compliance worksheet for Minworth SRO scheme: Minworth / GUC (100 Ml/d)
WFD_Annex_2_Minworth_115_280421	Completed ACWG WFD compliance worksheet for Minworth SRO scheme: Minworth / STT (115 Ml/d)
WFD_Annex_3_Minworth_215_280421	Completed ACWG WFD compliance worksheet for Minworth SRO scheme: Minworth / Combined (215 Ml/d)

Level 2 is a detailed screening for impact on each status element and RBMP2 programme of measures. For each WFD water body, the ACWG reporting spreadsheet sets out the published RBMP2 (2015) status of each WFD status element - for assessing elements included in status classification, not supporting elements. This provides the baseline for no deterioration to be established; therefore, supports the assessment of WFD Objective 1. This information also informs the assessment of WFD Objective 2 – for status elements already achieving Good status or their published RBMP3 target Objective 2 is not required to be tested. The spreadsheet also identifies the published Reasons for Not Achieving Good status assessments undertaken by the EA. The spreadsheet has been used to record the published RBMP2 programme of measures for the water body for the assessment of WFD Objective 3.

[5] As defined in Section 1.3
[6] Environment Agency Operational Instruction OI 488_10_SD01 WFD compliance assessment for new physical modifications

For construction and operation activity types, such as "cessation of existing discharge to a watercourse", the ACWG guideline has established a checklist of potential impact types such as "changes in flow velocity". This has been used to inform the change in pressure on status elements. The Reasons for Not Achieving Good status assessments has been used to guide the understanding of existing pressures on the WFD status element in that water body. In the assessment we document in the spreadsheet the impact of each action's potential impact type on WFD status elements and complete the impact score for each status element using the ACWG guideline's scale (-2 (very beneficial) to +3 (high adverse impact)). Compliance with WFD Objectives has been reported for each WFD status element and RBMP2 measure. Assessments have been undertaken proportionate to gate-1, noting the level of confidence in the assessment and the level of design certainty.

The Level 1 basic screening of the Minworth SRO Schemes is summarised in Section 4. The Level 2 assessment of the Minworth SRO Schemes is summarised in Section 5. STT SRO gate-1 documentation[7] provides part of the supporting physical environment, water quality and aquatic ecology assessments that underpin the WFD compliance assessment.

3.2 Specific commentary on completion of the ACWG template

The ACWG template has been completed two times. Each of the accompanying Excel workbooks is specific to one of the Minworth SRO Schemes – either the Minworth / STT (115 Ml/d) scheme or the Minworth / Combined (215 Ml/d) scheme. The WFD compliance assessment of each scheme includes the Level 1 screening, the selection of Level 2 activities and the Level 2 assessment. The summary worksheets are auto-generated in the template for consistency in summary across SROs.

3.3 Level 1 WFD screening

The Level 1 screening has been completed for all operating effects of the Minworth SRO schemes. It is noted that there are no in-river construction activities, for example there is no new construction of outfalls to the River Tame that are specific to the Minworth SRO. Construction activities associated with pipelines and river/canal outfalls are included exclusively within the assessment of the STT SRO (discharging to the River Avon) or the GUC SRO (discharging to the GUC) and are not included in the scope of the Minworth SRO.

A bespoke hydrological assessment of the Minworth / STT (115 Ml/d) scheme has been undertaken, reported in the STT SRO gate-1 documentation[8]. That reach-based assessment along the flow pathway of the STT has been used to identify which waterbodies are subject to a major, moderate, minor or negligible flow change when compared with normal conditions. That assessment reviewed river flows over a 30-year period (1990-2019) to characterise river flow into bands from exceptionally low flow to exceptionally high flow on a given date. An indicative operational pattern specific to this scheme was established for the 10-year period (1 January 2010-31 December 2019) and compared with river flows under normal conditions in those years. The Level 1 screening also considers those water bodies downstream of these changes along the flow pathway. Those water bodies with a major or moderate flow change have been passed forward from Level 1 screen as requiring further WFD consideration based on flow changes. A secondary screen based on potential water quality changes has been used to select additional water bodies to pass forward from the Level 1 screen as requiring further WFD consideration. All other water bodies have been screened out at Level 1 as these would not lead to WFD non-compliance.

A hydrological assessment of the Minworth / GUC (100 Ml/d) scheme and a Minworth / Combined (215 Ml/d) scheme has been included in this report to the same standard as the Minworth / STT (115 Ml/d) scheme.

The Minworth SRO does not include any activities relevant to the consideration of WFD groundwater bodies.

[7] Specifically STT SRO gate-1 Environmental Assessment Report Appendix B3 Environmental Assessment Reports
[8] Specifically STT SRO gate-1 Environmental Assessment Report Appendix B3.1 Modelling - Physical Environment Evidence

3.4 Level 2 WFD assessment

Within the ACWG template, we note the following style guide to how we have documented the WFD assessment:

- Assessment has been undertaken against published RBMP2 (2015) status, RBMP2 mitigation measures, and RBMP3 published status targets. The embedded data in the ACWG template also includes status in other years, these are not applicable and have not been assessed against.
- The ACWG template includes the objective "Assists attainment of water body objectives". That objective is outside the ACWG guidelines and has not been used in the assessment of Minworth SRO schemes
- For WFD status elements, in the upper section of the worksheet, the relevant WFD objectives that have been assessed against are "Deterioration between status classes" (Objective 1) and "Impediments to GES/GEP" (Objective 2).
- Where RBMP2 (2015) reported status is High or Good, Objective 2 is not applicable and has not been assessed against.
- Where RBMP2 (2015) reported status is at the RBMP3 target status, and that is noted as lower than High or Good, Objective 2 is not applicable and has not been assessed against.
- For RBMP2 mitigation measures, in the lower section of the worksheet, the relevant WFD objective that has been assessed against is "Compromise WB objectives" (Objective 3).
- The relevant WFD status elements for assessment of Objective 1 and Objective 2 in river water bodies[9] are those in the Water Framework Directive (WFD) Directions[10], as listed in **Table 2**. It is noted that the ACWG template includes hydro-morphological supporting elements and these are not applicable and have not been used in the assessment.
- The ACWG template includes data from the EA "Reasons for Not Achieving Good" [status] database. These are not applicable to Objectives 1, 2, or 3 and have not been used in the assessment.
- For proportionality of assessment, the ACWG template "potential impacts of asset" have been collated for each "activity" with one consolidated assessment undertaken for each WFD status element.
- All assessments have been undertaken using the mitigation measures designed into the Minworth SRO schemes, as documented in the Conceptual Design Reports. Furthermore this includes the assumptions/ mitigations as set out in the ACWG template which recognise compliance with regulations and good design practice. As such, there is no difference between the "impact" and "post mitigation impact" in the Level 2 assessment worksheet. Where there is potential for WFD objective non-compliance, additional mitigation actions that may reduce this potential and lead to WFD compliance is indicated in the narrative summary in Section 5 below, but not included in the WFD compliance assessment as it is <u>not</u> currently committed to or costed into Minworth SRO Scheme design.

The 2015 Directions note the reporting of additional substances from 2018. These are not status elements in RBMP2 and do not currently have a formal status. Although an interim status position has been documented by the EA for 2019, it is not considered appropriate at this time to include these substances in a WFD compliance assessment. It is noted that the gated process will continue beyond RBMP3 publication, at which point these additional substances will have a formal status and a target status for 2027 from which to update the WFD compliance assessment.

[9] It is noted that only river water bodies have been passed forward to the Level 2 WFD assessment of Minworth SRO.
[10] Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Table 2 Relevant WFD status elements from which to assess compliance in river water bodies

Ecological status			
Biological status elements	Fish Invertebrates Macrophytes & phytobenthos combined		
Physio-chemical	Water temperature pH Dissolved oxygen Ammonia Reactive phosphorus (orthophosphate)		
Specific pollutants	2,4-dichlorophenol 2,4-dichlorophenoxyacetic acid 3,4 dichloroaniline Arsenic Benzyl butyl phthalate Carbendazim Chlorothalonil Chromium (III) (VI) Chlorine	Copper Cyanide Cypermethrin Diazinon Dimethoate Glyphosate Iron Linuron Manganese	Mecoprop Methiocarb Pendimethalin Permethrin Phenol Tetrachloroethane Toluene Triclosan Zinc
Chemical status			
Priority Substances, Priority Hazardous Substances and Other pollutants contributing to chemical status	Alachlor Anthracene Atrazine Benzene Benzo(a)-pyrene (BaP) Benzo(b)-fluor-anthene Benzo(k)-fluor-anthene Benzo(g,h,i)-perylene Brominated diphenylether Cadmium and its compounds Carbon tetrachloride Chlorfenvinphos C10-13 chloroalkanes Chlorpyrifos Cyclodiene pesticides isodrin	DDT total Para-para-DDT 1,2-dichloro-ethane Dichloro-methane Di(2-ethylhexyl)-phthalate (DEHP) Diuron Endosulphan Fluoranthene Hexachloro-benzene Hexachloro-butadiene Hexachloro-cyclohexane Indeno(1,2,3-cd)-pyrene Isoproturon Lead and its compounds	Mercury and its compounds Naphthalene Nickel and its compounds Nonylphenol Octylphenol Pentachloro-benzene Pentachloro-phenol Simazine Tetrachloro-ethylene Tributyltin compounds Trichloro-benzenes Trichloro-ethylene Tricholoro-methane Trifluralin

4 Summary of basic Level 1 WFD screening of Minworth SRO

4.1 Introduction

For each of the Minworth SRO schemes, the ACWG template Level 1 screening comprises the following worksheets completed by Ricardo:

- "1. List relevant waterbodies" – these are the waterbodies in the study area as set out in the conceptualisation below
- "2. Level 1 activities" – completed for construction activities and operational activities as set out below

A third worksheet "3. Level 1 summary" is auto-generated by the template to summarise those water bodies to be carried forward to the level 2 assessment.

As the ACWG template does not have specific sections for documenting the reasoning behind the selection of water bodies or activities, relevant description is set out below.

4.2 Minworth / GUC (100 Ml/d) Scheme

4.2.1 Conceptualisation of study area

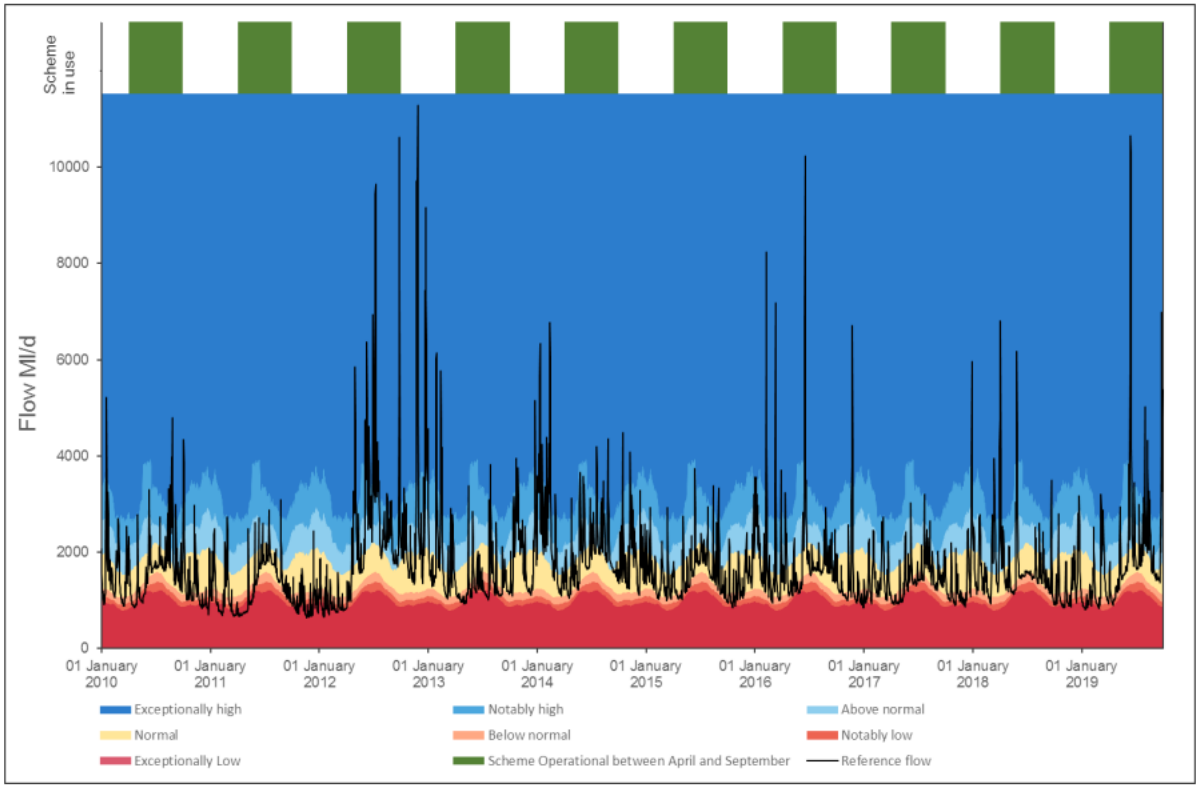
For the Minworth / GUC (100 Ml/d) Scheme, the flow pathway zone of influence in the River Trent catchment would extend from the Minworth WwTW outfall on the River Tame and along the remainder of the River Tame to the River Trent confluence and along the River Trent to an assessed zone of hydrological influence end at the River Derwent confluence. At times of discharge diversion there would be flow decrease in the River Tame and River Trent catchment from the Minworth WwTW outfall.

4.2.2 In-river hydrological effects from operation

STT SRO gate-1 documentation[8] has indicated an assessment approach for assessing flow changes and a gate-1 study period of 2010-2019. For the Minworth / GUC (100 Ml/d) scheme this assessment has been undertaken using EA flow gauge data as reference conditions and an indicative operating regime for the scheme. Affinity Water advise that for the 100 Ml/d GUC scheme, a precautionary assessment for gate-1 should include six months continuous operation of discharge diversion annually, commencing in April. For this gate-1 WFD compliance assessment, this initial operating pattern has been assessed for a period 2010-2019 for consistency with the STT SRO as shown in **Figure 3** (see also Section 4.3.2 below).

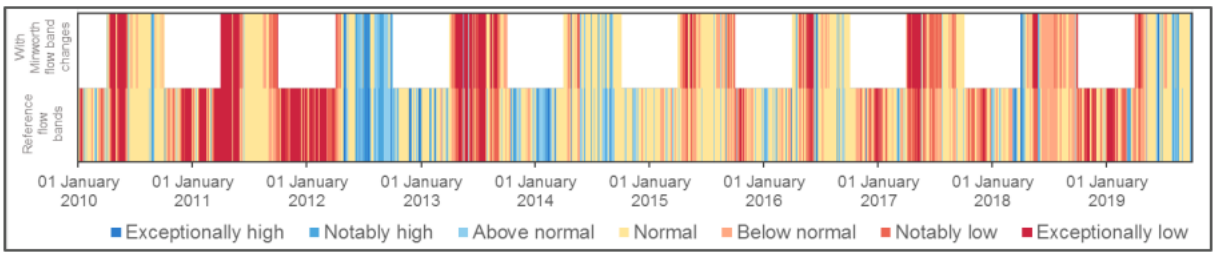
The assessed scenario described the Minworth / GUC (100 Ml/d) scheme would be operational as a support option for water resources purposes approximately 50% of the study period, with consistent use in April-September each year.

Figure 3: Flow context at Location 1, River Tame upstream of the River Anker confluence flow gauge daily flow 2010-2019 also showing indicative operating pattern used for Minworth / GUC (100 Ml/d) at gate-1



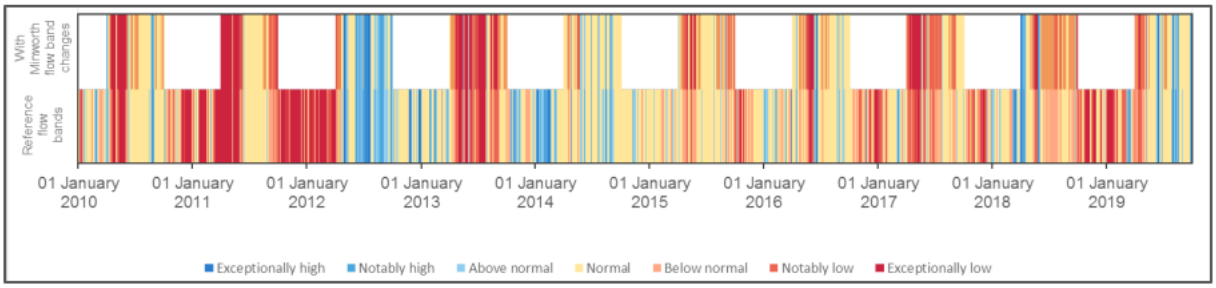
Hydrological assessment is presented for River Tame Location 1 in **Figure 4** and for Location 2 in **Figure 5**; and River Trent Location 3 in **Figure 6** and for Location 4 in **Figure 7** - compared with the reference conditions set out in the baseline for this reach.

Figure 4: Location 1, River Tame upstream of the River Anker confluence, Minworth / GUC (100 Ml/d) scheme in the 10-year study period compared with reference conditions



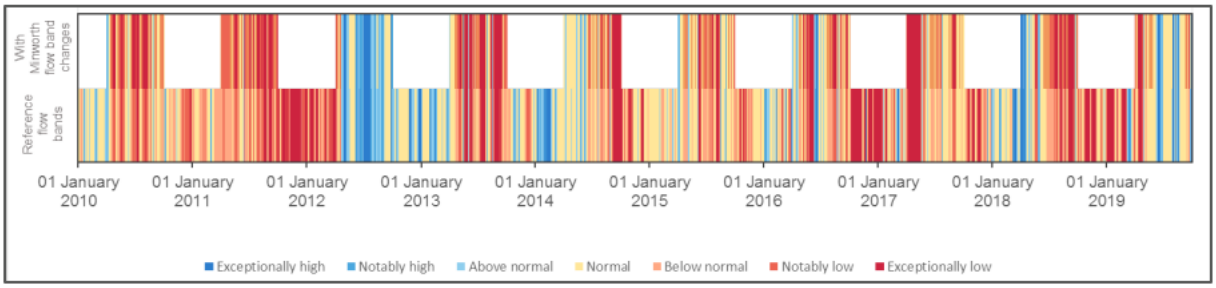
For the Minworth / GUC (100 Ml/d) scheme for Location 1, on 2,972 dates in the 10 year period, (83.5%), the same flow band would be retained, while 575 dates (16.1%) would result in change by one flow band, and 13 dates (0.4%) would decrease by two flow bands. The number of dates with *exceptionally low* flow in the River Tame in this reach during the study period would increase from 178 dates to 466 dates. Overall in the 10 year period, very low flow Q95 would reduce by 2% from 846 Ml/d to 829 Ml/d; and exceptionally low flow Q99 would reduce by 5% from 705 Ml/d to 672 Ml/d. Overall this is assessed as a moderate magnitude of flow change at this assessment location based on the increasing frequency of *exceptionally low* flow dates. This assessment recognises that in terms of flow statistics, there are dates (principally in 2011 and 2012) not influenced by the option that associate with gauged exceptionally low flows.

Figure 5: Location 2, River Tame at Hopwas Bridge, Minworth / GUC (100 Ml/d) scheme in the 10-year study period compared with reference conditions



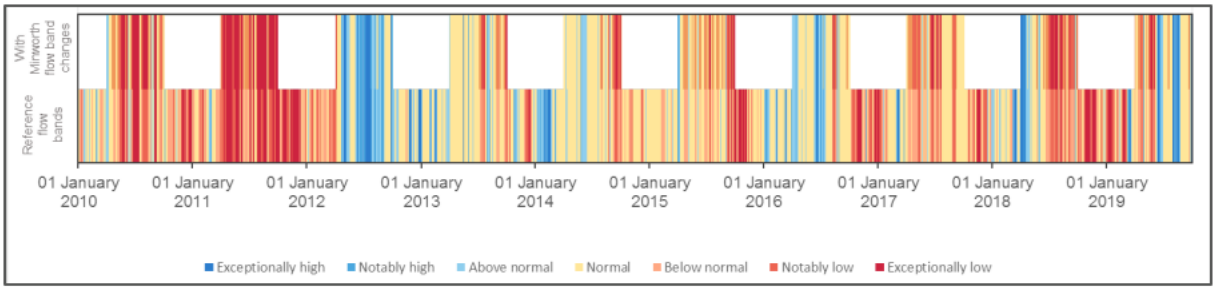
For the Minworth / GUC (100 Ml/d) scheme for Location 2, on 3,000 dates in the 10 year period, (84.3%), the same flow band would be retained, while 578 dates (16.2%) would result in change by one flow band, and 12 dates (0.4%) would decrease by two flow bands. The number of dates with *exceptionally low* flow in the River Tame in this reach during the study period would increase from 178 dates to 468 dates. Overall in the 10 year period, very low flow Q95 would reduce by 2% from 956 Ml/d to 937 Ml/d; and exceptionally low flow Q99 would reduce by 6% from 805 Ml/d to 753 Ml/d. Overall this is assessed as a moderate magnitude of flow change at this assessment location based on the increasing frequency of *exceptionally low* flow dates. This assessment recognises that in terms of flow statistics, there are dates (principally in 2011 and 2012) not influenced by the option that associate with gauged exceptionally low flows.

Figure 6: Location 3, River Trent at Drakelow Park, Minworth / GUC (100 Ml/d) scheme in the 10-year study period compared with reference conditions



For the Minworth / GUC (100 Ml/d) scheme for Location 3, on 3,066 dates in the 10 year period, (86.1%), the same flow band would be retained, while 493 dates (13.8%) would result in change by one flow band, and 1 date would decrease by two flow bands. The number of dates with *exceptionally low* flow in the River Tame in this reach during the study period would increase from 178 dates to 583 dates. Overall in the 10 year period, very low flow Q95 would reduce by 7% from 1,042 Ml/d to 971 Ml/d; and exceptionally low flow Q99 would reduce by 9% from 881 Ml/d to 799 Ml/d. Overall this is assessed as a major magnitude of flow change at this assessment location based on the increasing frequency of *exceptionally low* flow dates and the numeric flow reduction for very low and exceptionally low flow statistics.

Figure 7: Location 4, River Trent at Shardlow, Minworth / GUC (100 Ml/d) scheme in the 10-year study period compared with reference conditions



For the Minworth WwTW discharge diversion (100 Ml/d) scheme for Location 4, on 3,182 dates in the 10 year period, (89.4%), the same flow band would be retained, while 378 dates (10.6%) would result

in change by one flow band, and 0 dates would decrease by two flow bands. The number of dates with *exceptionally low* flow in the River Tame in this reach during the study period would increase from 178 dates to 374 dates. Overall in the 10 year period, very low flow Q95 would reduce by 6% from 1,500 Ml/d to 1,403 Ml/d; and exceptionally low flow Q99 would reduce by 7% from 1,316 Ml/d to 1,225 Ml/d. Overall this is assessed as a major magnitude of flow change at this assessment location based on the increasing frequency of *exceptionally low* flow dates and the numeric flow reduction for very low and exceptionally low flow statistics.

Indicative flow changes in the study reaches are summarised in **Table 3** listing the WFD water body and assessment of the magnitude of flow change. Downstream of the confluence of the River Derwent with the River Trent there is a large increase in total flow and hydrological effects have been assessed as minor downstream.

Table 3 Relevant reaches and associated indicative flow changes from operation of the Minworth / GUC (100 Ml/d) scheme

WFD water body	Flow change during operation	Assessed magnitude of flow change
Tame from R Rea to R Blythe (GB104028046841)	-100 Ml/d for periods extending 6-months	Moderate
Tame from R Blythe to River Anker (GB104028046440)	-100 Ml/d for periods extending 6-months	Moderate
Tame from River Anker to River Trent (GB104028047050)	-100 Ml/d for periods extending 6-months	Moderate
Trent - R Tame to R Dove (GB104028047180)	-100 Ml/d for periods extending 6-months	Major
Trent from Dove to Derwent (GB104028047420)	-100 Ml/d for periods extending 6-months	Major
Trent from Derwent to Soar (GB104028053120)	-100 Ml/d for periods extending 6-months	Minor

4.2.3 Water bodies and activities deemed WFD compliant and not passed forward from Level 1 screen

For the Minworth / GUC (100 Ml/d) scheme all operational effects from reduction in discharge flow have been passed forward from the Level 1 screen on precautionary basis. There are no in-river construction activities associated with the scheme.

4.2.4 Water bodies and activities passed forward from Level 1 screen as requiring further consideration

For the gate-1 Minworth / GUC (100 Ml/d) scheme the hydrological assessment identified five WFD river water bodies passed forward from Level 1 screen as requiring further consideration based on major or moderate hydrological effects. Water bodies and relevant activities from the ACWG list and the relevant STT element are summarised in **Table 4**. It is noted that in the ACWG template "Cessation of existing discharge to a watercourse" is listed as a decommissioning activity. In this assessment we are including it as an operational activity and not a complete cessation of discharge.

Table 4 Water bodies and activities passed forward from Level 1 screen as requiring further consideration for the Minworth / GUC (100 Ml/d) scheme

Water body	ACWG listed activity
Tame from R Rea to R Blythe (GB104028046841)	Cessation of existing discharge to a watercourse
Tame from R Blythe to River Anker (GB104028046440)	Cessation of existing discharge to a watercourse
Tame from River Anker to River Trent (GB104028047050)	Cessation of existing discharge to a watercourse
Trent - R Tame to R Dove (GB104028047180)	Cessation of existing discharge to a watercourse
Trent from Dove to Derwent (GB104028047420)	Cessation of existing discharge to a watercourse

4.3 Minworth / STT (115 Ml/d) Scheme

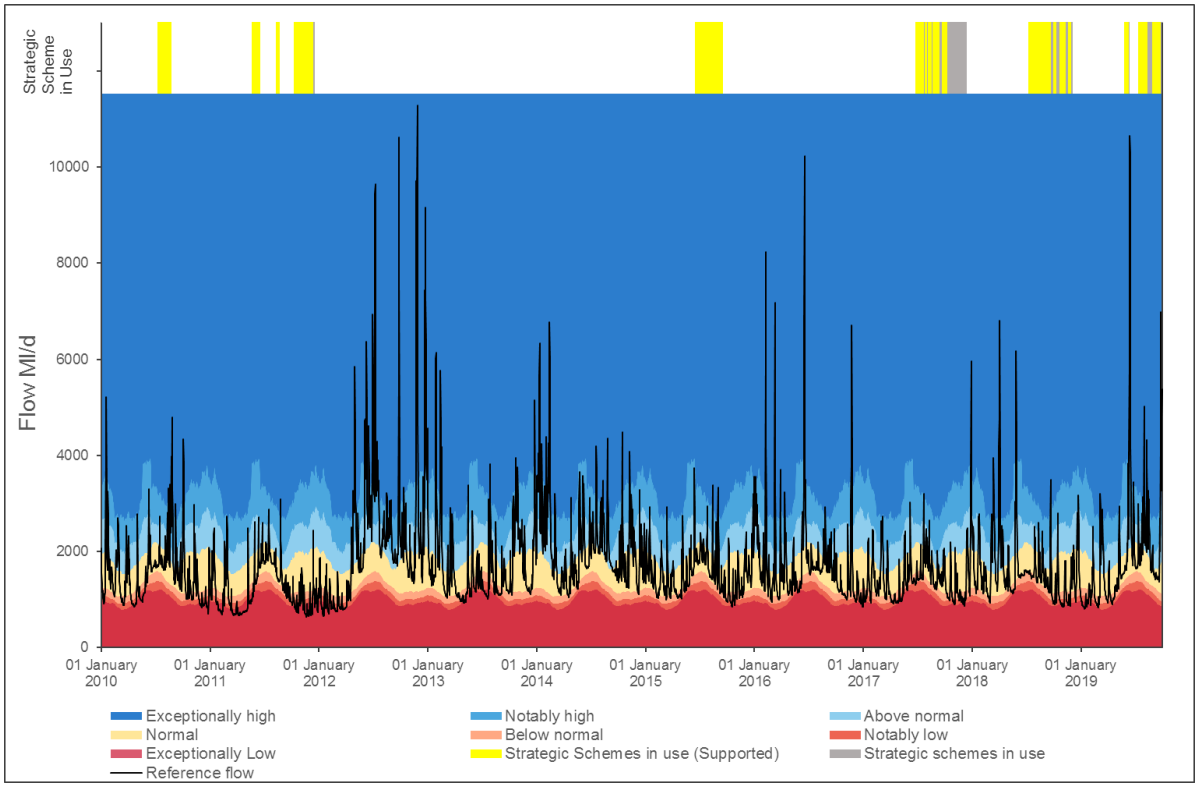
4.3.1 Conceptualisation of study area

For the Minworth / STT (115 Ml/d) scheme, the flow pathway zone of influence in the River Trent catchment would extend from the Minworth WwTW outfall on the River Tame and along the remainder of the River Tame to the River Trent confluence. At times of discharge diversion there would be flow decrease in the River Tame catchment from the Minworth WwTW outfall.

4.3.2 In-river hydrological effects from operation

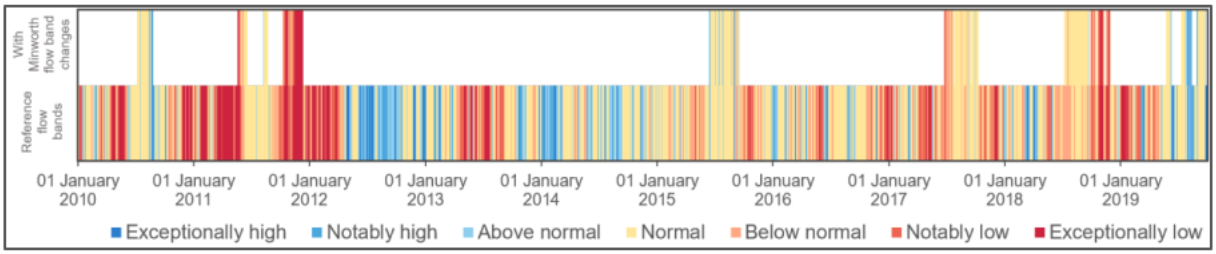
STT SRO gate-1 documentation[8] has indicated a scenario of flow changes in the study area for the period 2010-2019. This has been undertaken using EA flow gauge data as reference conditions and an indicative operating regime for the scheme. STT SRO gate-1 documentation[8] has indicated a scenario of flow changes in the study area for the period 2010-2019 for the Minworth / STT (115 Ml/d) scheme. This describes an indicative operating pattern for the selected 10 year flow series 2010-2019 as shown in **Figure 8**. The assessed scenario described the Minworth / STT (115 Ml/d) scheme would be operational as a support option for water resources purposes approximately 15% of the study period, clustered in six of the 10 years and within the months May to November. These range from continuous periods in June to September 2015 (96 dates) to shorter duration periods in 2010 (50 dates) and intermittent periods in 2011 (overall 112 dates), 2017 (overall 99 dates), 2018 (overall 128 dates) and 2019 (overall 78 dates).

Figure 8: Flow context at Location 1, River Tame upstream of the River Anker confluence flow gauge daily flow 2010-2019 also showing indicative operating pattern used for Minworth / STT (115 Ml/d) at gate-1



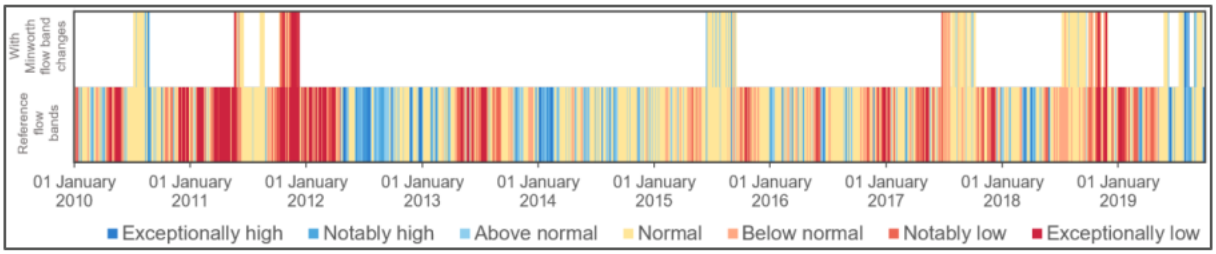
Hydrological assessment is presented for River Tame Location 1 in **Figure 9** and for Location 2 in **Figure 10** - compared with the reference conditions set out in the baseline for this reach.

Figure 9: Location 1, River Tame upstream of the River Anker confluence, Minworth / STT (115 Ml/d) scheme in the 10-year study period compared with reference conditions



For the Minworth / STT (115 Ml/d) scheme for Location 1, on 3,445 dates in the 10 year period, (96.8%), the same flow band would be retained, while 108 dates (3.0%) would result in change by one flow band, and 7 dates (0.2%) would increase by two flow bands – all from *exceptionally low* to *below normal*. For the 337 dates with *exceptionally low* flow in the River Tame in this reach during the study period, 19 dates would change to *notably low* which could be perceived as a benefit at those times. This is assessed as a minor magnitude of flow change.

Figure 10: Location 2, River Tame at Hopwas Bridge, Minworth / STT (115 Ml/d) scheme in the 10-year study period compared with reference conditions



For the Minworth / STT (115 Ml/d) scheme for Location 2, on 3,409 dates in the 10 year period, (95.8%), the same flow band would be retained, while 132 dates (3.7%) would result in change by one flow band, 19 dates (0.5%) would increase by two flow bands – either from *notably low* to *normal*, or *exceptionally low* to *below normal*. For the 357 dates with *exceptionally low* flow in the River Severn in this reach during the study period, 20 dates would change to *notably low* which could be perceived as a benefit at those times. This is assessed as a minor magnitude of flow change.

Indicative flow changes in the study reaches are summarised in **Table 5** listing the WFD water body and assessment of the magnitude of flow change. The hydrological zone of influence is considered to not extent into the River Trent and no River Trent water bodies are included in the assessment.

Table 5 Relevant reaches and associated indicative flow changes from operation of the Minworth / STT (115 Ml/d) scheme

WFD water body	Flow change during operation	Assessed magnitude of flow change
Tame from R Rea to R Blythe (GB104028046841)	-115 Ml/d	Minor
Tame from R Blythe to River Anker (GB104028046440)	-115 Ml/d	Minor
Tame from River Anker to River Trent (GB104028047050)	-115 Ml/d	Minor

4.3.3 Water bodies and activities deemed WFD compliant and not passed forward from Level 1 screen

For the Minworth WwTW discharge diversion (115 Ml/d) scheme all operational effects from reduction in discharge flow have been passed forward from the Level 1 screen on precautionary basis. There are no in-river construction activities associated with the scheme.

4.3.4 Water bodies and activities passed forward from Level 1 screen as requiring further consideration

For the gate-1 Minworth / STT (115 Ml/d) scheme the hydrological assessment identified no WFD river water bodies passed forward from Level 1 screen as requiring further consideration based on major or moderate hydrological effects. However, the Tame from R Rea to R Blythe (GB104028046841) water body was also included on a precautionary basis to review potential effects in the River Tame catchment from flow reduction there. Water bodies and relevant activities from the ACWG list and the relevant STT element are summarised in **Table 6**.

Table 6 Water bodies and activities passed forward from Level 1 screen as requiring further consideration for the Minworth / STT (115 Ml/d) scheme

Water body	ACWG listed activity
Tame from R Rea to R Blythe (GB104028046841	Cessation of existing discharge to a watercourse

4.4 Minworth / Combined (215 Ml/d) Scheme

4.4.1 Conceptualisation of study area

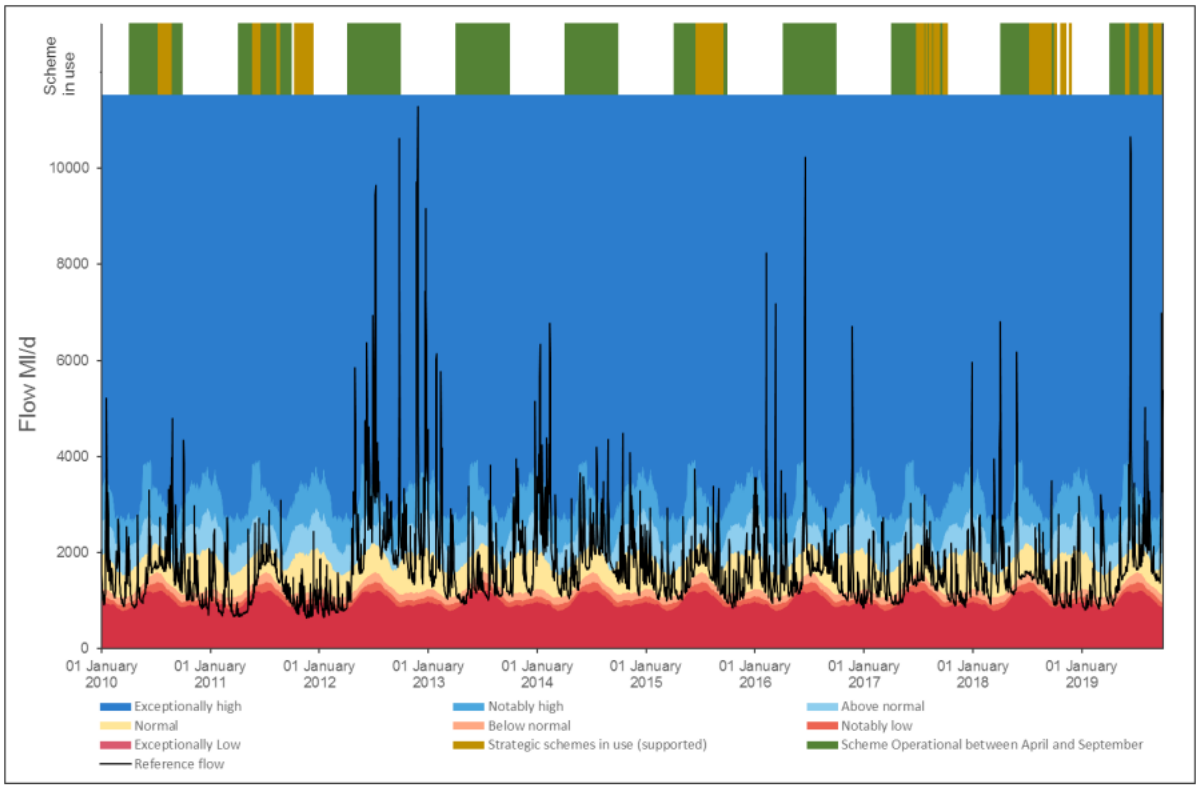
For the Minworth / Combined (215 Ml/d) Scheme, the flow pathway zone of influence in the River Trent catchment would extend from the Minworth WwTW outfall on the River Tame and along the remainder of the River Tame to the River Trent confluence and along the River Trent to an assessed zone of hydrological influence end at the River Derwent confluence. At times of discharge diversion there would be flow decrease in the River Tame and River Trent catchment from the Minworth WwTW outfall.

4.4.2 In-river hydrological effects from operation

STT SRO gate-1 documentation[8] has indicated a scenario of flow changes in the study area for the period 2010-2019 for the Minworth / STT (115 Ml/d) scheme, as described in Section 4.3.2 above. This has been undertaken using EA flow gauge data as reference conditions and an indicative operating regime for the scheme. Affinity Water advise that for the 100 Ml/d GUC SRO component of discharge diversion, a precautionary assessment for gate-1 should include six months continuous operation of discharge diversion annually, commencing in April. Together these describe an indicative operating pattern for the selected 10 year flow series 2010-2019 as shown in **Figure 11**.

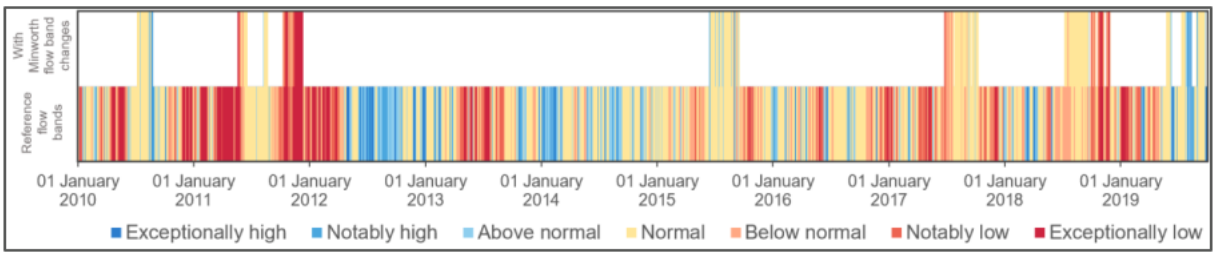
The assessed scenario described the Minworth / Combined (215 Ml/d) scheme would be operational as a support option for water resources purposes approximately 55% of the study period, including consistent use in April-September each year and sometimes also including parts of October, November and/or December.

Figure 11: Flow context at Location 1, River Tame upstream of the River Anker confluence flow gauge daily flow 2010-2019 also showing indicative operating pattern used for Minworth / Combined (215 Ml/d) at gate-1



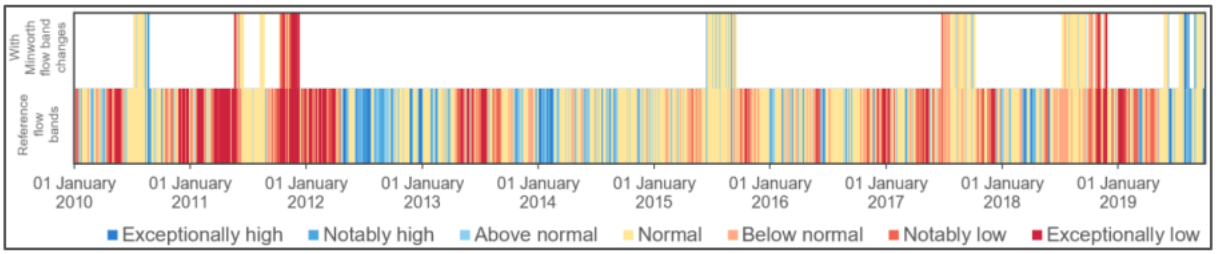
Hydrological assessment is presented for River Tame Location 1 in Figure 12 and for Location 2 in **Figure 13**; and River Trent Location 3 in **Figure 14** and for Location 4 in **Figure 15** - compared with the reference conditions set out in the baseline for this reach.

Figure 12: Location 1, River Tame upstream of the River Anker confluence, Minworth / Combined (215 Ml/d) scheme in the 10-year study period compared with reference conditions



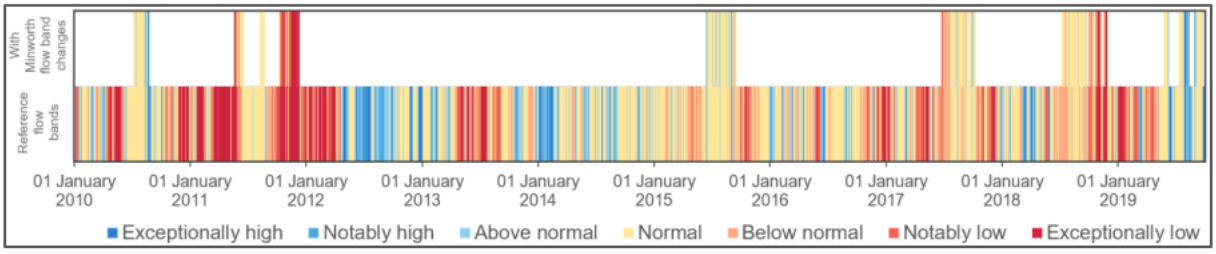
For the Minworth / Combined (215 Ml/d) scheme for Location 1, on 2,794 dates in the 10 year period, (78.4%), the same flow band would be retained, while 687 dates (19.2%) would result in change by one flow band, and 79 dates (2.2%) would decrease by two flow bands. The number of dates with *exceptionally low* flow in the River Tame in this reach during the study period would increase from 178 dates to 517 dates. Overall in the 10 year period, very low flow Q95 would reduce by 5% from 846 Ml/d to 802 Ml/d; and exceptionally low flow Q99 would reduce by 11% from 705 Ml/d to 625 Ml/d. Overall this is assessed as a major magnitude of flow change at this assessment location.

Figure 13: Location 2, River Tame at Hopwas Bridge, Minworth / Combined (215 Ml/d) scheme in the 10-year study period compared with reference conditions



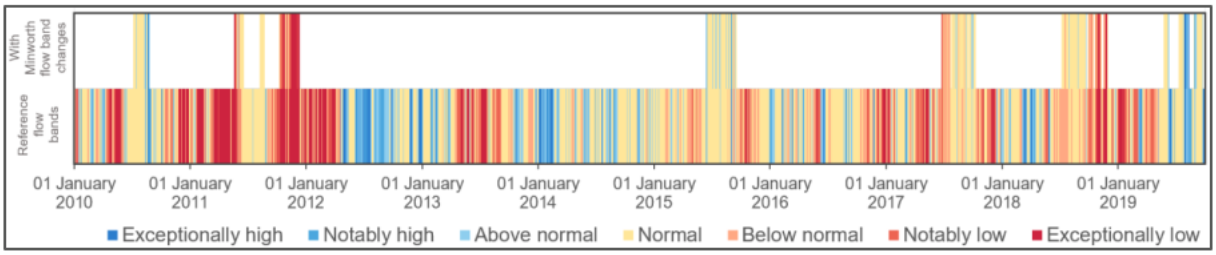
For the Minworth / Combined (215 Ml/d) scheme for Location 2, on 2,842 dates in the 10 year period, (79.8%), the same flow band would be retained, while 632 dates (17.7%) would result in change by one flow band, and 86 dates (2.4%) would decrease by two flow bands. The number of dates with *exceptionally low* flow in the River Tame in this reach during the study period would increase from 178 dates to 657 dates. Overall in the 10 year period, very low flow Q95 would reduce by 5% from 956 Ml/d to 905 Ml/d; and exceptionally low flow Q99 would reduce by 11% from 805 Ml/d to 714 Ml/d. Overall this is assessed as a major magnitude of flow change at this assessment location.

Figure 14: Location 3, River Trent at Drakelow Park, Minworth / Combined (215 Ml/d) scheme in the 10-year study period compared with reference conditions



For the Minworth / Combined (215 Ml/d) scheme for Location 3, on 2,937 dates in the 10 year period, (82.5%), the same flow band would be retained, while 552 dates (15.6%) would result in change by one flow band, and 71 dates (2.0%) would decrease by two flow bands. The number of dates with *exceptionally low* flow in the River Tame in this reach during the study period would increase from 178 dates to 657 dates. Overall in the 10 year period, very low flow Q95 would reduce by 13% from 1,042 Ml/d to 902 Ml/d; and exceptionally low flow Q99 would reduce by 15% from 881 Ml/d to 751 Ml/d. Overall this is assessed as a major magnitude of flow change at this assessment location.

Figure 15: Location 4, River Trent at Shardlow, Minworth / Combined (215 Ml/d) scheme in the 10-year study period compared with reference conditions



For the Minworth WwTW discharge diversion (215 Ml/d) scheme for Location 4, on 3,044 dates in the 10 year period, (85.5%), the same flow band would be retained, while 457 dates (12.8%) would result in change by one flow band, and 59 dates (1.7%) would decrease by two flow bands. The number of dates with *exceptionally low* flow in the River Tame in this reach during the study period would increase from 178 dates to 459 dates. Overall in the 10 year period, very low flow Q95 would reduce by 10% from 1,500 Ml/d to 1,350 Ml/d; and exceptionally low flow Q99 would reduce by 10% from 1,316 Ml/d to 1,184 Ml/d. Overall this is assessed as a major magnitude of flow change at this assessment location.

Indicative flow changes in the study reaches are summarised in **Table 7** listing the WFD water body and assessment of the magnitude of flow change. Downstream of the confluence of the River Derwent

with the River Trent there is a large increase in total flow and hydrological effects have been assessed as minor downstream.

Table 7 Relevant reaches and associated indicative flow changes from operation of the Minworth / Combined (215 Ml/d) scheme

WFD water body	Flow change during operation	Assessed magnitude of flow change
Tame from R Rea to R Blythe (GB104028046841)	-215 Ml/d on occasion	Major
Tame from R Blythe to River Anker (GB104028046440)	-215 Ml/d on occasion	Major
Tame from River Anker to River Trent (GB104028047050)	-215 Ml/d on occasion	Major
Trent - R Tame to R Dove (GB104028047180)	-215 Ml/d on occasion	Major
Trent from Dove to Derwent (GB104028047420)	-215 Ml/d on occasion	Major
Trent from Derwent to Soar (GB104028053120)	-215 Ml/d on occasion	Minor

4.4.3 Water bodies and activities deemed WFD compliant and not passed forward from Level 1 screen

For the Minworth / Combined (215 Ml/d) scheme all operational effects from reduction in discharge flow have been passed forward from the Level 1 screen on precautionary basis. There are no in-river construction activities associated with the scheme.

4.4.4 Water bodies and activities passed forward from Level 1 screen as requiring further consideration

For the gate-1 Minworth / Combined (215 Ml/d) scheme the hydrological assessment identified five WFD river water bodies passed forward from Level 1 screen as requiring further consideration based on major or moderate hydrological effects. Water bodies and relevant activities from the ACWG list and the relevant STT element are summarised in **Table 8**. It is noted that in the ACWG template "Cessation of existing discharge to a watercourse" is listed as a decommissioning activity. In this assessment we are including it as an operational activity and not a complete cessation of discharge.

Table 8 Water bodies and activities passed forward from Level 1 screen as requiring further consideration for the Minworth / Combined (215 Ml/d) scheme

Water body	ACWG listed activity
Tame from R Rea to R Blythe (GB104028046841)	Cessation of existing discharge to a watercourse
Tame from R Blythe to River Anker (GB104028046440)	Cessation of existing discharge to a watercourse
Tame from River Anker to River Trent (GB104028047050)	Cessation of existing discharge to a watercourse
Trent - R Tame to R Dove (GB104028047180)	Cessation of existing discharge to a watercourse
Trent from Dove to Derwent (GB104028047420)	Cessation of existing discharge to a watercourse

5 Summary of Level 2 WFD assessment of Minworth SRO

5.1 Introduction

For the Minworth SRO schemes, the ACWG template Level 2 assessment comprises the following worksheets completed by Ricardo:

- "*4. Assign Level2 WB Impacts*" – these are the specific activities to be assessed per water body. For consistency, these have been selected as those reported in worksheet "2. Level 1 activities" and set out in Section 4 above.
- "*5. Level 2 assessment template*" – a copy of this template has been set out for each of the water bodies carried forward to the Level 2 assessment and these are renamed as the water body ID code.

A third worksheet "6. Level 2 summary" is auto-generated by the template to summarise the per water body level 2 assessments.

Using the information presented in the spreadsheets, a narrative description of the WFD compliance assessment for each scheme is provided below. In particular, the narrative provides information on the confidence in the assessment – the data confidence and the design certainty. Where the assessment reports the potential for WFD objective non-compliance, additional mitigation actions that may reduce this potential and lead to WFD compliance is indicated in the narrative summary.

5.2 Minworth / GUC (100 Ml/d) Scheme

The Minworth / GUC (100 Ml/d) scheme has been assessed as with the potential to not comply with WFD objectives. As summarised in **Table 9** this is in five specific water bodies.

Table 9 WFD compliance assessment summary for the Minworth / GUC (100 Ml/d) scheme

Water body	WFD compliant against assessed WFD objectives	Potential non compliant issue
Tame from R Rea to R Blythe (GB104028046841)	No Low confidence	• Fish (Objective 1 status deterioration) • Macroinvertebrates (Objective 1 status deterioration) • Dissolved oxygen (Objective 1 status deterioration) • Ammonia (Objective 1 status deterioration)
Tame from R Blythe to River Anker (GB104028046440)	No Low confidence	• Fish (Objective 1 status deterioration) • Macroinvertebrates (Objective 1 status deterioration) • Dissolved oxygen (Objective 1 status deterioration or Objective 2 introducing impediments) • Ammonia (Objective 1 status deterioration)
Tame from River Anker to River Trent (GB104028047050)	No Low confidence	• Fish (Objective 1 status deterioration) • Macroinvertebrates (Objective 1 status deterioration or Objective 2 introducing impediments) • Dissolved oxygen (Objective 1 status deterioration) • Ammonia (Objective 1 status deterioration)
Trent - R Tame to R Dove (GB104028047180)	No Low confidence	• Fish (Objective 1 status deterioration or Objective 2 introducing impediments) • Macroinvertebrates (Objective 1 status deterioration or Objective 2 introducing impediments) • Dissolved oxygen (Objective 1 status deterioration) • Ammonia (Objective 1 status deterioration)
Trent from Dove to Derwent (GB104028047420)	No Low confidence	• Fish (Objective 1 status deterioration) • Macroinvertebrates (Objective 1 status deterioration or Objective 2 introducing impediments)

Water body	WFD compliant against assessed WFD objectives	Potential non compliant issue
		• Dissolved oxygen (Objective 1 status deterioration or Objective 2 introducing impediments) • Ammonia (Objective 1 status deterioration)

5.3 Minworth / STT (115 Ml/d) Scheme

The Minworth / STT (115 Ml/d) scheme has been assessed as compliant with WFD objectives.

Hydrological effects of discharge reduction from Minworth WwTW on the downstream River Tame were assessed as minor negative flow effect. In this context and with the assumption at gate-1 of the same water quality discharged the assessment is of compliance with WFD objectives, with medium confidence on account of the evidenced magnitude of flow change.

5.4 Minworth / Combined (215 Ml/d) Scheme

The Minworth / Combined (215 Ml/d) scheme has been assessed as with the potential to not comply with WFD objectives. As summarised in **Table 10** this is in five specific water bodies.

Table 10 WFD compliance assessment summary for the Minworth / Combined (215 Ml/d) scheme

Water body	WFD compliant against assessed WFD objectives	Potential non compliant issue
Tame from R Rea to R Blythe (GB104028046841)	No Low confidence	• Fish (Objective 1 status deterioration) • Macroinvertebrates (Objective 1 status deterioration) • Dissolved oxygen (Objective 1 status deterioration) • Ammonia (Objective 1 status deterioration)
Tame from R Blythe to River Anker (GB104028046440)	No Low confidence	• Fish (Objective 1 status deterioration) • Macroinvertebrates (Objective 1 status deterioration) • Dissolved oxygen (Objective 1 status deterioration or Objective 2 introducing impediments) • Ammonia (Objective 1 status deterioration)
Tame from River Anker to River Trent (GB104028047050)	No Low confidence	• Fish (Objective 1 status deterioration) • Macroinvertebrates (Objective 1 status deterioration or Objective 2 introducing impediments) • Dissolved oxygen (Objective 1 status deterioration) • Ammonia (Objective 1 status deterioration)
Trent - R Tame to R Dove (GB104028047180)	No Low confidence	• Fish (Objective 1 status deterioration or Objective 2 introducing impediments) • Macroinvertebrates (Objective 1 status deterioration or Objective 2 introducing impediments) • Dissolved oxygen (Objective 1 status deterioration) • Ammonia (Objective 1 status deterioration)
Trent from Dove to Derwent (GB104028047420)	No Low confidence	• Fish (Objective 1 status deterioration) • Macroinvertebrates (Objective 1 status deterioration or Objective 2 introducing impediments) • Dissolved oxygen (Objective 1 status deterioration or Objective 2 introducing impediments) • Ammonia (Objective 1 status deterioration)

5.4.1 Potential non-compliance with WFD objectives in the River Tame and downstream River Trent

In the Rivers Tame and Trent there is potential for status deterioration or introducing impediments to target status in five waterbodies. For gate-1 the initial hydrological assessment presented above

identifies a major hydrological influence of the scheme on the downstream Rivers Tame and Trent to the River Derwent confluence with the River Trent. That hydrological assessment is based on an outline operating regime for transfer to GUC SRO and an indicative assessment based on current understanding of operating rules for STT SRO. As such the operating regimes, overlaid on the reference condition flow regimes of the rivers using gauged data identify routine, extended duration significant reduction in late spring, summer and autumn river flows and particularly in low river flows.

Within the identified zone of hydrological influence the WFD compliance assessment has considered the sources and pathways of impact on WFD status elements from this flow reduction. This has been considered alongside the known pressures to target status for each of the five water bodies, as listed by the EA in their published Reasons for Not Achieving Good status (RNAG) assessments. In RBMP2, in each of the water bodies the hydrological regime has been assessed as supporting good status. It is noted that the hydrological regime assessment is itself not a WFD status element. Only in the Trent - R Tame to R Dove water body (GB104028047180) is flow implied directly as a RNAG – through the identification of barriers to fish movement impacting on fish stats. However, as the scheme would change the flow regime in the hydrological zone of influence outside the current envelope of flows, the RNAG is not considered a comprehensive guide to the potential scheme-based impacts on wetted habitat and connectivity.

Noting the hydrological regime changes, the gate-1 assessment considers a prolonged reduction in river flow at times of low river flow is likely to impact on diversity, connectivity and usable area of fish habitat in channel; on wetted habitat characteristics for macroinvertebrates in channel; and lead to redistribution of riparian and in-channel plant communities. This requires further assessment in gate-2, including a review of available information on both the ecological communities and habitats present and the extent of habitat change from flow reduction. As there is the potential for reduction in nutrient concentrations in the study area, from a reduction in continuous treated wastewater contribution – a known RNAG in four of the water bodies – this has been assessed at gate-1 to potentially offset the wetted habitat changes on the macrophytes and phytobenthos combined status element such that that status element is not considered at risk of deterioration or failing to meet target status due to the scheme in gate-1.

The seasonality, duration and extent of hydrological regime changes are considered in gate-1 to have the potential to change in-river physico-chemical processing, due to potential changes in velocity, time of travel, water depth, surface and feature re-aeration. Water temperature and the oxygen cycle are most likely to be potentially directly impacted. In the case of water temperature, this is considered unlikely to affect WFD status itself. To be assessed further in gate-2.

Potential for water temperature, dissolved oxygen and ammonia quality reductions, from change in river processes and additionally from reduction in buffering capacity for both continuous and intermittent water quality pressures known in this water body. To be assessed further in gate-2.

Prolonged reduction in river flow at times of low river flow considered likely to impact on wetted habitat characteristics for macroinvertebrates in channel. Potential for dissolved oxygen and ammonia quality reductions, from change in river processes and additionally from reduction in buffering capacity for both continuous and intermittent water quality pressures known in this water body. To be assessed further in gate-2.

The prolonged reduction in river flow, particularly at times of low river flow, has been considered at gate-1 to associate with a reduction in buffering capacity for downstream continuous and intermittent water quality pressures. The RNAG assessment identifies continuous and/or intermittent water quality pressures as impacting on RBMP2 target status for macroinvertebrates in four of the five water bodies. Only in the Trent from Dove to Derwent water body (GB104028047420) are macroinvertebrates reported as Good status in RBMP2. To be assessed further in gate-2.

6 Conclusions and recommendations

The three Minworth SRO Schemes set out for gate-1 have each been assessed using the ACWG guideline for WFD compliance assessments. In each case the ACWG template has been completed.

Conclusion on Minworth / GUC (100 Ml/d) scheme is potentially not compliant with WFD objectives, subject to further development of operating rules, together with a research programme in gate-2. That research programme should include habitat and ecological information review, gap analysis and additional bespoke aquatic habitat assessment; water quality gap analysis, water quality monitoring and water quality modelling in gate-2. A draft task list is included in **Table 11** based on the gap analysis report[11].

The assessment identified WFD compliance for the Minworth / STT (115 Ml/d) scheme. There is medium confidence in the WFD compliance assessment of the Minworth / STT (115 Ml/d) scheme, supported by bespoke hydrological assessment in the STT SRO gate-1 documentation which identified only minor hydrological impacts in the River Tame..

The Minworth / Combined (215 Ml/d) scheme is potentially not compliant with WFD objectives, subject to further development of operating rules, together with a research programme in gate-2. That research programme should include habitat and ecological information review, gap analysis and additional bespoke aquatic habitat assessment; water quality gap analysis, water quality monitoring and water quality modelling in gate-2. A draft task list is included in **Table 11** based on the gap analysis report[11].

Table 11 Draft Task list to support WFD compliance assessment in gate-2

Listed gap or limitation	Recommendations for further work to inform impact assessment
Lack of a comprehensive hydraulic model of the Tame, Trent and Humber river system	Further hydraulic modelling in specific targeted areas, as informed by baseline assessment, could be considered to inform the potential impacts identified in other topics.
Water quality modelling incomplete	Use software such as SAGIS to predict potential changes in Physico-chemical status as a result of potential changes in water quantity.
Hydro-ecological modelling/ecological impact modelling	Use hydro-ecological tools and ecological indices to predict potential changes in Ecological status/potential as a result of potential changes in water quantity.
2D hydraulic modelling and associated topographic and bathymetric surveys.	2D modelling, requiring recent topographic and bathymetric survey data, is recommended to identify the impacts of each scheme on essential supporting habitats in the study area.
Habitat surveys.	Habitat surveys are recommended for corroborating aerial imagery assessments and anecdotal information on essential supporting habitats.
Unknown sensitivity of aquatic species in study area to potential environmental changes	Undertake a detailed appraisal of WFD biotic indices and aquatic species data to better understand the aquatic ecological sensitivity to changes potentially resulting from the schemes.

[11] AECOM Ltd (2021) Tame Trent and Humber HEE (Hydrology, Ecology and Environment) Baseline Assessment: Data collation, literature review, stakeholder engagement and gap analysis Summary Report. Produced for Affinity Water in association with Anglian Water and Severn Trent Water

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