ANNEX B3.1

Environmental Assessment: Minworth and SLR Overall Report

Minworth SRO

Severn Trent Water & Affinity Water

Environmental Assessment for the Tame and Trent Strategic Resource Options (SRO)

Minworth SRO and South Lincolnshire Reservoir (SLR) SRO Results and Recommendations

Affinity Water, Anglian Water Services Ltd and Severn Trent Water Ltd

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1. Executive Summary

This report summarises the environmental assessments and recommendations for the Minworth and South Lincolnshire Reservoir (SLR) Strategic Resource Options (SRO), undertaken in 2021 and 2022 on behalf of Affinity Water, Anglian Water Services Limited, and Severn Trent Water Limited. Each topic assessment is summarised, including any links and interdependencies between them, any gaps, or limitations to the assessment, and any recommendations for further work for Gate 3.

This report assesses the impact of up to 230 Ml/d reduction of discharge from Minworth WwTW, which currently discharges a Dry Weather Flow of 417 Ml/d, separately and in-combination with potential abstraction of up to 300 Ml/d from the Trent for the SLR. The assessment supports concept design and scheme environmental assessment for Gate 2, investigating the environmental risks and opportunities associated with scheme delivery.

This report is supported by detailed technical appendices covering the following topic areas: SSSI Interaction; Ecology; River Mease Special Area of Conservation (SAC); Invasive Non-Native Species (INNS); Sedimentation; and Non-water resources benefits (Biodiversity Net Gain and Natural/Social Capital).

The environmental assessments are supported by an industry-wide precedent search of examples of direct and indirect water reuse internationally. The scale and complexity of the Minworth and SLR SROs, while superficially similar to some of the identified existing schemes in the UK or abroad, are sufficiently unique to necessitate a bespoke approach with regard to their assessment, although some lessons can be learned from other schemes.

The key outcomes of the environmental assessments are as follows, with further recommendations made for continuing assessment or the exploration of mitigation options as appropriate:

SSSI Interaction

The Minworth and SLR SROs are not anticipated to have a significant effect on water levels at the SSSIs along the tidal River Trent. No SSSI water features are considered to be at risk of impacts from transmission of changing river levels via groundwater level impacts. Of all the SSSIs investigated the River Blythe SSSI may be at risk due to lower water levels due to direct transmission via the River Tame and lower River Blythe. These effects are considered as part of fish passage assessment, which found no significant risk.

Further assessment is recommended at Gate 3 to investigate the continued connectivity of designated sites to the Rivers Tame and Trent, in particular during high flows and flood events.

Ecology

Twenty-six floodplain locations and riparian habitats were identified with potential to support sensitive wetland habitats and subjected to ground truthing surveys. Six wetland habitat types were recorded, with some sites of particular importance for wetland birds. Hydraulic model results show that changes in river level, depth, and wetted perimeter are very minor and only prevalent during extreme low flows, with effects rapidly diminishing downstream.

Although no significant effect on river baseflow levels on surface water features which sustain wetland habitats and species are predicted, there are opportunities for habitat creation or enhancement for these habitats and species, as well as ensuring connectivity of designated sites and habitats to the River Tame and River Trent.

An aquatic ecological assessment of fish passage and Water Framework Directive status was completed. Hydraulic modelling indicates that flow reductions may negatively affect fish passability due to the head drop at weirs, that may also reduce the efficacy of existing fish passes. Targeted 2D modelling is underway to further investigate these effects. WFD assessment will be further refined at Gate 3, including the effects on water quality and hydrological regime.

River Mease SAC

The removal of wastewater effluent from Packington WwTW and Measham WwTW will return flows to a natural state that fall within CSMG target flows and flows and levels in the lower River Mease are not anticipated to be influenced by changes in River Tame levels.

Habitats Regulations Assessment of the River Mease SAC concludes that the Minworth SRO will not result in a likely [adverse] significant effect on the River Mease SAC or its qualifying interest features either alone or in combination with other plans and projects.

Invasive Non-Native Species (INNS)

INNS assessment utilised the bespoke SRO INNS Assessment Tool to investigate the risks associated with INNS transfer, and of INNS surviving the treatment process at Minworth. There is a low risk associated with Minworth, and of reduced flows in the River Tame from Minworth SRO; there is a high risk associated with the SLR SRO transfer, without any mitigation, which reduces to low risk with mitigation. Recommendations are made for further assessment of potential INNS transfer from the River Trent to the River Witham, together with mitigation measures to inform abstraction from the River Trent.

Sedimentation

Hydraulic model results have been reviewed for flow depths and velocities, in order to provide commentary on sedimentation risks. Further investigation of flood and high flows in relation to sedimentation and riparian connectivity is recommended at Gate 3; however, baseflow reductions are unlikely to significantly affect spate or flood events and are therefore unlikely to significantly affect sediment transport rates. A reduction in depth could expose gravel bed features, which may benefit bed habitat diversity. The SROs present an opportunity to support on-going restoration efforts on the River Tame and the River Trent.

Non-Water Resources Impacts and Benefits

A Six Capitals assessment has been undertaken to understand the impacts and dependencies across the six capitals and infer multi-capital benefits and costs delivered by the implementation of the SROs. It has not been possible to present an overall summary of the value of all scoped-in components based on the current level of available data and information. The findings therefore feed into recommendations for further detailed assessment of flow scenarios at Gate 3.

A preliminary Biodiversity Net Gain Assessment has been undertaken using DEFRA's Biodiversity Metric 3.0. Due to the low levels of impacts predicted from hydrological and hydraulic modelling, post-impact habitat enhancement was forecast across all habitats of a medium to high distinctiveness value. The predicted potential benefit is 11.16% BNG across both Minworth and SLR, but it is expected that each scheme would look to achieve a minimum 10% net gain through local biodiversity opportunities.

A Scoping Checklist provides the requirements for further assessment and mitigation beyond Gate 2, summarising the outcome of each topic assessment, recommendations for further assessment, and appropriate mitigation options, further context and detail of which is presented in each accompanying technical appendix.

2. Introduction

2.1 Background

2.1.1 This report summarises the environmental assessments and recommendations for the Minworth and South Lincolnshire Reservoir (SLR) Strategic Resource Options (SRO), undertaken in 2021 and 2022 on behalf of Affinity Water, Anglian Water Services Limited and Severn Trent Water Limited.

2.1.2 AECOM previously completed the Hydrology, Environment and Ecological (HEE) gap analysis of the River Tame, River Trent and Humber (TTH) system for Gate 1, carried out jointly for Minworth and the South Lincolnshire Reservoir (SLR). Subsequent investigations completed for Gate 2 include baseline Aquatic Ecological Monitoring (May2022), water quality monitoring in the River Tame (June 2022), and Hydrological, Aquator and Hydraulic Modelling of the rivers Tame and Trent (June 2022). The latter is running parallel with these assessments and provides modelling outputs to inform the assessment of potential environmental impacts.

2.1.3 The HEE baseline study for the TTH in support of Minworth and SLR for Gate 1 encompassed 19 in-depth topic reports and an overall summary report to inform further environmental assessment for the SROs.

2.1.4 The Gate 1 work involved considering Water Framework Directive (WFD) related impacts and benefits, baseline ecological data, and in particular the potential impacts of changes in flow to ecological receptors such as designated sites and their qualifying features, protected and notable species, and particular constraints from the presence or future spread of Invasive Non-Native Species (INNS). Other topics assessed were Navigation, Sedimentation, Assets along the Trent, Abstraction and Discharge Licences, Saline Intrusion, Fish Habitats and Migration, Biodiversity Net Gain, Natural and Social Capital, and Soil and Humidity. This scope considered the data gaps and topics that required further detailed assessment at Gate 2, as presented in this report and the accompanying technical appendices.

2.2 Assessment Rationale

2.2.1 This report of results and recommendations collates the assessments from each task, including any links and interdependencies between them, any gaps, or limitations to the assessment (e.g., the availability of supporting information, which would have been established and flagged at an early stage), and any recommendations for further work required to incorporate into further assessment for Gate 3. This will inform the next stage of environmental assessment of the Trent SROs in support of the two related SRO schemes:

- Minworth SRO; and
- South Lincolnshire Reservoir (SLR).

2.2.2 The purpose of the Gate 2 assessment is to assess the impact of the reduction of discharge from Minworth, which currently discharges a Dry Weather Flow (DWF) of 417 Ml/d (as per Concept Design Report CDR, Jacobs 2022), of up to 230 Ml/d. This has been assessed separately and in-combination with the potential abstraction of up to 300 Ml/d (as an absolute maximum) for the SLR SRO. This assessment is critical to supporting concept design and scheme environmental assessment for key SROs at Gate 2.

2.2.3 A key element of the two SROs is to investigate the environmental risks and opportunities associated with delivery of the schemes.

2.3 Objectives

2.3.1 The key objectives of the Gate 2 Environmental Assessments are as follows:

- Build on the work completed in Gate 1 to provide a robust impact assessment of the discharge reduction of up to 230 Ml/d from Minworth to the TTH system and surrounding environment (particularly, connected watercourses e.g., River Mease and connected water dependent habitat), and assess the impact the proposed transfer could have on the flow regime, ecology, habitats etc.
- Build on the work completed in Gate 1 to provide a robust impact assessment of the abstraction of up to 300 Ml/d for the SLR, to the Trent and Humber system and surrounding environment, and assess the impact the proposed transfer could have on flow regime, ecology, habitats etc.
- Define what mitigation measures (Section 5) need to be implemented, in further discussion with regulators, to ensure that the SROs are viable. Any mitigation measures that require engineering solutions such as modification to fish passes or weirs, should be fed back into the Engineering workstream.
- Support engagement with key stakeholders including the Environment Agency (EA), Natural England (NE), Canal and River Trust, Water Resources East, and the River Trent Working Group. This has taken the form of monthly workshops to present findings and/or discuss key themes, risks, or mitigations, site visits to inform the assessment of specific features, data sharing, and regular informal consultation.
- Produce an environmental scoping checklist (Section 5) to ensure identification of the likely significant environmental effects of the proposed projects and ensure all assessments and data collection are completed to support further environmental assessment at Gate 3; for example, to support Environmental Impact Assessment (EIA), if required to do so, in line with regional planning requirements.

2.3.2 This report sets out the preliminary findings of field surveys, monitoring, and desk-based environmental assessments; to drive engagement with relevant regulators and other decision-makers; to agree the survey specifications and locations for any data collection or studies. This covers the following key themes:

- SSSI Interaction;
- Ecology;
- River Mease Special Area of Conservation (SAC);
- Invasive Non-Native Species (INNS);
- Sedimentation; and
- Non-water resources benefits (Biodiversity Net Gain and Natural/Social Capital).

2.4 Environmental Assessment

2.4.1 The outcome of the environmental assessments supports an assessment of the potential impact and changes to the environment and ecology within the River Tame and Trent and associated water bodies and habitats as a result of activity associated with the SROs. This report and supporting appendices detail the assessment and demonstrate a clear line of sight to further environmental assessment at Gate 3. The specific requirements for Gate 3 are not yet known, but are likely to include identifying potential significant effects, and other detailed assessments as set out in the Strategic regional water resource solutions guidance for Gate 2 (RAPID, April 2022[1]):

- Water Framework Directive (WFD) Compliance Assessment;
- Informal Habitats Regulations Assessment (HRA);
- Environmental Appraisal (including Strategic Environmental Assessment (SEA)); and
- Other Environmental Considerations including Biodiversity Net Gain (BNG) and Natural Capital Assessment (NCA).

[1] Regulators' Alliance for Progressing Infrastructure Development (RAPID) (April 2022). Strategic regional water resource solutions guidance for gate two.

2.4.2 The detailed assessments above will be presented separately for each SRO.

2.4.3 The results of the current environmental assessments and supporting technical appendices (refer to Section 3.4) are collated into this single report, supported by technical appendices, informed by regular liaison with the project teams and stakeholder engagement, for incorporation into the Gate 2 submission. This includes the results and recommendations from each topic within the environmental assessment.

2.4.4 The overall approach to the assessment and monitoring specification includes, but is not limited to, the extent of designated sites and Priority Habitats for ground truthing and walkover surveys, the extent of fluvial walkover surveys, and the range of data and supporting information required to support the assessment. This overall report can be read as a standalone document, but the detailed assessments for each topic are presented in the accompanying technical appendices and figures (refer to Section 3.4 for report references).

2.4.5 This overall report forms the basis of a final single report deliverable, the focus of which is as follows:

i. Results and recommendations from each topic assessment;

ii. A detailed assessment of the potential impacts and changes to the environment and ecology within TTH system, including associated water bodies, habitats, and species, as a result of activities associated with the SROs (refer to each technical appendix for figures illustrating the spatial scope of the assessments);

iii. The single report deliverable will support subsequent assessment for RAPID Gate 2;

iv. Ensure a clear line of sight toward future environmental assessment and any additional planning requirements, e.g., HRA, SEA, WFD compliance assessment, etc. This will include identifying receptors to potential impacts, the likely extent, scale, and significance of impacts according to industry standards, and preliminary recommendations for appropriate mitigation;

v. A key component of the final report will be an environmental scoping checklist to identify and grade likely significant environmental effects, to form the basis of and inform future environmental assessment at Gate 3;

vi. Clear identification of any gaps and limitations in the assessment, which would have been identified and discussed with the Clients and stakeholders at an early stage.

2.5 Assessment Scenarios

2.5.1 Assessment of different scenarios for operation of the SRO schemes will be undertaken. This is based on the likely seasonal operation and operational regime requirements for the Minworth transfers and SLR abstraction, summarised as detailed in the sections below.

Minworth SRO

2.5.2 The Minworth SRO supports two options for transfer of final effluent, resulting in corresponding reductions in the discharge of effluent to the River Tame. These are transfer to the Grand Union Canal (GUC) SRO, and transfer to the River Avon for the Severn to Thames Transfer (STT) SRO. This is currently divided into the following volume options:

- 57 Ml/d (Megalitres per day) discharge to GUC SRO;
- 115 Ml/d discharge to GUC SRO;
- 57 Ml/d discharge to River Avon for STT SRO;
- 115 Ml/d discharge to River Avon for STT SRO; or
- Combined 230 Ml/d transfer to both River Avon and GUC (115 Ml/d to each).

2.5.3 Therefore, the current approximately 417 Ml/d (DWF) discharge of final treated effluent from Minworth would reduce by a maximum of 230 Ml/d as an absolute worst-case scenario. However, the total 230 Ml/d reduction is very unlikely to happen in the next 25 years; STT is selected in the 2040s at the earliest, with a phased approach with Minworth third-in-line for the supply hierarchy.

GUC Transfer

2.5.4 For GUC transfer, current modelling suggests that the full volume (115 Ml/d) would only be required in extreme drought conditions in the Affinity Water area (likely close to Q99 flows) – and not necessarily the same drought conditions in the Severn Trent Water area. This would be for Affinity Water supply and is where hosepipe and non-essential use bans would take effect. In most dry years it would only be run at 80% (92 Ml/d) but only for summer months during peak demands; and for normal years around 25% (28.75 Ml/d). It is considered that in most drought years the GUC scheme would operate less than 80% because hosepipe bans, and non-essential-use bans would kick in and reduce demand accordingly.

2.5.5 The GUC transfer is demand-driven except in the most extreme drought years when hydrological constraints (groundwater levels) also take effect. Operation of the GUC scheme is not constant and the environmental assessment should take into account this likely frequency and scale of operation, as summarised in the bullet points below:

- Full utilisation expected in the summer months to cope with increased summer peak demands;
- Most dry years, GUC will run at 80% capacity (92 Ml/d);
- 25% (28.75 Ml/d) utilisation October-April (inclusive);
- May: 50% utilisation (57 Ml/d) to ramp up to June-Aug c. 80% utilisation;
- September dropping to 50% utilisation.

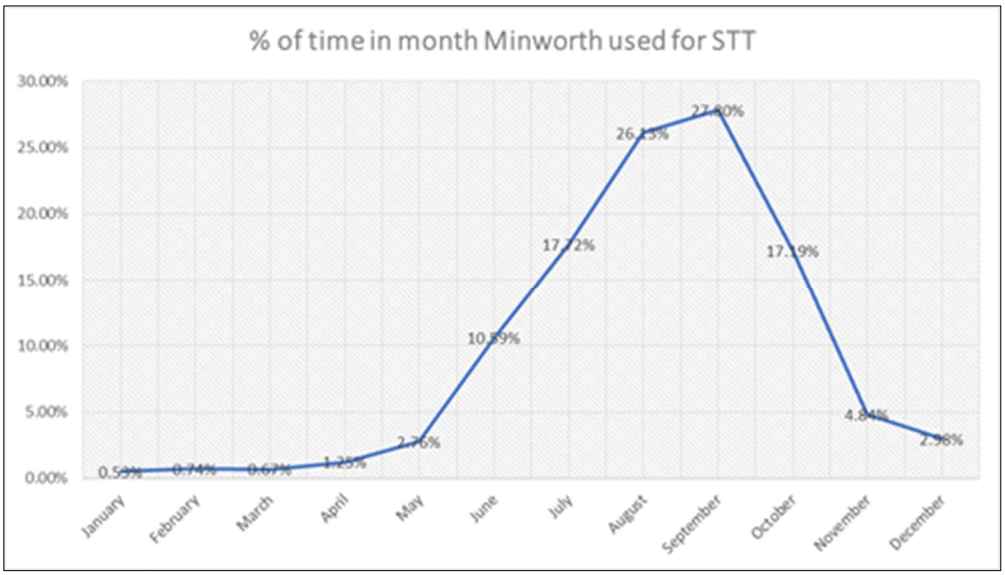
2.5.6 Further detail of the proposed operational regime of the Minworth SRO is presented in Table 1.

Severn to Thames Transfer (STT)

2.5.7 Minworth will support the Severn to Thames Transfer as required, alongside supply from other sources – Lake Vyrnwy reservoir (Powys, Wales) releases and Netheridge Sewage Treatment Works (STW). Netheridge STW serves the city of Gloucester, currently discharging final effluent to the River Severn.

2.5.8 The likely frequency of use of the Minworth transfer for STT (based on when the transfer will be required, not on a particular volume scenario) has been modelled as a percentage of time used over the 90-year record, as shown in Figure 2-1.

Figure 2-1: STT modelled utilisation, percentage of time



2.5.9 Modelled STT utilisation is based on a 500 Ml/d transfer between the Severn and the Thames (although it is likely that there will be no limit on abstraction during spate), with a maximum of 300 Ml/d coming from supported sources, i.e., Lake Vyrnwy, Netheridge STW, and Minworth. Peak transfer from Minworth (112 Ml/d – the current maximum that would be required based on the modelled scenarios [Jacobs]) would only be required 9% of the time over the 90-year period; otherwise Minworth is currently predicted to only rarely support STT.

SLR SRO

2.5.10 The SLR SRO includes an option for abstraction from the River Trent to the River Witham, supported by further abstraction from the River Witham downstream. The Trent transfer has a maximum capacity of 300 Ml/d, with abstraction subjected to the Hands-off Flow (HoF) on the River Trent – when the HoF level is reached, abstraction will cease (SLR will cease abstraction when the HoF kicks in; the SLR will not operate at Q95 flows in the Trent). The Trent transfer will support the SLR when there is insufficient flow in the River Witham if there is sufficient flow in the River Trent.

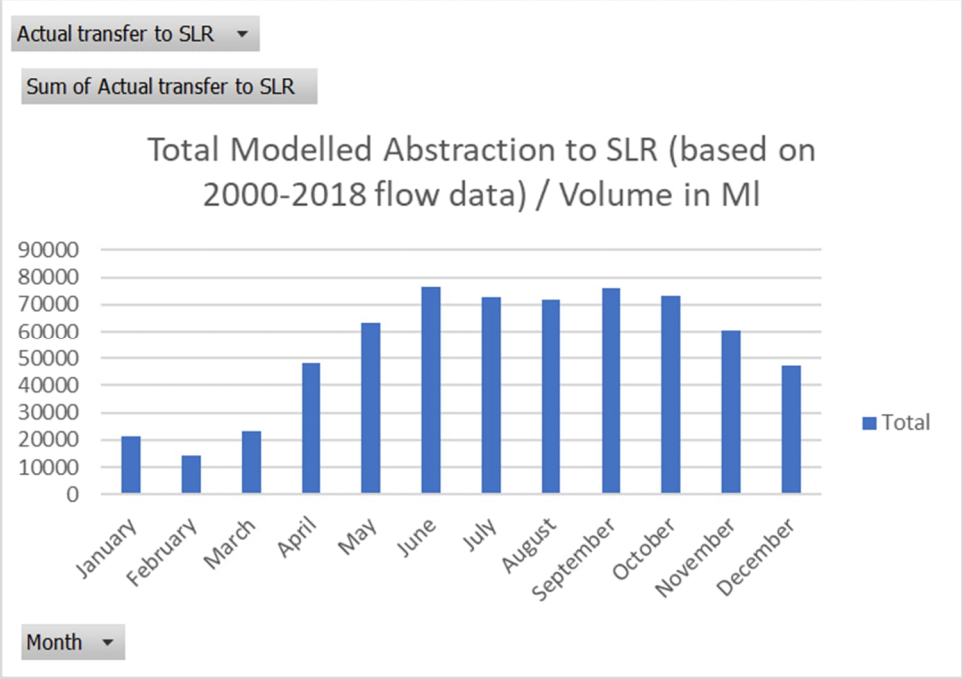
2.5.11 Modelled data shows that, based on measured flows between 2000 and 2018, peak abstractions would occur between June and October, as shown in Figure 2. During this period, the upper range of abstraction (250-300 Ml/d) will only be reached on a limited number of occasions, as follows:

- In June, abstraction will reach 250-300 Ml/d for 7.5% of all days;
- In July, abstraction will reach 250-300 Ml/d for 19.5% of all days;
- In August, abstraction will reach 250-300 Ml/d for 17.7% of all days;
- In September, abstraction will reach 250-300 Ml/d for 21.6% of all days; and
- In October, abstraction will reach 250-300 Ml/d for 28.0% of all days.

2.5.12 At Gate 2 this modelled utilisation has been used to inform hydraulic modelling, which has taken into account cumulative impacts due to the interaction of Minworth and SLR. This will be explored in further detail at Gate 3.

2.5.13 Further analysis is being undertaken to understand the abstraction regime for SLR, and hydraulic and hydrologic modelling is being undertaken to determine the likely impacts of this regime on levels in the River Trent.

Figure 2-2: Modelled abstraction from Trent for SLR



2.5.14 In summary for SLR:

- Trent transfer will support the SLR when there is insufficient flow in the River Witham, and when there is sufficient flow in the Trent;
- Peak abstractions will occur between June and October;
- During this period, the upper range of abstraction (250-300 Ml/d) will only be reached on a limited number of occasions, e.g., 7.5% of all days in June; 28% of all days in October;
- SLR will cease abstraction when the HoF kicks in; the SLR will not operate at Q95 flows in the Trent. Abstraction for SLR ramps down when flow levels approach the HoF, and once the HoF is reached it ceases, to ensure that there remains sufficient flow in the Trent for navigation and other abstractors.
- In terms of the relationship between the River Witham and the Trent, when flow is high in the Witham, it's also likely to be high in the Trent, so peaks of flow in the Trent will continue to occur because the Witham is the primary source for the SLR.

2.5.15 A summary of the operational regime of the Trent transfer for SLR is provided in Table 2-1 below.

Table 2-1: Operational regime of the Minworth and SLR SROs

Operation / Seasonality	Minworth GUC Transfer (based on current modelled utilisation)	Minworth STT Transfer (based on current modelled utilisation)	SLR Trent Transfer (based on transfer from Trent at North Muskham) *
Winter / Autumn – during periods of moderate to high flow	September to April Outside of the summer months (May to August) this will mostly operate at 25% capacity (around 27 Ml/d)	November to May Lake Vyrnwy and Netheridge are prioritised to supply STT up to 188 Ml/d. Minworth, being third-in-line in the supply hierarchy, is rarely used to support STT.	Lower supply demand between September and November; and March to April. Peak of lowest abstraction range (0-50 Ml/d) between December and March; i.e., when utilisation is modelled to be lowest. Lowest abstractions between February and March: 82.9% of abstractions in this period are between 0-50 Ml/d; 57.6% of abstractions in this period are 0 Ml/d.
Summer – during periods of low flow	May to August During summer this will increase up to 80% (around 92 Ml/d) but only during dry years. During extreme dry years (> 1 in 50-year drought) this may increase in the summer to the full transfer of 115 Ml/d.	June to October Peak transfer from Minworth (112 Ml/d) would only be required 9% of the time over the modelled 90-year period.	Peak of supply demand between June and August. Peak of abstraction (250-300 Ml/d) between June and October: 10.6% = 300 Ml/d.
Activation of Trent HoF	During extreme dry years (> 1 in 50-year drought) this may increase in the summer to the full transfer of 115 Ml/d, and therefore consideration will need to be given to its contribution to HoF in the Trent (under all scenarios).	Consideration will need to be given to contribution to HoF in the Trent, in combination with GUC and SLR.	SLR will cease abstraction when the HoF kicks in; therefore, minimising cumulative effects of Minworth and SLR.
Additional operational requirements	Additional treatment will be installed at Minworth to ensure that effluent quality is of a suitable standard to be transferred to the River Avon and GUC. This will be a combination of CoMag flocculation and settlement, ozonation, BAC/GAC, and UV disinfection. Some effluent treated to this higher standard will be returned to the River Tame when not required for GUC and/or STT.		There will be days where the Trent won't be able to supply the SLR as required – this is based on flow stopping at the HOF and being reduced from around Q90 in the Trent. Therefore, the SLR will not operate at Q95 flows in the Trent. It will be seasonally variable.

* Trent transfer prediction based on modelled utilisation for 2000-2018

The utilisation profiles are based on current modelling for the SROs as of May 2022 and may change as the design of each scheme progresses.

3. Scope and Approach

3.1 Introduction

3.1.1 This section sets out the approach to Environmental Assessment of the Minworth and SLR SRO schemes, informed by RAPID guidance for Gate 2 and on-going stakeholder engagement.

3.2 Projects and Work Completed to Date

3.2.1 Key findings and recommendations from the TTH baseline assessment for Gate 1 included:

- Identification of ecologically sensitive designated sites, Priority Habitats, protected/notable species, hydro-geomorphological features, WFD statuses.
- Recommendations to complete and maintain the baseline assessment, inform subsequent impact assessment, and data refresh.
- AECOM is now undertaking follow-on work to inform Gate 2, including macroinvertebrate, macrophyte, River Habitat Surveys (RHS), Invasive Non-Native Species (INNS) surveys, Water Quality monitoring, and Hydrological, Aquator and Hydraulic Modelling of the rivers Tame and Trent.

3.2.2 The desk-based assessments to date (i.e., at Gate 1) involved contacting statutory and local bodies, scientific literature databases, with data sources listed.

3.2.3 Gate 1 Reports set out the literature review and baseline information for each topic, including data gaps/recommendations, links to the consistent methodology (including SEA framework) currently being developed for the environmental assessment of SROs. This helped to demonstrate to regulators and stakeholders that the evidence effectively informed the strategic assessments.

3.2.4 These reports critically evaluated the information gathered and identified gaps in knowledge, reviewed areas of uncertainty or conflicting opinion, and formed the basis for further environmental investigation and impact assessment, including recommendations for the next stages (Gate 2) of the assessment process, as informed by stakeholder/Regulator review and feedback on the Gate 1 reports.

3.3 Desk-Based Review

3.3.1 A comprehensive international desk-based review of available data and literature has been undertaken (see Section 4.2), to establish whether there is any precedent in the UK or abroad for the redirection of discharge from a WwTW. In addition, it was undertaken to understand if there were any associated effects (technically, socially, politically, environmental) on the depleted reach of the receiving watercourse and what criteria had to be met to allow this diversion.

3.3.2 A key part of this study is to identify the potential effects of the abstractions for the SLR and Minworth on this watercourse and surrounding environment. This will allow potential significant effects to be scoped in for further assessment post-Gate 2, e.g., for HRA consideration.

3.3.3 There are likely to be relevant examples both within and outside the water industry, for example large abstractions for the power industry, agriculture, or for renewable energy. Only examples that are relevant to inform the specific assessment for the Minworth and SLR SROs have been used, to identify specific scenarios where robust environmental assessment has been completed to satisfy regulatory and legislative requirements.

3.3.4 It is worth noting that the regulatory regime internationally is often very different, and potentially less stringent, than that in the UK. Therefore, the level of environmental assessment for similar schemes internationally may not be representative of the requirements in the UK, and this will be borne in mind throughout our assessment process.

3.4 Scope of Field Surveys, Monitoring and Desk-Based Environmental Assessments

3.4.1 Critical to the assessment is the requirement to liaise with stakeholders and Regulators to agree the monitoring specification and purpose of the on-going assessment. This has been an on-going and iterative process through regular engagement, and consideration of each stage of the assessment as it progresses, and as more information becomes available.

3.4.2 Through the assessments for the TTH baseline study, it was noted that constraints and limitations may be encountered, for example due to the availability and completeness of available data. Therefore, it has been critical to engage stakeholders/Regulators at each stage to address potential concerns, and tailor the assessment methodology to maximise the benefits of available data and information. This is critical to ensure the success of the assessment through Gate 2.

3.4.3 The outcomes of the Gate 1 baseline assessment and outputs of parallel monitoring and modelling work also underway have been used to support the large-scale environmental assessment.

3.4.4 The scope and methodology for each theme of the Gate 2 assessment is set out below. The detailed assessments for each theme are provided in the accompanying technical appendices, referenced as follows:

a. Appendix A SSSI Interaction: 60669746_REP_003_App-A_SSSI_V4; Annex B3.1.1
b. Appendix B(i) Terrestrial Ecology: 60669746_REP_003_App-B(i)_Ecology_V5; Annex B3.1.2 B(i)
c. Appendix B(ii) Aquatic Ecology: 60669746_REP_003_App-B(ii)_Aquatic-Ecology_V4 Annex B3.1.2 B(ii)
d. Appendix C River Mease SAC: 60669746_REP_003_App-C_River Mease SAC_V4; Annex B3.1.3
e. Appendix D Invasive Non-Native Species: 60669746_REP_003_App-D_INNS_V4; Annex B3.1.4
f. Appendix E Sedimentation: 60669746_REP_003_App-E_Sedimentation_V4; Annex B3.1.5
g. Appendix F Non-Water Resources Benefits: 60669746_REP_003_App-F_Nat Cap BNG_V4; Annex B3.1.6

3.5 SSSI Interaction

Objectives

3.5.1 Key objectives for the SSSI assessment, as identified by the Client and agreed in consultation with NE, the EA and local wildlife trusts, are as follows:

- Build on the work completed in Gate 1 to provide a robust impact assessment of the discharge reduction from Minworth in to the TTH system and surrounding environment (particularly, SSSIs and interaction with SSSIs), and assess the impact the proposed transfers could have on these designated sites.
- Build on the work completed in Gate 1 to provide a robust impact assessment of the abstraction of up to 300Ml/d for the SLR, to the TTH system and surrounding environment and assess the impact the proposed transfer could have on SSSIs.
- Define what mitigation measures need to be implemented to satisfy regulators that the SROs are viable (Section 5). Any mitigation measures that require engineering solutions such as modification to fish passes or weirs, should be fed back into the Engineering workstream.
- Support engagement with key stakeholders including the Environment Agency, Natural England, Canal and River Trust, Water Resources East, and the River Trent Working Group. This has taken the form of monthly workshops to present findings and/or discuss key themes, risks, or mitigations, and site visits to inform the assessment of specific features.

SSSI Interaction - Scope of Assessment

3.5.2 The Minworth SRO will result in a reduction to the existing discharge from Minworth treatment works into the rivers Tame and Trent, when required to supply either the STT or GUC transfer, or both. Otherwise, the sweetening flow running through the enhanced treatment would supply improved quality effluent to the River Tame. The separate SLR SRO will abstract up to 300 Ml/d from the River Trent with an indicative location upstream of Cromwell Weir, close to East Stoke.

3.5.3 The Gate 1 baseline assessment prioritised SSSIs based on water dependency, likely water level, flow, and ecological impacts. This involved identifying proximity of sites close to the Rivers Tame and Trent, their ecological sensitivity, and whether they are over aquifers or within flood zone 3, and whether the Cranfield University soil data implies greater humidity and soil moisture levels.

3.5.4 The potential for significant impacts of the Minworth SRO have been identified using the same approach as that used for the SLR SRO (refresh and widen data searches/requests, development of SSSI conceptual models, site walkovers and development of the scoping checklist).

Stakeholder engagement

3.5.5 Natural England and the Environment Agency have been involved in the assessment process from the outset at Gate 1 and have contributed to the methodology described herein.

3.5.6 Site walkover surveys were organised with the intention to involve all relevant stakeholders, however due to the reporting schedule it was only possible to visit Attenborough Gravel Pits with stakeholders: Natural England and Nottinghamshire Wildlife Trust.

3.5.7 Workshops with Natural England and the Environment Agency have been conducted throughout the collation of the SSSI baselines and development of the conceptual models at each site, with the addition of the Tame Valley Wetlands with regard to SSSIs along the River Tame.

3.5.8 Stakeholders would be engaged to determine further monitoring requirements and potential mitigation measures for likely significant effects, where these are identified.

Priority SSSIs

3.5.9 In the Gate 1 study the SSSIs downstream of the Minworth discharge along the rivers Tame and Trent were classified to identify priority sites for consideration at Gate 2.

3.5.10 Sites that are within 100m of the River Tame / Trent and within flood zone 3, or associated with a highly productive aquifer, are assumed to have the greatest potential to be impacted by the proposed SROs with respect to soils and humidity; these are identified in Appendix A.

3.5.11 The second highest category of potential impact includes sites within 500m of the rivers Tame / Trent within flood zone 3, associated with higher productivity aquifers, with higher ecological sensitivity scores (>3), and naturally wet soils; these sites are shaded Amber.

3.5.12 These SSSIs are presented in Table 2.1, Appendix A, together with the detailed baseline and impact assessment. A summary of the findings is in Section 4 of this report.

3.5.13 At Gate 2 the objective was to develop a conceptual model for each SSSI as detailed as possible with the available information, to determine the relative importance of groundwater and surface water inflows to the SSSI, groundwater-surface water interactions, and how water moves through the SSSI, including whether any water level management occurs.

3.5.14 Refer to Appendix A for detailed methodology for the SSSI assessment.

3.6 Ecology

Objectives

3.6.1 The following Gate 2 project topic objectives were identified by the Client for Ecology:

- *Obtain site management/restoration plans for statutory designated sites from NE / LPA.*

- *Carry out impact assessment in relation to the SRO on those designated sites or areas of habitat to high ecological sensitivity. Through engagement with local EA, we will cover locally designated sites and priority habitats where necessary.*
- *Assess where information on designated sites may be out of date owing to a lack of current data and ensure all sites have been included through engagement with National Appraisal Unit (NAU) and Natural England (NE). Ground-truthing Phase 1 Habitat or National Vegetation Classification (NVC) surveys to assess the current condition of designated sites where citations and assessments are believed to be out of date. We will work with NE, so they have sight of proposed survey locations and survey levels proposed.*
- *Targeted ecological walkover surveys on wetland priority habitats to identify the importance of these habitats for avian species in relation to designated sites, dependent species and migratory species.*
- *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 SRO scheme.*
- *Investigation of the distribution and abundance of riparian species, notably otter and water vole, would be beneficial in identifying sensitive riparian habitats, and informing future mitigation requirements.*
- *What impact could reduced flows during lower flow events have on the functionality of the fish passes already present? Do lower flows for an extended period impact the ability of fish to move upstream through the fish passage/impact certain species. Some consideration should be given to this. (Anglian Water have undertaken EIA's on R. Trent abstractions for drought permits which could provide useful context here).*

Ecological Assessment for Gate 2

Terrestrial Ecology

3.6.2 In order to inform the ecology assessment at Gate 2 further baseline information has been obtained about the study area (the Tame and Trent system, as defined and scoped at Gate 1) to fill the gaps previously identified at Gate 1. This has included liaison with Natural England and the Environment Agency. Site management/restoration plans for statutory designated sites not obtained during Gate 1 have been sourced where available, as have historic management plans and documents pertaining to designated sites and habitats.

3.6.3 During Gate 1, a total of 15 statutory and 44 non-statutory designated sites of high ecological sensitivity to the proposed SRO schemes were identified (see Annex A.1).

3.6.4 Following engagement with NE and the EA (via the National Appraisal Unit NAU), where information about the condition of habitat types/plant communities at the designated sites is missing or has not been recorded since 2012, site visits have been undertaken. Site visits, where possible, have been undertaken between May and July 2022, when most plant species will be evident to determine which NVC plant communities are present. Where information on site condition is considered a limiting factor to the Gate 2 assessment, preliminary ground truthing surveys to ascertain extent of sensitive wetland habitats have been undertaken at 26 sites (see section 2.13) prior to May 2022 in order to prioritise data to inform the assessment.

3.6.5 During this Gate 2 assessment the designated sites and water-dependent habitats identified during the Gate 1 desk-top assessment were reviewed. A total of 26 floodplain locations within 500m of the Rivers Tame and Trent (hereafter referred to as the Study Area for the purposes of the terrestrial ecology assessment), were identified with potential to support sensitive wetland habitats from aerial imagery and then subject to preliminary ground truthing survey visits during winter or spring 2021/22; refer to Appendix B(i) for a list of sites and survey dates.

3.6.6 At each of the 26 designated sites, wetland habitats were mapped in accordance with UKHab (which aligns habitat classification for the Defra Metric 3.0 Biodiversity Net Gain [BNG] assessment – refer to Appendix F, Non-Water Resources Benefits). The following wetland habitat types were recorded during the preliminary ground-truthing survey sites:

- Coastal saltmarsh, a habitat of principal importance in Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006[2]. This habitat is represented by a zonation of salt tolerant plant communities between upper saltmarsh and intertidal mud.
- Grassland medium/high (UKHab name) = lowland meadow, a habitat of principal importance: Flooded grassland characterised by meadow foxtail (*Alopecurus pratensis*) and great burnet (*Sanguisorba officinalis*).
- Wetland = wet grassland. This grassland is characterised by an abundance of rush species (*Juncus* spp.) and/or sedge species (*Carex* spp.) which are adapted waterlogged ground.
- Wetland = swamp. Characterised by tall emergent and ruderal plants including bulrush (*Typha latifolia*), reed canary-grass (*Phalaris arundinacea*), great willowherb (*Epilobium hirsutum*) and common nettle (*Urtica dioica*).
- Wetland = reedbed, a habitat of principal importance. This habitat is dominated by common reed (*Phragmites australis*).
- Woodland = wet woodland, a habitat of principal importance. This habitat is characterised mainly by willow species (*Salix* spp.) and/or alder (*Alnus glutinosa*).

3.6.7 Due to the fact that vegetation surveys for assessing habitat condition, and also the otter and water vole surveys described below, are seasonally constrained, this survey data is not available to inform the Gate 2 assessment. Therefore, the results of such surveys, if required (as influenced by the Minworth and SLR SRO river level modelling), subsequent to Gate 2 will inform future stages of the assessment, i.e., Gate 3.

3.6.8 Designated sites and non-designated habitats of importance to waterbirds3 as defined in the Gate 1 assessment were reviewed. A total of 12 sites within the Study Area identified during the Gate 1 desk-based review were assessed to be of particular importance to breeding, passage and/or wintering wetland birds; refer to Appendix B(i) for a list of these sites.

3.6.9 The distribution of otter and water vole from recent (since 2012) records returned to the county biological records centres were reviewed. Presence/absence survey visits could be undertaken firstly between May and June and secondly between August and September 2022, due to the seasonally constrained nature of these surveys.

3.6.10 Based on the findings of the ecological assessment, the potential impacts on ecological features and mitigation likely to be required to address those impacts has been included in this report where sufficient ecological data is available at the time of reporting – it is acknowledged that further seasonally-constrained ecological surveys will be required after the date of submission of the Gate 2 final report.

Aquatic Ecology

3.6.11 We have undertaken a detailed appraisal of macrophytes and macroinvertebrate species across Environment Agency monitoring sites, including review of various ecological indices that are used to develop WFD scores at the sites. This has provided understanding of the sensitivity of these to Physical Environment changes, which may occur as a result of the SRO schemes. Indices that have been appraised, where available, include a number that can be used to predict communities' sensitivity to flow, e.g., LIFE (Lotic-invertebrate Index for Flow Evaluation) (Extence *et al*, 1999b), sedimentation (notably Proportion of Sediment-sensitive Invertebrates (PSI) (Extence *et* al, 2011) scores, at a species level) and pollution (including Whalley, Hawkes, Paisley, Trigg (WHPT) method (WFD-UKTAG, 2021)) and corresponding ASPT (Average Score Per Taxon), NTAXA (Number of taxa) and BMWP (Biological Monitoring Working Party), which may be exacerbated through flow reductions. These biotic indices can be utilised to infer likely impacts of flow, sedimentation, or water quality, and inform appropriate mitigation options.

3.6.12 Multi-species fish passage and distribution for protected and notable species in the study area are considered to be constrained by the presence of multiple barriers in the Rivers Trent and Tame;

[2] Natural Environment and Rural Communities Act 2006 (chapter 16). Her Majesty's Stationery Office, London.

[3] A 'waterbird' in this assessment includes ducks, geese, swans, waders, rails, grebes, cormorants, and herons.

primarily weirs and one set of sluices. Barriers to fish passage lower down the catchment have received more attention from the Environment Agency and partners, than those upstream of Sawley Weir in the River Trent. The reason for this is not stated though it generally makes sense to focus on enabling passage from lowermost barriers. During the previous review, very little available data was accessible for the 8 weirs on the River Tame, likely owing to the numerous high priority barriers to upstream passage for protected and notable migratory species in the River Trent. At each of the barriers, varying levels of fish passage measures are in place ranging from none to species-specific passes (e.g., eel passes) to multi-species fish passes. A number of works have also been planned, to improve/ construct new passes, and some of these may have been recently implemented. These were initially described during the Gate 1 reviews and have been progressed in this review.

3.6.13 Fish passes should be designed to work through a wide flow range to enable passage at periods when different species would be expected to pass. Reduced flows can impact upon the passability of fish passes, as reduced levels and flow velocities would be expected through the pass, with a shift in flow conditions being experienced compared to the design levels. For certain species, these may result in more favourable conditions more often (e.g., for species that are less able to swim against stronger currents) but generally it is likely to result in reduced fish passage efficacy and most likely for the target species.

3.6.14 For this study, each of the 23 Trent or Tame barriers identified in the previous study have been visited, where publicly accessible to confirm the status of the existing passes, including confirmation of any recently constructed passes and status of the passes, noting that these can deteriorate without maintenance. Local hydraulics around the passes have been inspected during the visits, as in channel access to the fish pass is important to understand passage efficacy. We have reviewed available design information for those with fish passes as well as supporting survey information that has been previously obtained, to appraise how fish passage rates may change due to the SRO schemes. Existing Water Company Environmental Assessment Reports, for drought permits, have been reviewed, where available, as these include an initial appraisal of how fish passage would be impacted by low flows. The review considers existing recorded and target species of the system noting that different species have different migration requirements (levels and velocities), and advice on potential mitigation has been provided.

3.7 River Mease SAC

Objectives

3.7.1 The objectives of the assessment of the River Mease SAC, as set out by the Client, are as follows:

- *As part of Gate 1 engagement with the EA and Natural England, the River Mease SAC was flagged as being a potential area of interest. Although Gate 1 work ruled it out, the regulators have requested a more detailed assessment to reaching a conclusion with this SAC. We propose to assess the relevance of this site and produce an audit trail for requiring further work or not.*
- *Should further work be deemed necessary, we will carry out investigations to increase the certainty that the River Mease SAC will not be impacted by the Minworth SRO e.g., groundwater interaction, movement of designated species- working with EA who are undertaking a hydrological study of the River Mease due to complex groundwater interactions throughout the catchment.*
- *The EA are currently undertaking a hydrological study of the River Mease due to:*

"Complex groundwater interactions throughout the catchment and the potential to relocate the discharge from Packington WTW on Gilwiskaw Brook (Mease) out of the SAC catchment although to restore natural flows within this protected site. Depending on the destination of water removed from the Mease catchment, this 'pump out' solution to restore natural flows could have in-combination effects on flows in the Trent once combined with the Minworth proposal." https://www.rivermease.co.uk/activity/projects/

3.7.2 The assessment has been designed to meet these objectives, as set out in detail below.

Hydrological Assessment

3.7.3 The TTH Gate 1 assessment concluded that the River Mease SAC/SSSI is of Medium Ecological Sensitivity in relation to the SRO proposals, due to its connectivity to the Trent and its reasons for designation – diverse macrophyte community, and populations of both spined loach *Cobitis taenia* and bullhead *Cottus gobio*. Therefore, the River Mease SAC was considered unlikely to be significantly impacted by changes in flow in the Trent.

3.7.4 A staged approach has been undertaken to assess the relevance of the River Mease SAC to the study, as follows:

1. Liaised with the Environment Agency to understand the scope of the hydrological assessment that they are undertaking for the River Mease SAC, in relation to proposals for Packington WwTW.

2. Identified and requested reports/outputs of the hydrological assessment from the Environment Agency and review in the context of the Minworth SRO.

3. Reviewed the 'pump out' options associated with Packington WwTW on the Gilwiskaw Brook (tributary of the River Mease). Identified where the 'relocation' of discharge from Packington WwTW is proposed and assessed if this will remove flows from the wider River Trent catchment or enters the Tame or Trent at a different location.

4. Reviewed the reduction of flows at the confluence of the River Mease with the River Trent, where feasible, based on the outputs of the Environment Agency hydrological assessment and the Gate 1 and Gate 2 work undertaken assessing low flows on the River Tame/Trent.

5. Summarised the findings of Stage 1-4 to provide an audit trail of evidence reviewed, assumptions, limitations, and uncertainties. The outcome has provided an indication of whether further work is required and recommendations for required work.

3.7.5 It has been critical to liaise with the Environment Agency from the outset to identify constraints/limitations with access to the River Mease hydrological assessment and associated outputs. In addition, regular updates have been provided on progress and the likelihood for the requirement of additional work to allow appropriate planning for investigations.

Habitats Regulations Assessment (HRA)

3.7.6 As a precursor to the detailed assessment that may follow, a screening exercise has been undertaken to determine the likelihood of impacts to the River Mease Special Area of Conservation (SAC), a European designated site. This includes, in close liaison with the EA and NE, an assessment of groundwater interaction with the Tame and Trent catchment, the degree of movement of designated species between the Tame and Trent and the River Mease SAC, and hydrological connectivity between the SRO study area and the SAC.

3.7.7 The approach to the assessment of the River Mease SAC has been closely informed by liaison with the EA, NE, and other relevant stakeholders. This has established the concerns regarding potential cumulative and 'in-combination' effects, for example between the SROs and other plans and schemes (the latter of which will be assessed in further detail at Gate 3), the scope and extent of the assessment, any further work required to undertake the assessment, and allowed for discussion with stakeholders at all stages of the assessment process to obtain their input and agreement.

3.7.8 Regulation 63[4] states that 'A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which… is likely to have a significant effect on a European site [a Special Area of Conservation, Special Protection Area or, as a matter of Government policy, a Ramsar site] or a European offshore marine site (either alone or in combination with other plans or projects) …must make an appropriate assessment of the implications of the plan or project for that site in view of that site's conservation objectives'. This entire process is called Habitats Regulations Assessment (HRA). The HRA process follows available guidance including that published

[4] The Conservation of Habitats and Species Regulations 2017. UK Statutory Instruments 2017 No. 1012.

by UKWIR[5], that was published by the government in July 2019[6] and that in the Habitats Regulations Assessment Handbook[7].

3.7.9 An informal HRA report will be produced to accompany the environmental outputs of the Gate 2 process, but this Appendix C report contains the key excerpts of that HRA relevant to the River Mease SAC.

HRA Screening

3.7.10 HRA commences with a simple Test of Likely Significant Effects (also dubbed 'HRA Screening') which considers the interest features of the SAC, relevance being determined by the impact pathways likely to arise from the scheme, and either professional judgment or available guidance on the distance such impacts are likely to affect European sites. This may include any water resource modelling information regarding drawdown or effects on water levels and flow for European sites that may be connected to the Tame/Trent catchment.

3.7.11 This HRA builds on the assessment undertaken for Gate 1. Using this approach, it has been determined whether the risk of an adverse effect exists (beyond reasonable scientific doubt) and thus whether an appropriate assessment is required. If not, the assessment can stop at the HRA screening stage. It is understood that three possible impact 'corridors' have been identified – 1) the fluvial Trent and direct linkages via watercourses and riparian habitats, 2) groundwater linkage to the Tame/Trent corridor; and 3) the discharge from Packington WwTW on Gilwiskaw Brook out of the SAC catchment.

3.7.12 The preliminary Gate 1 assessment did not identify any significant transmission pathways by which a Likely Significant Effect could reasonably occur. This has been determined and verified for Gate 2.

3.7.13 The primary information utilised in the HRA are the outputs of the other ecological and hydrological studies for Gate 2 assessment, specifically regarding groundwater interaction with the Tame and Trent catchment, the degree of movement of designated species between the Tame and Trent and the River Mease SAC, and hydrological connectivity between the SRO study area and the SAC (demonstrated by hydrological modelling and interpretation of interaction at the confluence of the River Mease with the River Trent).

3.7.14 Information has also been obtained from the Environment Agency and Severn Trent Water regarding proposals for Packington WwTW.

3.7.15 Other data relevant to the HRA is available online and has been used in the assessment, including the Natura 2000 data form, the Conservation Objectives for the SAC, the Supplementary Advice on the Conservation Objectives (SACO) and the Site Improvement Plan (although in some areas this will have been superseded by the SACO). There is also useful information on the River Mease Partnership website[8].

3.8 Invasive Non-Native Species

Objectives

3.8.1 The key objectives of the Gate 2 Invasive Non-Native Species (INNS) assessment are as follows:

- *Use the EA's INNS Asset and Raw Water Transfer (RWT) tool[9] to estimate the EA risk score associated with the Minworth asset and the Trent SLR, taking into account the limitations within the tool.*
- *Investigate the existing potential INNS sources at Minworth WwTW and potential INNS risks associated with Minworth SRO.*

[5] UK Water Industry Research (UKWIR), 2012. Strategic Environmental Assessment and Habitats Regulations Assessment - Guidance for Water Resources Management Plans and Drought Plans.
[6] https://www.gov.uk/guidance/appropriate-assessment
[7] The Habitats Regulations Assessment Handbook [Online] https://www.dtapublications.co.uk/
[8] https://www.rivermease.co.uk/
[9] Environment Agency (2021). SRO Aquatic INNS Risk Assessment Tool. Developed by APEM for the Environment Agency, November 2021

- *Investigate the potential for the Trent SLR to transfer INNS to the River Witham catchment, including the potential for INNS to survive the potential treatment processes for the SLR.*
- *Consider further investigation to pathogen and parasite INNS.*

3.8.2 A baseline Aquatic Ecological Monitoring work package has been completed, the data and findings from which will reduce uncertainties in the outcomes of this risk assessment. The results of this have been incorporated into the assessment.

Assessment Methodology

3.8.3 Raw Water Transfer (RWT) risk assessments require a detailed and individual approach. The aim of the risk assessments is to identify points or pathways of greatest risk within the transfer network and within individual transfer operations through which INNS may be transferred. This aim was achieved utilising EA guidance and tools, and also by carrying out further investigations into the water sources, pathways, and receptors.

3.8.4 The assessment methodology applied to understand the potential INNS pathways and risks within water treatment processes and water transfers is based upon a desk-based study, including ecological data and scientific literature review, hydrological context and relevant experience.

3.8.5 The preliminary data and findings, of the baseline Ecological Monitoring work package, have been assessed and integrated into the INNS risk assessment with the aim of reducing uncertainties in the outcomes of this risk assessment. This has allowed for more refined risk assessments that incorporate both pathways and INNS presence in future assessments.

3.8.6 The assessment has taken into account a number of assessments, which are detailed further within this section:

- A baseline assessment of the hydrological context, the INNS records, and ecological receptors (see Section 3).
- Use of the EA INNS Risk Assessment Tool for:
    - Minworth SRO: the existing INNS risk associated with the Minworth Wastewater Treatment Works (WwTW) asset; and
    - SLR SRO: the risk of INNS transfers to the River Witham via the RWT.
- EA RWT prioritisation guidance[10] (PR19) for the SLR SRO.
- Further consideration of the INNS risks at Minworth beyond the EA INNS tool:
    - a review of the INNS on the Minworth WwTW site and downstream riparian zone;
    - an assessment of the existing INNS sources associated with the Minworth WwTW, based on a literature review and relevant experience, and the changes to this risk associated with the SRO; and
    - an assessment of the potential effects to the River Tame INNS species with reduced flows due to the Minworth SRO transfer.
- Further consideration of the INNS risk at the Trent SLR beyond the EA INNS tool:
    - consideration of the potential reaches of the River Witham that could become colonised by INNS with no treatment in place; and
    - review of the survivability of the INNS species with different inlet types.

3.8.7 Liaison has been maintained with the project team, the EA, and other stakeholders where appropriate, as described elsewhere in this report.

[10] Environment Agency (2017). PR19 – Assessing the risks of spread of invasive non-native species posed by existing water transfers

Environment Agency INNS Risk Assessment Tool background and methodology

3.8.8 The EA have published a tool, developed by APEM Ltd, to allow assessment of the risk of aquatic INNS in relation to SROs. The tool is built using excel tool and assesses assets and RWTs separately; however, it can include multiple assets and RWT options. The tool provides a risk score for each SRO and can be combined for an entire scheme.

3.8.9 The tool can be used to assess the existing and future risk of an asset and a RWT. Minworth WwTW was assessed as an asset within the tool, and the Trent SLR SRO is assessed under the RWT risk assessment.

3.8.10 The EA INNS tool has a tab to carry out an INNS Risk Assessment for each asset in the SRO. Within this tab information concerning the assets that collectively comprise the SRO was entered, as identified within the SRO Information tab.

3.8.11 The asset tool provides a risk score that takes into account surveyed INNS presence, as well as the potential for future colonisation with INNS due to site operations, including maintenance frequency and frequency of staff entering the water, as well as external factors such as angling, navigation and water fowl presence. The tool also provides contextual recommendations for biosecurity measures. This assessment has been carried out for the risk associated with the existing Minworth WwTW, however in reality the risk associated with the continued discharge to the TTH system is reduced over the existing case, given the lower flow volume.

3.8.12 The EA INNS tool has a tab to carry out an INNS Risk Assessment for each RWT in the SRO. Within this tab information concerning the RWT was entered for each of the RWTs that collectively comprise the SRO, as identified within the SRO Information tab.

3.8.13 The RWT tool provides a risk score associated with the current and future potential for INNS presence on the source and pathway, and a consideration of the existing connectivity to the receptor. However, further assessment has been carried out for the SLR SRO to understand the INNS species that provide the highest risk.

3.8.14 The EA risk assessment tool has been integrated within the assessment; however, there are some limitations to its use in assessing the detailed risk, and, as such, this assessment builds on top of the methodology provided by the EA (as detailed below).

Environment Agency RWT significance guidance

3.8.15 Another key criterion is determined is the ‘significance’ of a RWT, and therefore importance, of a pathway to the WFD situation in which the specific transfer takes place. This is based upon the EA guidance (PR19), as shown in Figure 3-1. The criteria are:

- within WFD waterbody (lowest criteria);
- between WFD waterbody (medium criteria); and
- between catchment (highest criteria).

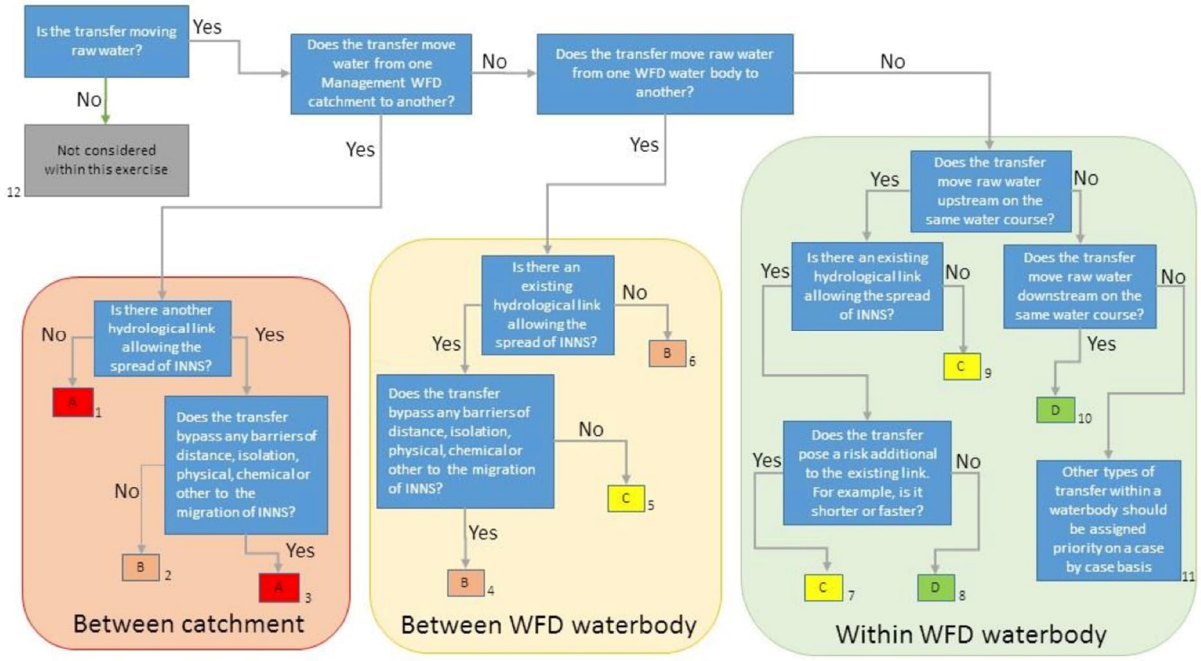


Figure 3-1 Prioritisation of existing raw water transfers (EA, 2017)

3.8.16 The significance of the SLR SRO has also been assessed according to these criteria to assess the potential risk associated with the transfer. Refer to Appendix D for detailed assessment methodology specific to the SLR SRO.

Priority Areas for Assessment

3.8.17 The key focus of the assessment is:

- The proposed location of abstraction from the River Trent for SLR, and the risk of cross-catchment spread of INNS from the Trent to the River Witham and beyond.
- The potential change to INNS risks associated with the Minworth WwTW due to the SRO, including the potential impacts to the River Trent associated with the reduced flow.

Data and Information Requirements

3.8.18 Information on INNS distribution has been obtained from the EA, Local Environmental Records Centres (LERC), and AECOM aquatic ecological monitoring.

3.8.19 Aquatic ecological monitoring is currently underway to add to the available database of INNS records within the River Tame and Trent system. This includes both conventional and eDNA surveys to establish INNS presence at targeted locations. The preliminary information currently available has been used in this assessment, and additional monitoring will provide further up to date records upon which to base the INNS risk assessment.

3.8.20 A desk-based study into the RWT location is based upon preliminary information provided by the project team and a desk-based assessment. The desk-based assessment includes review of the study area habitats utilising the ecological assessment and online published data sources. Data related to the operations at Minworth has been obtained from Severn Trent Water.

3.8.21 A desk-study into the River Witham, in terms of INNS desktop study, supported by the preliminary aquatic ecological monitoring and existing INNS records, has been carried out.

3.9 Sedimentation

Objectives

3.9.1 The objectives for the sedimentation assessment, as set out by the Client, are as follows:

- *Assess where to expect impacts to geomorphology based on understanding of the SRO. Clearly low flows occur already, where Minworth discharges are still available to the system. Modelling of impacts of low flows on levels including the HoF at North Muskham is underway. We will incorporate the outputs of this modelling to inform an understanding of how geomorphology would be impacted.*
- *Carry out fluvial audits targeted to the SRO locations to define geomorphological baselines and allow assessments of the effects of the SRO.*

Assessment Methodology

3.9.2 The Gate 1 assessments for the whole of the Tame and Trent to the Humber identified that geomorphology and sedimentation baseline data for the study area were largely unavailable. Instead, indicative data were synthesised by AECOM, to map areas along the River Tame and River Trent channels that are likely to have relatively high risks of sedimentation and are likely to be sensitive to changes around Minworth and the SLR abstraction.

3.9.3 Gate 2 sedimentation assessment for the Minworth and SLR SROs builds on Gate 1 scoping, to review targeted impact zones using fluvial audit desk-based surveys and field surveys where the river banks are safely accessible. Geomorphological data has been requested from the Environment Agency, and substantial relevant information has been provided for parts of the River Tame, but baseline geomorphological and sediment data are largely unavailable for the study area.

3.9.4 From Minworth, impacts on the River Tame would be mitigated by the confluence with the River Blythe approximately 5km downstream, but effects could still persist further downstream. Fluvial audit has therefore been extended from the River Rea confluence at Nechells upstream of Minworth to Lea Marston downstream. It is important to assess river reaches upstream of the SROs to interpret flow and sediment delivery into the impacted reach, thereby providing understanding of the potential impacts of the SRO. Nechells to Lea Marston is a distance along the River Tame channel of approximately 17 km, but access is limited, and survey has been confined to safe visibility from intermittent highway crossings for most of this area.

3.9.5 For the SLR, impacts would mainly be downstream of the proposed abstraction location at East Stoke, including Newark-on-Trent and the Cromwell Weir some 8km downstream of Newark-on-Trent. The Cromwell weir is the tidal limit, so habitats and sedimentation further downstream will have increasing tidal influence and will naturally be dominated by sedimentation and sediment recirculation. Fluvial audit has therefore been extended from Newark-on-Trent to Gainsborough, which is a distance of 58 km along the River Trent, but only intermittent observations were required. The Trent is a large, low-lying river with generally consistent character through this area, meaning that large areas can be assessed rapidly.

3.9.6 The geomorphological assessment has also focused on weirs as impoundments to sediment transport, morphological continuity, and fish passage, and has taken a holistic approach to interactions between sediment, physical habitats, water quality, and ecology.

3.9.7 Sediment sampling, or sediment transport or sedimentation modelling, has not been undertaken. Rather, assessments are qualitative and based on expert judgement of geomorphological risks in the context of WFD objectives. Fluvial audits have been completed at an appropriate spatial scale to the potential impacts.

3.9.8 The sedimentation assessment benchmarks the existing sediment conditions in the rivers and assesses the potential effects of the SROs. Audits are presented as concise, map-based reports to summarise geomorphology/sediment baselines in the context of physical habitats underpinning river ecology and SSSIs.

3.9.9 Sediment sources are reviewed to demonstrate historic river and catchment uses (urbanisation and agriculture, and construction of weirs and flood embankments), as being the primary controls on river sediment loads, with water resource abstraction likely to be a relatively minor effect. Potential impacts of the SROs have been assessed through interpretation of baseline sedimentation patterns throughout the study reaches, and the potential for increased sedimentation associated with changing low flow patterns as indicated by hydrological and hydraulic modelling. Sediment zones have been updated in relation to key channel assets and habitats maps produced for the Gate 1 sedimentation assessments using the fluvial audits and model outputs.

Priority Areas

3.9.10 Fluvial audits cover two areas: at the River Tame from Minworth to at least the confluence with the River Blythe; and for the proposed locations of the SLR intake to at least the next confluence downstream (the River Devon). These assessments advise if geomorphological and sedimentological impacts would be 'absorbed' by the river locally, or if further assessments are needed at larger scale.

Data and Information Requirements

3.9.11 Information has been obtained by direct correspondence with the EA, including site walkovers guided by local EA catchment officers. Direct liaison with the EA through Gate 2 has also uncovered considerable historic river information that was not available at Gate 1, including records of historic river restoration schemes, especially through the River Trent, which have been implemented inclusive of sedimentation considerations as a key component of holistic ecological processes.

3.9.12 Sedimentation assessments have been undertaken based on data and information produced in collaboration with other Gate 2 Topics, including hydraulic modelling. Otherwise, data collection for sedimentation focussed on targeted site visits as scoped from the Gate 1 analysis.

3.10 Non-Water Resources Impacts and Benefits

Objectives

Whilst carrying out these assessments, identify opportunities for the SROs to create benefits to the environment and socio-economically.

- *Liaise with catchment partnerships such as Trent Rivers Trust, to investigate opportunities to deliver net gain at the landscape scale. A number of Biodiversity Opportunity Maps may have also been produced and would provide vital information and would complement this approach.*
- *We will develop an understanding of biodiversity impacts of the SRO proposals in order to understand the net gain requirements. This means understanding impacts on non-designated sites. We will present ecological habitat survey reports in UkHab language.*
- *Discussions with Natural England and the inclusion in relevant guidance (e.g., 25-year plan) show SROs would be expected to have no net negative impact as a minimum and would be expected to have a net positive impact where practically possible.*

Proposed Assessment Methodology

3.10.1 For the Gate 1 baseline study, studies which sought to define the socio-economic benefits from habitats and species associated with main river system of the Trent were reviewed. The review focused on studies within the last 15 years that covered habitats within 5 km of the River Tame, River Trent and the Humber Estuary.

3.10.2 The results showed that the majority of the studies reviewed (74%, or 17 of 23 studies) covered freshwater, wetlands and floodplains. Other studies tended to cover riparian habitats near the River Trent including enclosed farmland, urban green space and woodland. Only 26% of studies (6 out of 23) covered coastal margins given most of the study area is inland with the exception of the Humber Estuary.

3.10.3 Most studies covered more than one Ecosystem Service, and the results show that the majority of the studies reviewed focused on biodiversity (78%), natural hazard regulation (70%), aesthetic value

(65%) and recreation (65%). This is a function of the variety of studies that focused on flood risk attenuation in relation to the River Trent and the Humber Estuary, which have historically been susceptible to flooding. The material services that are not well covered by the literature included local climate regulation, pollination, disease and pest control and minerals. These services tend to be challenging to quantify in physical and monetary terms due to limitations in the existing evidence and approaches available. However, it has been possible to capture some of their characteristics by compiling and monitoring indicators of the extent and condition (quantity and quality) of habitats within the study area. This inventory of indicators constitutes a Natural Capital Asset Register for the study area.

3.10.4 Relatively few studies covered economic impacts, compared to the coverage of ecosystem services. The economic impacts primarily considered tended to be job creation and tourism. The latter impact is correlated with recreational benefits, which are well covered in the literature.

3.10.5 Social impacts were significantly less considered in the literature, compared to ecosystem services and, to a lesser extent, economic impacts. At most, 2 out of the 17 studies considered a given social impact. Social impacts, particularly those associated with community engagement, awareness raising, and preparedness are important in the context of the study area, given its historical susceptibility to flooding and pollution.

3.10.6 In close liaison with other assessment streams, baseline information was gathered to inform an understanding of the potential biodiversity and wider ecosystem services impacts of the SRO schemes. For example:

- Baseline ecological data has been collected using the UK Habitat Classification format (UKHab) format for new data collection, e.g., for ground-truthing Phase 1 habitat or National Vegetation Classification (NVC) surveys for condition assessment of designated sites and priority habitats. This is a key part of the BNG process and allows Net Gain to be accurately calculated or predicted.
- The requirements for BNG assessment have been considered when designing the scope of ecological assessment and the associated condition assessment of designated sites and priority habitats, notably wetland habitats.
- There has been a focus on the designated sites and habitats identified as of High Ecological Sensitivity in the TTH baseline assessment, whilst considering other areas within the Tame and Trent system that may be at risk of impacts due to the SRO proposals.
- Consideration of where existing or proposed Biodiversity Opportunities or Offsetting may be at risk due to the SRO proposals is critical in informing where further consideration has been necessary to ensure that potential impacts to these areas are accurately assessed in the light of the future baseline.
- Consideration of where designated sites or habitats are critical for protected or notable species, in particular where these are listed in the citations of designated sites, and where potential impacts to these species may be detrimental to the ability of these sites to reach target condition, has been critical to assess their potential to contribute to Net Gain.
- Consideration has been made of the effects of the SRO proposals on other ecosystem services provided by the river system and water-dependent habitats including, for example, opportunities for instream recreation (boating and angling), carbon storage and sequestration and flood control.

3.10.7 Initiatives to deliver Net Gain have been identified, and where possible inference of Natural Capital benefits, including but not limited to:

  - Biodiversity Opportunity Mapping – this is well developed for some Local Authority areas such as Nottinghamshire and can provide a valuable focus on opportunities for habitat reinstatement, management, and linkages.
  - Catchment-scale initiatives – the Catchment Based Approach (CaBA) is well developed in some areas with initiatives such as engaging with landowners and farmers to facilitate sympathetic land management practices, for example to reduce agricultural runoff and resulting pollution and nutrient enrichment.

- Engagement with stakeholders and regulators has been important to identify key areas where there may be aspirations for BNG at the catchment scale.

3.10.8 In order to provide additional background to the assessment, a baseline natural capital account for the full scheme was prepared for the full scheme area using AECOM's BioInstinct (version 0.7) tool. This tool allows rapid, automated assessments of natural capital assets and ecosystem service flows over large areas. The outputs are high level, broad estimates rather than local and specific. The outputs are intended to provide a broad overview of the baseline conditions across the scheme's area, in order to inform the more detailed assessments undertaken later on. Full details of the calculations and data sources used within version 0.7 of the BioInstinct tool are available upon request.

3.10.9 A consistent approach to measuring biodiversity and environmental net gain has been taken. Applying a common approach and metric promotes a more consistent approach across the catchment for measuring and reporting biodiversity and wider environmental losses and gains with respect to land management and development activity. For biodiversity, the use of DEFRA's Biodiversity Metric is the approach recommended in the EA's WRMP Guidelines and is also mandated for use through the planning system as set out in the Environment Act. At Gate 2 version 3.0 of the DEFRA metric has been used to measure biodiversity net gain. It is understood that subsequent gates will update metric calculations to the recently released Metric 3.1.

3.10.10 In preparation for the need for local authorities to develop Local Nature Recovery Strategies (LNRS), NE has created a National Habitat Network mapping layer. This provides spatial information on habitats most suitable for restoration and enhancement and is one of the data sources used to inform the design of LNRS. It is therefore recommended that any aspirations for habitat creation are aligned with the goals of the relevant LNRS.

3.10.11 In addition to considering opportunities to deliver BNG, an assessment has been made of where and how efforts to achieve BNG could also deliver wider environmental and socio-economic benefits, for example:

- Environmental benefits in terms of ecosystem services, such as flood risk protection, carbon sequestration, opportunities for recreation.
- Social benefits in terms of community engagement, greater inclusion, health benefits from recreation.
- Economic benefits in terms of gross value added of different activities including expenditure linked to recreational trips to the river and surrounding habitats.

3.10.12 The benefits are assumed to be co-benefits of other actions that are either associated with the design of the SROs or the opportunities that are identified to deliver BNG. As such these two elements are the basis for identifying opportunities to deliver socio-economic benefits and wider environmental net gain.

3.10.13 We have articulated the potential benefits in qualitative terms with reference to the potential scale and location of benefits, and the receptors/beneficiaries. The assessment has been undertaken in accordance with good practice including Government guidance, such as Defra's resource on Enabling a Natural Capital Approach (ENCA).

3.10.14 The outcome of the Natural Capital and BNG Assessment is a preliminary assessment of the likelihood of Net Gain, or no net negative impact as a minimum, as a result of the potential impacts of the SRO proposals.

Biodiversity Net Gain Assessment

3.10.15 DEFRA's 25-year Environment Plan seeks to 'embed an environmental net gain principle for development, including housing and infrastructure'[11] it is also government policy that planning decisions should seek to minimise impacts on, and provide net gains for, biodiversity[12]. The Environment Act 2021[13] includes provisions to mandate the delivery of Biodiversity Net Gain in

[11] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf
[12] National Planning Policy Framework - GOV.UK (www.gov.uk)
[13] https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted

England. Secondary legislation, anticipated in late 2023, will require all relevant developments to achieve a minimum 10% net gain in biodiversity units relative to the site's baseline biodiversity value. Therefore, a BNG Assessment has been undertaken using DEFRA's Biodiversity Metric 3.0, in accordance with the metrics accompanying guidance[14] and industry accepted best practice principles[15].

3.10.16 The approach to the Biodiversity Net Gain Assessment has been informed by further guidance set out in both the All Company Working Group (ACWG) 'WRMP environmental assessment guidance and applicability with SROs' and RAPID (2022) 'Strategic regional water resource solutions guidance for gate two'.

3.10.17 ACWG guidance sets out how:

- Biodiversity net gain or net loss (BNG/BNL) must be considered at both the option and programme level and that each option should look to maximise biodiversity net gains
- That a biodiversity baseline should be developed from spatial data sets derived from habitat inventories and assessed in line with metric guidance to allow BNG change to be calculated for each option.
- That Priority Habitat Inventories and site designations including Sites of Special Scientific Interest (SSSI) and Ramsar should be used to identify areas with high biodiversity importance.
- That metric calculations should assign biodiversity units to the pre-impact land use according to the habitats present in the project boundary and that post-impact land use (including agreed mitigation) should be used to calculate the post-impact biodiversity score and calculate any percentage net gain or losses in biodiversity, and
- That individual schemes should seek to supplement the open-source habitat data used in the assessment with local datasets or Phase 1/UKHab site data to increase the accuracy of the BNG calculation for each option.

3.10.18 RAPID Gate 2 Guidance sets out how:

- The Gate 2 submission should be supported by an environmental appraisal that describes the connection to other assessments including BNG and that developments in England should seek to support the net gain actions in the Government's 25-year plan as described in para 2.4.20.

Site Identification

3.10.19 Following a review of the designated sites and water-dependent wetland habitats identified during the Gate 1 desk-top assessment a total of 26 floodplain locations within 500m of the Rivers Tame and Trent (hereafter referred to as the Study Area), were identified for inclusion in the Gate 2 BNG Assessment. The sites subject to preliminary ground truthing survey visits during winter and/or spring 2021/22 are listed in Appendix F

Habitat Identification/classification

3.10.20 At Gate 2 biodiversity metric calculations have been undertaken using a tiered approach to habitat identification/classification. Habitat types used in the Gate 2 BNG Assessment include:

- Wetland habitats identified during preliminary ground truthing survey visits during winter and/or spring 2021/22
- Wider non-water dependant site habitats, identified using open source Priority Habitat Inventory data[16] held for each site, and
- For areas of 'white space' within each site boundary, neither identified as wetland or priority habitat, a proxy UKHab habitat of "Grassland - Floodplain Wetland Mosaic" has been used to ensure full site coverage.

[14] http://nepubprod.appspot.com/publication/5850908674228224
[15] https://cieem.net/resource/biodiversity-net-gain-good-practice-principles-for-development-a-practical-guide/
[16] https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england

3.10.21 Habitat data has been converted into UK Habitat (UKHab) Classification habitat types used by the Metric 3.0 by a qualified ecologist. Both Phase 1/UKHab and NVC vegetation surveys are seasonally constrained. Therefore, it is intended that the results of the habitat condition assessment surveys scheduled for 2022 will further refine the above data set in order to fully inform the Gate 3 assessment.

3.10.22 Habitat areas have been recorded and measured digitally using a Geographic Information System and mapped against an OS Master Map base layer. Net gain calculations have been undertaken in excel using the published Metric 3.0 algorithms.

Assigning Habitat Distinctiveness and Condition

3.10.23 At this high-level assessment stage habitat condition has been assigned using distinctiveness as a proxy. Therefore, habitats with a 'Very High' distinctiveness have been assigned a 'Good' condition, habitats with a 'Medium' distinctiveness have been assigned a 'Moderate' condition and habitats with a 'Low' condition have been assigned a 'Poor' Condition. This precautionary approach weights the value of higher distinctiveness habitats to ensure potential impacts are not underestimated at this stage in the assessment.

Assigning Strategic Significance

3.10.24 At this high-level assessment stage Strategic Significance has been assigned based on each sites statutory or non-statutory nature conservation designation. With all sites being designated Local Wildlife Site or higher all sites have been assigned as being of 'High' strategic significance. At Gate 3 Strategic Significance for each site will be further refined using an 'opportunity mapping' approach using a combination of open-source habitat datasets alongside Local Nature Recovery/Biodiversity Opportunity Areas. The final strategic significance scores for each site/habitat at Gate 3 will be agreed during stakeholder engagement sessions.

Post-impact habitat data

3.10.25 The river level, depth, and wetted perimeter changes as a consequence of the proposed options have been determined through hydraulic modelling. From the preliminary model results, it appears that changes in river level, depth and wetted perimeter are very minor and prevalent during extreme low flows. The greatest change in river level is predicted in the upper Tame in two localities:

- Between Ladywalk LWS and Whitacre Heath SSSI, and
- Between Coton Pools LWS and Kingsbury Water Park LWS

3.10.26 Seasonal winter flooding of the Tame and Trent floodplains is predicted to continue and will not be affected by the scheme options. Potential impacts on summer flooding will be investigated further, including taking into account the effects of climate change, at Gate 3. The SRO options are predicted not to have a significant effect on water levels on wetland habitats either side of the tidal River Trent (downstream of Cromwell Lock).

3.10.27 The hydrological assessment has considered whether surface waters in the SSSIs may be affected directly from lower flows in the rivers Tame and Trent, and whether changing water levels will affect groundwater levels that then may affect surface water features in the SSSIs. This has then been considered in the context of natural seasonal variation in water levels in the rivers and aquifers, and other features controlling water levels near the SSSIs such as weirs, abstractions, and discharges.

3.10.28 From the preliminary model results no significant effect on groundwater levels that then may affect surface water features which sustain wetland habitats are predicted. Therefore, post-development modelling of BNG assumes no reduction in existing habitat condition or any degree of habitat loss or reduction in habitat extent. Therefore a 10% gain for all scenarios has been modelled by calculating metrics that aim to enhance existing habitat condition values.

3.10.29 The findings of this semi-quantitative preliminary BNG assessment with supporting figures and the accompanying metric spreadsheet has been provided in the Annex of this report.

3.10.30 At Gate 3, in order to demonstrate a more accurate 10% Biodiversity Net Gain for the proposed scheme, it is recommended that opportunities to create and enhance wetland habitats within the Study Area are identified through a combination of habitat opportunity mapping and stakeholder engagement. The creation of new wetlands within the Study Area will particularly benefit those species

associated with those habitat types. The selection of candidate wetland habitat creation and enhancement sites will need to be discussed with local biodiversity groups and will aim to benefit key habitats and the species they support.

Priority Areas

3.10.31 A baseline register has been compiled of habitat extent and condition at key sites within the River Trent, River Tame and Humber Estuary study area.

3.10.32 This baseline has been informed by existing data sets held by Natural England, Local Biodiversity Record Centres, Local Nature Conservation organisations (inc. Wildlife Trusts), Centre for Ecology & Hydrology (CEH) Landcover mapping and the analysis of aerial imagery.

3.10.33 Where the requirement for further ecological site surveys was identified, BNG habitat condition surveys (UKHab) have been completed as part of the survey methodology. However, as BNG Condition Assessments, Phase 1 habitat, and NVC vegetation surveys are seasonally constrained, it is possible that comprehensive survey data will not be available to inform the Gate 2 assessment. Therefore, the results of these surveys will inform future stages of the assessment, i.e., Gate 3. At the Gate 2 stage, where existing condition data does not exist, a combination of habitat distinctiveness and professional judgement has been used to determine an indicative habitat condition value.

3.10.34 Habitat extent and condition data has been compiled into a GIS system to facilitate access, data sharing and ease of update. This mapping tool has been used to identify where opportunities to protect, restore or enhance biodiversity and other ecosystem services may be targeted during further stages of the project.

3.10.35 To ensure a strategic approach is taken to identifying potential offsetting sites, additional key partners and stakeholders have been identified through a scoping exercise.

3.10.36 The impacts of flow changes on ecosystem services and the associated social and economic benefits those services provide have been focused on areas where the outputs of the hydrological modelling and ecological assessments reveal changes in flow levels that could impact upon instream recreation (boating, angling) or on the condition of SSSIs and other terrestrial habitats that provide carbon storage, sequestration, and flood control services.

Data and Information Requirements

Site	Data Type
SAC/SPA/SSSIs/NNR	Natural England condition survey data, integrated site assessment data, site citations, site improvement plans, any appropriate review of consents, catchment management plans and diffuse pollution plans. Where not available from Gate 1 assessment, further data will be sought.
LWS	Local Authorities and Local Wildlife Trusts. Where not available from Gate 1 assessment, further data will be sought.
Third party data	Local biological record centres Habitat and species data (potential cost to commission – some licenses already in place). CEH Landcover map (cost to purchase).
Open Data	National priority habitat data (magic.gov.uk) National Habitat Network data (magic.gov.uk) Protected sites data boundaries (magic.gov.uk)

3.11 Limitations

SSSI Assessment

3.11.1 The following limitations have been identified in terms of the SSSI assessment:

- There is no monitoring of groundwater levels, water feature levels, and river levels at each of the sites. Therefore, there is no quantitative assessment of the relationship between the SSSI water features, and the river affected by the SRO.
- The assessment is based on hydrological and hydrogeological principles used to develop a conceptual model of each site; and a source-pathway-receptor assessment as to whether river level changes as a result of the SROs could impact SSSI water features.
- Hydraulic modelling predictions have informed the impact assessment. Refer to the report on hydraulic modelling to understand the assumptions and limitations of modelling.

Ecology Assessment

Terrestrial Ecology

3.11.2 The following limitations have been identified in terms of the terrestrial ecology assessment:

- The preliminary ground-truthing survey visits were undertaken at a sub-optimal time for mapping wetland habitats. However, with professional judgement the correct habitat types have been recorded; their plant composition would be best recorded during the spring/summer when more species are evident.
- No information is available about the management or habitat condition at the Local Wildlife Sites, but they were subject to the preliminary ground-truthing survey visits.
- Access arrangements to Eon Meadows (Whitacre Flood Meadow LWS & Whitacre Pool LWS) and Stanton Barn Marsh LWS were not facilitated and so these sites were viewed from adjacent public rights of way.
- No otter or water vole surveys, which are seasonally constrained, have been conducted to date.

Aquatic Ecology

3.11.3 The following limitations have been identified in terms of the fish passage at barriers assessment.

- Hydraulic modelling results have been obtained for the River Tame, and for the River Trent upstream of the SLR abstraction location. The assessment for weirs downstream of that location will need to be updated when the modelling results for the lower River Trent become available.
- Targeted 2D hydraulic modelling, informed by bathymetric surveys, is also underway at targeted locations on the Rivers Tame and Trent. The assessment for these locations will be refined once the results of 2D modelling become available.

River Mease SAC Assessment

3.11.4 The following limitations have been identified in terms of the River Mease SAC assessment.

3.11.5 The full report of the Environment Agency River Mease hydrological assessment study of the River Mease in relation to proposals for Packington WwTW has not yet been available, and the findings of this assessment will be reviewed when it is published. However, the results have been presented by the EA and have informed this assessment. When the full report of the hydrological study of the River Mease becomes available, this assessment can be updated.

INNS Assessment

EA INNS Risk Assessment Tool

3.11.6 The EA risk assessment tool has a range of limitations regarding its use in assessing the detailed risk. The following key limitations identified in relation to the Minworth and SLR SROs including that specific INNS are not considered, the tool does not account for existing (inbuilt) or proposed treatment and mitigation measures into the risk weighting, and the weightings do not reflect catchment connections as much as AECOM would expect.

3.11.7 Overall, a review of the EA INNS Risk Assessment tool, and consultation with the team that developed the tool, indicate that the tool is functioning as intended. The results of the tool are provided below (Section 4). However, as the tool does not consider in detail key risks associated with each SRO, the ratings should not be used to compare risk scores, generated using the tool, to other SRO projects at a national scale. Rather, the tool is more suited to local scale comparisons for different options associated with the same SRO.

Data limitations

3.11.8 The River Witham barrier assessment, to inform the Trent SLR further assessment methodology, is a desktop review of available data sources. The presence and details of their barriers is not known, and a visual survey is recommended to identify whether these structures provide a barrier to the spread of INNS within the catchment.

Sedimentation Assessment

3.11.9 The following limitations have been identified in terms of the sedimentation assessment:

- Detailed geomorphological baseline assessments are generally absent for the River Tame and River Trent. Geomorphological information is available from various sources but is far from comprehensive. Information can be interpreted from other studies, but direct assessments of geomorphology and sedimentation are generally not available.
- Sediment and sedimentation monitoring data are generally non-existent.
- Hydraulic modelling to date is preliminary and does not cover the whole study area.
- Modelling focusses on baseflow hydraulic properties, and does not include sediment transport, spate or flood events, or floodplain inundation events. Floodplain connectivity is a critical component of sediment systems, since floodplain inundation frequencies, extents, and durations control rates of out-of-channel floodplain sedimentation.
- Sediment transport modelling, based on hydraulic model outputs, is not feasible until hydraulic model results are finalised. Sediment transport modelling is highly complex, but high-level assessments would be informative and could be used to quantify the sedimentation effects of the SROs.

Non-Water Resources Benefits Assessment

3.11.10 The following limitations have been identified in terms of the six capitals and BNG assessment:

- The use of Gate 1 baseline assessment data as well as the extensive use of assumptions to cover the current limited quantitative data, result in a reduced level of confidence in the accuracy of the assessment. Where data was available the capitals impacts have been valued to the highest resolution possible. However generally, detailed data to undertake quantitative assessment of the scoped in impacts is not yet available. The data gaps are explored further in the results section. These gaps will be filled with further results expected from ongoing assessments and further information regarding potential mitigation measures, which will help refine this assessment at Gate 3.
- There are potential overlaps between the impact and dependencies identified across the six capitals. However, the risk of double-counting has been avoided by utilising tools and data sets which measure specific and different parameters for the services that have been scoped in.

- The assessment has been performed using a combination of ground truthing and open-source habitat data. Therefore, a precautionary approach has been applied by using habitat distinctiveness as a proxy when assigning habitat condition. Habitat condition surveys are scheduled to be undertaken during the 2022 survey season and will be used to refine the calculation at the Gate 3 stage.
- Condition enhancement has been modelled across all sites selected for inclusion in the Gate 2 assessment. Distinctiveness values across all habitats ranged from 'Moderate' – 'V.High'. Only those habitats with a distinctiveness values between 'moderate' to 'high' have been included in the condition enhancement modelling at this stage in the assessment. At Gate 3 a more targeted and strategic approach will be undertaken to habitat enhancement and creation. With a combination of opportunity mapping and stake holder engagement used to identify habitats suitable for restoration, enhancement, or creation.

4. Results

4.1 Introduction

4.1.1 This section summarises the preliminary results of the Environmental Assessments to date. Refer to the technical appendix for each topic for further detail of the assessment.

4.2 Desk-Based Assessment

Industry-Wide Precedent Search

4.2.1 The search has included the assessment of direct and indirect water reuse, with particular focus on reuse for drinking water as this is the intended usage for the Minworth and SLR SROs.

4.2.2 The terminology used to describe wastewater type, treatment method, and intended final usage can vary globally. For instance, some countries use the term “reclaimed water” and “recycled water” interchangeably. Similarly, the terms “water recycling” and “water reuse” are often used synonymously. This document uses the terms reclaimed water and water reuse. To aid with understanding, Table 2 summarises and defines the most common terminology.

Table 4-1: Industry terminology

Terminology	Definition
Direct reuse (DPR)	The introduction of reclaimed water (with or without retention in an engineered storage buffer) directly into a drinking water treatment plant. This includes the treatment of reclaimed water at an Advanced Wastewater Treatment Facility for direct distribution.
Indirect reuse (IPR)	Deliberate augmentation of a drinking water source (surface water or groundwater aquifer) with treated reclaimed water, which provides an environmental buffer prior to subsequent use.
Planned potable reuse	The publicly acknowledged, intentional use of reclaimed wastewater for drinking water supply. Commonly referred to simply as potable reuse.
De facto reuse	A situation where reuse of treated wastewater is practiced but is not officially recognized (e.g., a drinking water supply intake located downstream from a wastewater treatment plant [WWTP] discharge point).

4.2.3 Table 3 below summarises the results of the industry-wide precedent search, with a brief overview of each scheme, any specific effects identified broken down by category (technical, social, political, or environmental effects), criteria required to allow the diversion, and sources of information.

Table 4-2: Precedent search findings

Precedent Name	Volume (Ml/d)	Location	Brief overview of scheme	Technical Effects	Social Effects	Environmental Effects	Criteria required to allow diversion	Sources of Information
Illinois River	2678 (max scenario)	USA	Hypothetical water reuse scenarios, testing a metric for impact assessment. Paper seeking to quantitatively assess the impacts of consumptive use of reclaimed water (municipal wastewater effluent) downstream of WwTW, on the depleted reach, in a water abundant region.	Impacts to barge transportation are marginal and decrease with distance downstream of effluent consumption.			Federal, State and Local laws will affect any water reuse. *	Linking Reclaimed Water Consumption with Quantitative Downstream Flow Impacts. Purcell et al (2021)
Rio Grande River	220 (max scenario)	USA	As above but for a water scarce region.			Impacts to the Rio Grande silvery minnow worsen downstream of water reuse.	As above	As above
Coachella Valley Water District	N/A	USA	A wastewater change petition submitted in 2017 to upgrade one of its treatment plants to produce non-potable recycled water for irrigation purposes. This petition is still pending (as of 2019, online searches have found no further information). Efforts to reuse water in the Coachella and Imperial valleys will mean less water draining into the Salton Sea.			Increased use of recycled water would decrease flows to the already shrinking and vulnerable Salton Sea. Reusing treated wastewater may harm environmental quality, particularly in effluent dominated water bodies that provide habitat for endangered species.	Not yet operational, no information found directly relating to the project only briefly mentioned in source link. Federal, State and Local laws will affect any water reuse. *	PPIC (2019)
Thames Water Utilities Ltd; Deephams STW	N/A	UK	AECOM undertook an assessment of the effect of a proposed effluent re-use scheme on the watercourses currently receiving the treated effluent stream, with a focus on whether it would prevent WFD objectives from being met.			Assessment determined that WFD deterioration was likely for several biological elements and identified high level mitigation in the form of structure removal and channel modifications in order to support scheme development.	Mitigation required to prevent WFD status deterioration.	AECOM (2011-15)
Essex and Suffolk Water, Langford recycling scheme	40	UK	Indirect water re-use to increase water available for treatment in a water scarce region. An opportunity to recycle wastewater		Initially negative public perception, but this was managed with	Water discharged to the river has to meet very stringent quality criteria, including limits on	No information regarding flow criteria needing to be met.	Water Treatment and Supply (2002)

Precedent Name	Volume (Ml/d)	Location	Brief overview of scheme	Technical Effects	Social Effects	Environmental Effects	Criteria required to allow diversion	Sources of Information
			was identified at Langford and a pilot scheme was trialled, which proved successful. Adjacent to Langford an existing pipeline transports wastewater from Chelmsford sewage treatment works and discharges it into the tidal River Chelmer. Recycling was demonstrated to provide sufficient water sustainably, quickly and cost effectively with minimal impact on the environment. This innovative scheme is thought to be the first large scale example in the UK of planned indirect reuse of recycled wastewater.		effective and well-planned communications. Through careful communications and revisions of its effluent re-use scheme, Essex and Suffolk Water turned around negative public perception and successfully operates Langford water recycling scheme.	biological oxygen demand (BOD), nitrogen in its various forms, phosphorus, and dissolved oxygen, and also has to be UV disinfected. The treated water is closely monitored and, if it fails to meet any of the consent criteria, discharge to the river is stopped, and it is diverted to the effluent pipe.		
Seqwater, Western Corridor Recycled Water Scheme, Brisbane, Australia	230	AUS	Premise of the scheme is to pump treated effluent (to drinking water standard) from a number of WwTWs upstream into Brisbane's main water supply dam (Wivenhoe Dam) where water is released back via the Brisbane River to 'naturalise' flows prior to abstraction and treatment for use into the Brisbane potable water network.					Water Research Australia
Singapore NEWater	196	SIN	IPR, surface water supply reservoirs. Purified recycled water is one of Singapore's 'Four national taps', with rainfall, imported water from Malaysia, and desalination. The NEWater is primarily supplied to industry (wafer fabrication plants) and commercial buildings. NEWater makes up 1-30% of the drinking water supply, depending on industrial demand and storage levels.					US EPA (2017)

Precedent Name	Volume (Ml/d)	Location	Brief overview of scheme	Technical Effects	Social Effects	Environmental Effects	Criteria required to allow diversion	Sources of Information
Upper Occoquan Service Authority, Virginia	204	USA	IPR, Surface water supply reservoirs. Water reclamation plant discharges to upstream reservoir, flows downstream to Occoquan reservoir where water is removed for potable water treatment.					US EPA (2017)
Los Alamitos Barrier Water Replenishment district of Southern California. Vander Lans Advanced Water Treatment Facility (LVLAWTF).	30	USA	IPR to groundwater aquifer. Project seeking to eliminate dependence on imported water as a groundwater replenishment source and instead utilise alternative supplies such as storm water and recycled water. Tertiary treated recycled water from the Long Beach Water Reclamation Plant (LBWRP) has been used as influent water to scheme since construction in 2005, expanded in 2014.					US EPA (2017)
Orange County Water District Groundwater Replenish System (GWRS), California	378	USA	IPR to groundwater aquifer. Orange County began recycling water for drinking in 1975 with Water Factory 21, which purified wastewater for a seawater intrusion barrier. In 2008 a Groundwater Replenishment System was added, increasing capacity and updating the technology. The success of this scheme and its public outreach program has been a major influence on other projects around the world.		Research using focus groups and telephone surveys identified that key issues for customers were: • Cost • Health • Safety • Water reliability • Suspicion of jargon • Importance of RO purification. These insights were used to develop talking points, and the project name was changed from 'Orange County Reclamation Project' to 'Groundwater			US EPA (2017)

Precedent Name	Volume (Ml/d)	Location	Brief overview of scheme	Technical Effects	Social Effects	Environmental Effects	Criteria required to allow diversion	Sources of Information
					Replenishment System' to better communicate the objective. This work also helped to identify business, environmental, political, and other community leaders who would help to influence public opinion.			
Cloudcroft PURe Water project, New Mexico	0.4	USA	DPR, wastewater will be treated and then blended with spring and groundwater before being introduced into the water supply. Not yet completed, as of (2018).					US EPA (2017)
Big Spring, Texas	7	USA	DPR, Severe drought prompts both Big Spring and Wichita Falls to recycle wastewater effluent for drinking water use. The Big Spring plant treats the wastewater effluent at a new $14 million facility using microfiltration, reverse osmosis (RO), and ultraviolet disinfection (UV). That water is then added to a raw water pipeline that also sources water from an area lake. This mix (20 percent recycled water, 80 percent raw water) is then distributed to five drinking water facilities in the region (serving a total of 250,000 people) where it is treated again using conventional drinking water treatment techniques.		In both Big Spring and Wichita Falls, gaining community support for DPR wasn't as difficult as some expected. Despite the "yuck factor" often associated with water recycling, both communities were mostly supportive of the projects from the beginning. It was the dire drought conditions that convinced people that DPR was necessary		Texas Commission of Environmental Quality (TCEQ) to develop guidelines from scratch. For both Wichita Falls and Big Spring, extensive testing and verification required. While there was little precedent in terms of recycled water regulations, the Clean Water Act did assist indirectly in making a DPR facility possible.	US EPA (2017)
El Paso, Texas	38	USA	DPR and IPR. Groundwater augmentation and treated water augmentation. El Paso began treating wastewater to drinking water standards in the 1980s.				Discharge effluent as required by Clean Water Act permit to help maintain the river ecosystem.	US EPA (2017) and WSAA (2019)

Precedent Name	Volume (Ml/d)	Location	Brief overview of scheme	Technical Effects	Social Effects	Environmental Effects	Criteria required to allow diversion	Sources of Information
			The reclaimed water was supplied to unlined ponds where it took about a year to percolate back into the Hueco Bolson, mixing with the groundwater. El Paso now plans to build a new system which would put recycled water directly into the city's drinking water distribution network by 2020.					
Prairie Waters Project	190	Colorado, USA	The first stage of the Prairie Waters Project involves recovering water from South Platte River, close to the city of Brighton. This water contains a high degree of wastewater discharge (>80%). The recovered water is filtered and then pumped, via a pipeline back upstream of Aurora to the Peter Binney Water Purification Facility, adjacent to the Aurora Reservoir for Advanced water treatment. Subsequently, the water is blended in a ratio of 1:2 with Aurora's current supply and delivered to the city's distribution system.				The city of Aurora has limited availability of freshwater resources from which it can draw. However, it owns water rights in the South Platte River Basin. The net quantities of water than can legally be extracted are finite, but in most cases, Aurora's water rights allow the city to use the water "to extinction". That is, water which is returned to the river as treated municipal wastewater, may be recycled and reused without adding to the tally of legal water extractions. The Project was conceived and constructed to capitalise on this opportunity.	Water Research Australia (2022)
River Kelvin Valley Sewer Project – SEPA	N/A	Scotland, UK	This significant improvement in water quality is due largely to the £67 million Kelvin Valley Sewer (KVS) Project, which resulted in			The systematic removal of sewage inputs from the River Kelvin and its tributaries produced an		SEPA.org.uk

Precedent Name	Volume (Ml/d)	Location	Brief overview of scheme	Technical Effects	Social Effects	Environmental Effects	Criteria required to allow diversion	Sources of Information
			the closure of a number of separate sewage treatment works (STWs) between 1997 and 2003. Sewage from a number of communities is now diverted via the valley sewer and treated to a higher standard at Glasgow's Dalmuir STW before being discharged to the Clyde Estuary. This is not a water reuse project however the removal of water effluent is the same, and the effects of this loss on the affected water course has been documented which is useful for this assessment.			immediate improvement in chemical quality and, more recently, ecological improvements downstream of the former discharges.		
Colorado River Municipal Water District	5.7	Colorado, USA	CRMWD constructed the nation's first "direct potable reuse" facility to reclaim and clean previously used water for municipal use. Reclaimed water is treated then mixed with raw water (50/50) then distributed to treatment plants to undergo conventional drinking water treatment techniques.				The reclaimed water is carefully monitored for safety levels by both the state and District.	Reuse - CRMWD.ORG (2013)
Affinity Water Connect 2050 project	NA	UK	The investigation will inform the National Framework Environmental Destination for Affinity Water, ultimately supporting the Water Resource Management Plan 2024 (WRMP24) and the regional plan for the Water Resources in the South East (WRSE) group. Connect 2050 is an evolution of the previous 'Supply 2040' strategy, capturing the environmental destination scenarios and Strategic Resource Option (SRO) requirements.					AECOM (2021)

Precedent Name	Volume (Ml/d)	Location	Brief overview of scheme	Technical Effects	Social Effects	Environmental Effects	Criteria required to allow diversion	Sources of Information
			Review of available data; discussions with stakeholders; recommendations and delivery of more detailed assessment; development of options and assessment of benefits for upgrades to the existing Affinity Water strategic network.					
WateReuse California	NA	California, USA	WateReuse represents a coalition of utilities that recycle water, businesses that support the development of recycled water projects, and consumers of recycled water. WateReuse California is actively engaged in working with our appointed and elected officials to pass legislation and develop regulations that will accelerate the implementation of both non-potable and potable reuse. The depth and breadth of experience within the organization also makes us the go-to organization for communities who are advancing water reuse to meet local demand for water.					watereuse.org
United Utilities; Huntington Water Treatment Works abstraction; River Dee PR19 WINEP Study	NA	UK	United Utilities (UU) identified turbidity as a significant contributing factor to the resilient operation of the Huntington Water Treatment Works abstraction. AECOM was commissioned to help deliver a review of sources of turbidity across the catchment as part of a PR19 WINEP study. Ultimately this will identify measures to: • Improve catchment management to reduce sediment input and identify additional measures for future funding.					AECOM (2020)

Precedent Name	Volume (Ml/d)	Location	Brief overview of scheme	Technical Effects	Social Effects	Environmental Effects	Criteria required to allow diversion	Sources of Information
			• Reduce the scale and frequency of turbidity spikes. • Avoid the need for demand reduction; additional treatment and/or alternative supplies. • Ensure final treated water meets regulatory standards.					

*Regulations summary:

US federal and state legislation concerning reclaimed water is limited. Guidelines published by the EPA (USEPA 2012) discuss quality, quantity, uses, existing state regulations, and development programs, with the intent to assist state, regional, and municipal governments in designing reclaimed water policies. Since the first introduction of these guidelines, the focus has been protecting the reclaimed water customer from quality issues. Currently, these guidelines are the best tool for assessing reclaimed water projects and policies; however, they fall short in quantifying external impacts and are not legally binding. When assessing the displacement of wastewater effluent, further consideration of the impacts to downstream users must be considered.

The above seems to be generally true for the rest of the World as well, from the information found regarding UK, EU, and Australian regulations.

Summary

4.2.5 The industry-wide precedent search has identified that the scale and complexity (i.e., number of water transfer options, distance of conveyance) of the Minworth and SLR SRO schemes, while superficially similar to some of the identified existing schemes in the UK or abroad, are sufficiently unique to necessitate a bespoke approach with regard to their assessment. However, there are lessons that can be learned from the analysis of previous industry precedent.

4.2.6 The most relevant example identified by the precedent search is the Langford Water Recycling scheme (UK). Adjacent to Langford a pre-existing 15-km-long pipeline transported wastewater from Chelmsford sewage treatment works (STW) and discharged into the tidal waters of the River Chelmer. The recycling scheme provides advanced treatment to the effluent from Chelmsford STW, with the treated water discharged (up to 40 Ml/d) to the River Chelmer 3km upstream of the water treatment works (WTW) intakes. The recycled water is added to the flow of the River Chelmer allowing more water to be abstracted from the river downstream of the discharge point.

4.2.7 The importance of effective and well-planned communications with the public is highlighted with this scheme, which can help prevent a negative public perception.

4.2.8 This scheme was the first large scale example in the UK of planned indirect reuse of recycled water. Recycling was demonstrated to provide sufficient water sustainably, quickly and cost effectively with minimal impact on the environment.

4.3 SSSI Interaction

4.3.1 This section provides a summary of the conceptual model and impact assessment. Sites are described from upstream nearest the Minworth STW to downstream on the tidal River Trent.

4.3.2 Baseline data has been compiled and interpreted for each site in Appendix A Annex II. Site visits are described in Appendix A Section 4. A conceptual understanding and conclusions regarding the potential impacts of the SROs on each of the SSSIs is presented in Appendix A Section 5.

4.3.3 The assessment has considered whether surface waters in the SSSIs may be affected directly from lower flows in the rivers Tame and Trent, and whether changing water levels will affect groundwater levels that then may affect surface water features in the SSSIs. This has then been considered in the context of natural seasonal variation in water levels in the rivers and aquifers, and other features controlling water levels near the SSSIs such as weirs, abstractions, and discharges. This assessment has not considered climate change impacts.

4.3.4 The River Blythe is designated SSSI for its in-river habitats. The River Blythe is designated SSSI for the in-river environment, and therefore the overall impact assessment relates to riverine habitats and fisheries. Changes to River Tame levels are not considered to affect groundwater levels in the superficial deposits aquifer significantly to cause a significant change in baseflow in the River Blythe. The river level changes and effects of the surface water abstraction and weirs in the lower Blythe may affect fish passage. This is discussed in Section 4.4 and concluded (4.4.21) that fish passage would not be affected.

4.3.5 Whitacre Heath was found to have had all the superficial deposits removed by quarrying except for in the immediate vicinity of the River Tame and a thin outcrop across the site. The surface water features on site, consisting of ponds, are not connected to the superficial deposits, and so are hydraulically disconnected from the River Tame. The ponds are dependent on rainfall ponding on the low permeability ground comprising mudstone and pulverised fuel ash. The ponds are anticipated to also be supported by flooding of the site. The reduction in flow due to the Minworth SRO is not anticipated to prevent flooding of the site to support water features, with the maximum SRO volume as a proportion of flow during flood periods being 8% of Q5 flows.

4.3.6 The River Mease is designated SSSI for its in-river habitats. It has been established that the River Mease does not gain flow from the River Tame across the superficial deposits aquifer. Hydraulic modelling predicts an insignificant reduction in water levels in the River Trent near the confluence with the River Mease, with a maximum fall in River Trent levels of 8.2 cm at Q95. Groundwater levels in the superficial deposits aquifer are not expected to fall to levels that may cause flow loss from the River Mease to the aquifer. Therefore, the in-river habitats in the lower Mease are not considered to be affected by level changes in the rivers Tame and Trent.

4.3.7 Donington Park is classed as an SSSI due to the ancient oaks on site that provide a supporting environment for bats, deer herd and invertebrate fauna. It was found to not contain a hydrogeological or hydrological link with the River Trent, due to the SSSI being located on bedrock at significantly higher elevation that the River Trent. River levels can interact with the superficial aquifer and the Helsby Sandstone principal aquifer, but these are hydraulically separated from the bedrock underlying the SSSI, which comprises mudstone.

4.3.8 Lockington Marshes SSSI contains permanent wet mire, lowland fens and lowland mixed deciduous woodland. Holme Pit SSSI comprises of a flooded pit that contains some of the best remaining areas of marsh, reed swamp and open water in Nottinghamshire.

4.3.9 Attenborough Gravel Pits comprises a series of flooded gravel pits with islands and connecting causeways that have been colonised by vegetation over many years producing a mosaic of habitats which also include Lowland Fen and Reedbed Priority Habitats.

4.3.10 Lea Marsh SSSI is an important area of unimproved floodplain meadow and wet pasture with an unusually large area of a nationally rare grassland type. It is situated along the tidal reaches of the River Trent.

4.3.11 Attenborough Gravel Pits, Holme Pit, Lockington Marshes, and Lea Marsh SSSIs contain surface waters that have been found to not be directly connected to the River Trent. At high river levels streams on site were found to be at higher elevation and discharging under gravity. Sluices also control outflows, and therefore surface waters on the site are not supported by high river levels backing up across the SSSIs. Changes in river level may propagate through the superficial aquifer toward surface water features at the SSSIs.

4.3.12 The water level changes predicted by hydraulic modelling are a maximum fall in River Trent levels of 1.8 cm at Q95 above Beeston Weir upstream of Attenborough Gravel Pits and Holme Pit; and a maximum fall in River Trent levels of 4.2 cm at Q95 below Beeston Weir is predicted where Holme Pit stream discharges to the River Trent. Modelling predicts a maximum fall in River Trent levels of 2.6 cm at Q50 at the nearest location to Lockington Marshes upstream of the River Soar confluence. These changes are not considered to be significant in the context of the natural seasonal variation and may not persist as far as SSSI water features considering local recharge and rainfall events affecting river levels.

4.3.13 Humber Estuary SSSI is the second largest coastal plain estuary in the UK and contains features such as mud and sand flats, saline lagoons, salt marshes, and sub-tidal sandbanks.

4.3.14 Lea Marsh SSSI and Humber Estuary SSSI are in the tidal reaches of the River Trent. Modelling predicts a maximum fall in water level above Cromwell Weir and downstream of the proposed SLR abstraction from the Minworth and SLR SROs combined of 4.8 cm at Q95, which is considered to be insignificant relative to the daily change in water levels resulting from the tides.

4.3.15 Therefore, the Minworth and SLR SROs are not anticipated to have a significant effect on water levels at the SSSIs along the tidal River Trent.

4.3.16 Therefore, no SSSI water features are considered to be at risk of impacts from transmission of changing river levels via groundwater level impacts. Of all the SSSIs investigated the River Blythe SSSI may be at risk due to lower water levels due to direct transmission via the River Tame and lower River Blythe. These effects were considered as part of fish passage assessment (4.4.21) and found no significant risk.

4.3.17 Section 5 summarises recommendations and mitigation options for the SSSIs.

4.4 Ecology

Terrestrial Ecology

Background

4.4.1 A total of 26 floodplain locations and riparian habitats within 500m of the Rivers Tame and Trent (hereafter referred to as the Study Area), were identified with potential to support sensitive wetland habitats from aerial imagery and then subject to preliminary ground truthing survey visits during winter or spring 2021/22.

Wetland Habitats and Designated Sites

4.4.2 Six wetland habitat types were recorded during the preliminary ground-truthing survey visits to the 26 sites:

- Coastal saltmarsh, a habitat of principal importance in Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006. This habitat is represented by a zonation of salt tolerant plant communities between upper saltmarsh and intertidal mud.
- Grassland medium/high (UKHab name) = lowland meadow, a habitat of principal importance This includes grassland characterised by meadow foxtail (Alopecurus pratensis) and great burnet (Sanguisorba officinalis).
- Wetland = wet grassland. This grassland is characterised by an abundance of rush species (Juncus spp.) and/or sedge species (Carex spp.) which are adapted waterlogged ground.

- Wetland = swamp. Characterised by tall emergent and ruderal plants including bulrush (Typha latifolia), reed canary-grass (Phalaris arundinacea), great willowherb (Epilobium hirsutum) and common nettle (Urtica dioica).
- Wetland = reedbed, a habitat of principal importance. This habitat is characterised by mono-dominant stands of common reed (Phragmites australis).
- Woodland = wet woodland, a habitat of principal importance. This habitat is characterised mainly by willow species (Salix spp.) and/or alder (Alnus glutinosa).

Wetland Birds

4.4.3 A total of 12 sites within the Study Area identified during the Gate 1 desk-based review were assessed to be of particular importance to breeding, passage and/or wintering wetland birds, which are:

- Humber Estuary Special Protection Area (SPA) and Ramsar site are of international importance for breeding, passage and wintering waterbirds.
- Attenborough Gravel Pits Site of Special Scientific Interest (SSSI) is of national importance for wintering waterbirds.
- Alkborough Flats Local Wildlife Site (LWS) is of at least county importance for breeding, passage and wintering waterbirds.
- Ladywalk LWS is of county importance for breeding, passage and wintering waterbirds.
- Whitacre Heath SSSI – is of county importance breeding waders.
- Lea Marston Lake LWS and Coton Pools LWS are of county importance for breeding, passage and wintering waterbirds.
- Kingsbury Wetlands (Water Park) LWS is of county importance for breeding, passage and wintering waterbirds.
- The Royal Society for the Protection of Birds (RSPB) Middleton Lakes is of county importance for breeding, passage and wintering waterbirds.
- Drakelow Reserve LWS is of county importance for breeding, passage and wintering waterbirds.
- Netherfield Lagoons LNR and Netherfield Pits LWS are of county importance for breeding, passage and wintering waterbirds.
- E.ON Meadows (Whitacre Flood Meadow LWS and Whitacre Pool LWS) is of district/borough importance for small numbers of wintering waterbirds.
- Clifton Grove, Clifton Woods & Holme Pit Pond LNR (including Holme Pit SSSI and Trent Carr LWS) is of district/borough importance for breeding and wintering waterbirds.

Otter and Water Vole

4.4.4 Records of otter (*Lutra lutra*) have been returned from several clustered locations within the Study Area since 2012, these are:

- upstream of Tamworth
- Alrewas
- Willington
- Attenborough, Nottingham
- Newark-on-Trent
- Sutton-on-Trent
- Gainsborough
- Althorpe

4.4.5 Water vole (*Arvicola amphibius*) has a more restricted distribution within the Study Area compared to otter. Since 2012 water vole records have been returned from sites along and near the River Trent downstream of Burton-on-Trent to the Humber Estuary. Downstream of Sutton-on-Trent records of

water vole are more prevalent and clustered around the floodplain drainage ditches near Gainsborough and Althorpe.

Conclusions

4.4.6 The river level, depth, and wetted perimeter changes as a consequence of both SRO schemes have been determined through hydraulic modelling. From the preliminary model results, it appears that changes in river level, depth and wetted perimeter are very minor and only prevalent during extreme low flows. The greatest change in river level for the 'worst-case' 230 Ml/d scenario, for the upper Tame, are as follows:

- between Ladywalk LWS and Whitacre Heath SSSI, the predicted river level -19.1cm, depth diff -16.4% (Q95[17]) [for the 115 Ml/d scenario the modelled changes are -9.1 cm depth; -7.82% at Q95];
- between Coton Pools LWS and Kingsbury Water Park LWS; the predicted river level -19.8cm, depth diff -18.3% (Q95) [for the 115 Ml/d scenario the modelled changes are -7.9 cm depth; -7.31% at Q95]; and
- The lowest effect on the Tame is at Broadmeadow LNR, Tamworth; predicted river level -7.3 cm, -3.56% at Q95 [for the 115 Ml/d scenario the modelled changes are -3.1 cm depth; -1.51% at Q95].

4.4.7 As demonstrated by the model results above, the effect of flow reductions on the River Tame rapidly diminish downstream, in particular after the confluences with tributaries such as the River Anker, downstream of Broadmeadow LNR.

4.4.8 Seasonal winter flooding of the Tame and Trent floodplains is predicted to continue and will be not affected by these SRO schemes. The SRO schemes are predicted not to have a significant effect on water levels on wetland habitats along the tidal River Trent (downstream of Cromwell Lock).

4.4.9 The hydrological assessment has considered whether surface waters in the SSSIs may be affected directly from lower flows in the rivers Tame and Trent, and whether changing water levels will affect groundwater levels that then may affect surface water features in the SSSIs. This has then been considered in the context of natural seasonal variation in water levels in the rivers and aquifers, and other features controlling water levels near the SSSIs such as weirs, abstractions, and discharges.

4.4.10 From the preliminary model results no significant effect on river baseflow levels that then may affect surface water features which sustain wetland habitats and species (wetland birds, otter, and water vole) within the Study Area are predicted. However, there are opportunities for habitat creation or enhancement for these habitats and species, as well as ensuring connectivity of designated sites and habitats to the River Tame and River Trent; see below.

Recommendations

4.4.11 If and when the SRO scheme(s) come to planning and construction, a view will need to be taken on where the minimum 10% biodiversity net gain is applied. If it is applied to the sites impacted by the Minworth diversion, then it is recommended that opportunities to create and enhance wetland habitats within the Study Area are progressed during Gate 3. The creation of new wetlands within the Study Area will particularly benefit those species associated with those habitat types. The selection of candidate wetland habitat creation and enhancement sites will need to be discussed with local biodiversity groups and will aim to benefit key species. Also at Gate 3, it is proposed that preliminary botanical and ornithological surveys will take place at candidate wetland habitat creation and enhancement sites in order to establish baseline conditions prior to inform potential site works, including to ensure the continued connectivity of designated sites and habitats to the River Tame in high flows (which do not over-top) via backwaters, side channels, fish refuges, etc.

[17] The flow value at which 95% of all recorded daily flows are higher, so a low flow, which is likely to occur during the summer.

Aquatic Ecology

Water Framework Directive Status

4.4.12 Aquatic ecology is monitored along the Rivers Trent and Tame by the Environment Agency (EA) for the purpose of the WFD. An appraisal of EA biological monitoring data, supplemented with data from surveys undertaken by AECOM during 2021/2022, and ecological WFD classification for the rivers Tame and Trent within the study area has been completed.

4.4.13 The official 2019 WFD classification showed the River Tame to be of Poor biological status throughout, whilst classification derived from AECOM data indicated the river improved from Bad to Moderate biological status moving downstream within the study area (the latter based on one year of targeted monitoring only). Reasons for not achieving good (RNAG) assigned by the EA include diffuse pollution and physical modification resulting from urbanisation of the water course, point source intermittent and continuous sewage discharge from waste water treatment, and diffuse pollution due to poor livestock management. Severn Trent Water has recently published its River Pledges[18], which are aiming to remove these wastewater discharge RNAGs throughout the region by 2030.

4.4.14 The 2019 WFD classification for the River Trent showed the watercourse to vary in biological status from Moderate in the middle reaches (between the River Dove and The Beck confluences), to Bad at the downstream extent, and Poor in the reach immediately downstream of the confluence with the River Tame. Classification derived from AECOM data, however, indicated the river to be of Poor biological status throughout. RNAG cited include diffuse pollution from poor livestock management, urbanisation of the water course, transport drainage and poor soil management, alongside intermittent and continuous point source sewage discharge from waste water treatment.

4.4.15 Trend analysis of the available survey data indicated water quality, in particular nutrient/organic enrichment demonstrated in diatom and macrophyte data trends, and/or habitat pressures were present at various reaches of both rivers. These pressures were most evident at sites located on the River Tame.

Fish Passage at Weirs

4.4.16 A total of 25 barriers have been reviewed within the Gate 2 to appraise how fish passage rates may change due to the SRO schemes. Of these, 23 were scoped during Gate 1 along Rivers Tame and Trent. The other 2 were included during Gate 2: one of these was identified during the site visits carried out, located in River Tame within Lea Marston Lakes; the second is located in the River Blythe and it was included following advice that there was a potential barrier on the lower reaches of River Blythe.

4.4.17 Site visits were undertaken to each of the 25 barriers and observations regarding the hydraulics and in channel access at each site were made. In addition, the site visits provided useful information such as the presence of fish passes already installed on weirs and allowed evaluation of its condition. Overall, it was identified that just 7 of these barriers have fish passes installed though 3 of us are considered to be suboptimal or defunct.

4.4.18 In addition, liaison has been undertaken with Fisheries Officers at the Environment Agency who cover the area in which the Tame and Trent barriers lie. We have discussed each scheme and their potential effects and also obtained further information on the sites, such as design drawings of existing fish passes.

4.4.19 The literature review provided further information of future modifications proposed at the sites of study which will enable fish passage upstream of these barriers. Future modification plans have been drawn up at 12 of these barriers (some at currently sub-optimal fish passes). These modifications are mainly included within HEP schemes proposed adjacent to weirs. Other weir modifications are considered within the Lea Marston Lakes system restoration scheme or local fish passage reviews at weirs.

4.4.20 Hydraulic modelling has been undertaken to appraise the effects of the SROs on fish passability. Hydraulic models have been developed for the River Tame within the study area, and for the River Trent as far downstream as Burton Joyce, slightly upstream of Gunthorpe Weir. For these reaches

[18] https://www.stwater.co.uk/get-river-positive/

results have been provided for the Q_{50} (median) and Q_{95} (low) flow conditions for Baseline scenario (including 450 Ml/d dry weather flow at Minworth WwTW); Scenario A (115 Ml/d flow reduction at Minworth WwTW); and Scenario B (230 Ml/d flow reduction at Minworth WwTW).

4.4.21 Three of these barriers have been screened out to carry out further assessment. These are Site 1, Site 2, and Site 25. The first two are located upstream of the discharge and it is deemed variation on the Minworth WwTW would not affect fish passability. In addition to this, there is an eel pass at Site 1 and further fish passes have been proposed (i.e., low-cost baffles). Site 2 is a bridge with flowing river beneath and as such it is not considered to be a barrier. Lastly, Site 25 is a submerged weir on the River Blythe where previous hydrological assessment determined that at all flows, the weir is drowned out with enough water depth to enable fish passage.

4.4.22 Overall, results for Site 3 to Site 24 indicate that flow reductions at Minworth WwTW would negatively affect fish passability. This is mainly due to reductions on water depth which are translated on an increment of the head drop at the weirs but also as such drops can also reduce the efficacy of existing fish passes, where present. At the majority of these locations 2D modelling will be necessary to unpick the relative effects of the SROs on fish passage.

4.4.23 In addition, consideration of future modifications will need to be considered. This will be the case of the Lea Marston Lakes restoration as it will remove barriers. Also, these modifications could potentially affect the hydraulics on River Tame and subsequently River Trent.

4.4.24 Initial 1D hydraulic modelling results have been provided with further runs being undertaken (e.g., Q10). Depending on timeframes, further analysis of model results may need to be undertaken during Gate 3 (noting that 2D is preferred for future phases).

4.5 River Mease SAC

Hydrological Assessment

4.5.1 Liaison with the Environment Agency, Natural England, and Severn Trent Water (STW) has been undertaken, along with data requests for key information and hydrological data. The River Mease hydrological assessment being undertaken by the EA has focused on assessing existing flows within the Mease SSSI/SAC against the Common Standards Monitoring Guidance (CSMG) to identify if removal of wastewater discharge at Packington WwTW and Measham WwTW can aid the return of flows in the River Mease to a ‘natural’ state.

4.5.2 Whilst the full report of the River Mease hydrological assessment study referred to within the scope has not yet been available at the time of reporting, the Environment Agency presented the initial findings of the study, including the main outcomes, and the associated spot flow gauging data used within the study. This has informed a better understanding of the potential impacts of the removal of WwTW discharges and how these may interact with the wider objectives of the Minworth SRO scheme.

4.5.3 Liaison with Severn Trent Water identified three ‘pump out’ options for the future destination of WwTW flow removal; only general details were provided for potential destinations for diverted discharges, these being:

- River Tame – upstream of the confluence with the River Trent and the discharge of the River Mease into the River Trent.
- River Trent – in the vicinity of the River Mease discharge into the River Trent.
- Staunton Harold Reservoir – provided that there are no drinking water issues (i.e., the effluent is treated to a high enough standard).

4.5.4 The delivery of the agreed option (to be confirmed) will be by March 2027. The impacts of the removal of wastewater effluent have been shown to have a greater impact on flows within the Gilwiskaw Brook (a tributary of the River Mease) and will reduce as contributing catchment area increases in a downstream direction. In addition, the CSMG target flow standard deviation from naturalised flow

increases from 5% at <Q95 between Packington and Snarestone to 10% at <Q95 between Snarestone and the confluence with the River Trent.

4.5.5 Based on information provided by the EA, existing flows are outside of the CSMG target flows. The removal of wastewater effluent from Packington WwTW and Measham WwTW will return flows to a natural state that fall within the CSMG target flows.

4.5.6 As per the SSSI Interaction assessment[19], it has been established that the River Mease does not gain flow from the River Tame across the superficial deposits aquifer. The flows and levels in the lower River Mease are not anticipated to be influenced by changes in River Tame levels via hydraulic continuity with the river terrace gravels secondary aquifer, and therefore are not expected to be affected by reduction in discharge at Minworth. River flows are dependent on local recharge to the superficial aquifer and the sandstone principal aquifer in its upper reaches and upstream discharges.

4.5.7 Based on contour mapping, there is a reduction in elevation between SK 2040 1996 (55 m contour) and SK1929 1440 (50 m contour) over a 4 km distance on the River Mease. The effects of a reduction in water level in the River Trent associated with a reduction in discharge at Minworth are unlikely to propagate significantly upstream on the River Mease.

4.5.8 Hydraulic modelling has been used to assess the impact of in-combination effects on water levels at the confluence of the River Mease and River Trent. Modelling outputs indicate a fall in River Trent levels of no more than 8.2 cm at the confluence with the River Mease (with a 230 Ml/d flow reduction at Minworth WwTW, equivalent to both GUC and STT operating at their maximum – i.e., a worst-case scenario), which is not considered significant compared to seasonal variation in river levels, aquifer recharge, and the influence of discharges and evaporative losses from former quarry lakes on river levels.

4.5.9 With respect to variation in river levels on the River Mease, the lowest level recorded at Clifton Hall (12 km upstream of confluence with River Trent) is 0.086 m Above Stage Datum (mASD). The highest recorded level is 2.353 mASD. Stage typically varies annually up to 1.2 mASD based on flows up to circa 5 cumecs, during flood events, this stage will be exceeded.

Habitats Regulations Assessment

4.5.10 The Natural England standing advice for the River Mease SAC describes the river as containing a diverse range of physical in-channel features including riffles, pools, slacks, vegetated channel margins and bankside tree cover, providing the conditions necessary to sustain populations of spined loach (*Cobitis taenia*) and bullhead (*Cottus gobio*). The river is also considered to support a significant presence of water-crowfoot (*Ranunculus* spp.) and water-starwort (*Callitriche* sp.).

4.5.11 The River Mease is primarily designated as a SAC due to its population of spined loach, for which the SAC is one of only four known outstanding localities in the UK, as well as for its population of bullhead. Although not primary reasons for site selection the SAC also qualifies due to its floating vegetation often dominated by water-crowfoot and because it has a significant presence of both otter (*Lutra lutra*), and historically white-clawed crayfish (*Austropotamobius pallipes*).

4.5.12 The conservation objectives of the SAC are to 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;

[19] AECOM (2022). Environmental Assessment for the Trent Strategic Resource Options (SRO) – Minworth SRO and South Lincolnshire Reservoir SRO – Appendix A: SSSI Interaction (REP-003A).

- the populations of qualifying species; and
- the distributions of qualifying species within the site.

4.5.13 The principal risks to the integrity of River Mease SAC20 are:

- water pollution;
- drainage discharges;
- inappropriate weirs and dams and other structures within, and adjacent to, the river corridor, thus blocking movement of fish or otter;
- invasive species;
- siltation; and
- water abstraction.

4.5.14 The river is vulnerable to deterioration of water quality from agricultural runoff, direct pollution, and discharge of treated sewage effluent. According to the Environment Agency, the current water quality status of the river is either poor or moderate with a target to be good by 2027[21]. The river is not currently achieving its target due to 'rural diffuse pollution and water company point source pollution'. Like any river, it is also vulnerable to excessive abstraction for public water supply, particularly at inappropriate times of year such as periods of low flow, around summer.

4.5.15 For the Gate 2 study, an investigation has been undertaken into potential hydrological linkages between the River Tame and the River Mease SAC. The underlying geology for the River Mease consists of superficial river terrace deposits overlying the Gunthorpe Member (comprising mudstone). The river terrace deposits allow for more groundwater movement and infiltration of surface water due to their high permeability, whereas the Gunthorpe member has very low permeability. It therefore allows limited amounts of groundwater movement and there is limited infiltration from surface water. Due to the high permeability of the river terrace deposits, it is expected that these deposits will have relatively high hydraulic conductivity and interact with the River Mease, providing baseflow.

4.5.16 The accretion data indicate that the Mease does not gain additional baseflow from the superficial aquifer in the Tame surface water catchment at the expense of the River Tame but continues to accrete from baseflow from the superficial aquifer within the Mease surface water catchment. The flows and levels in lower River Mease will therefore not be influenced by changes in River Tame levels via hydraulic continuity with the river terrace gravels secondary aquifer and are therefore not expected to be affected by reduction in discharge at Minworth. Rather river flows are dependent on local recharge to the superficial aquifer and the sandstone principal aquifer in its upper reaches, and upstream discharges.

4.5.17 Moreover, even under the scenario with a 230 Ml/d flow reduction at Minworth (equivalent to both GUC and STT operating at their maximum) the predicted fall in River Trent levels (8.2 cm at Q95 and 5.2 cm at Q50) is not considered likely to lower groundwater levels in the lower Mease area sufficiently to result in loss of flow to the superficial secondary aquifer, compared to seasonal variation in river levels, aquifer recharge, and the influence of discharges and evaporative losses from former quarry lakes on river levels.

4.5.18 Water levels are recorded on the River Trent near the confluence with the River Mease at Croxall. Water levels show a seasonal variation in excess of 1 m. Water levels are recorded on the River Tame at Tamworth, upstream of where River Tame water levels may interact with the superficial aquifer considered to be in hydraulic continuity with the lower River Mease. The gauge shows a typical seasonal variation of approximately 0.3 m, with occasional brief peaks in excess of 1m higher than the typical range.

4.5.19 Abstractions and discharges local to the site may influence flow and river levels. The Gate 1 assessment identified that there are no significant surface water abstractions near the mouth of the

[20] Natural England Site Improvement Plan: River Mease SAC
http://publications.naturalengland.org.uk/publication/6640857448972288
[21] http://environment.data.gov.uk/catchment-planning/OperationalCatchment/3303/Summary [Accessed 17 September 2018]

River Mease as it flows into the River Trent. There are five discharge points close to the mouth of the River Mease which are associated with Barton quarry and Alrewas quarry, discharging to the River Tame and River Trent. However, these locally augment flow near the River Mease and may support local groundwater levels in the superficial aquifer and are therefore not expected to reduce flows in the Mease in combination with the Minworth SRO.

4.5.20 Since changes in levels and flows in the River Tame will not affect levels and flows in the River Mease SAC, and even the maximum reduction in flow at Minworth would not result in a sufficient fall in River Trent levels to materially affect the superficial aquifer linked to the lower River Mease, it can be concluded that the Minworth SRO **will not result in a likely [adverse] significant effect** on the River Mease SAC or its qualifying interest features either alone or in combination with other plans and projects.

4.5.21 Moreover, since both white-clawed crayfish and bullhead are species preferring relatively shallow water (as identified in the Supplementary Advice on the Conservation Objectives for River Mease SAC) it is understood that Natural England have an aspiration to reduce flow levels in the River Mease SAC to restore them to a more natural level compatible with its international interest features. This is reflected in the SAC target (associated with the Supplementary Advice on the Conservation Objectives) to 'Restore the natural flow regime of the river, with daily flows as close to what would be expected in the absence of abstractions and discharges (the naturalised flow)'. As such, it is possible that the Minworth SRO could make a minor positive contribution to this objective when considered in combination with the planned reduction in flows in the River Mease that will arise from the Environment Agency's intention to relocate the discharge from Packington WTW on the Gilwiskaw Brook out of the River Mease SAC catchment, although any beneficial in combination effect will be very minor.

4.6 Invasive Non-Native Species

4.6.1 The purpose of the INNS evaluation was to assess the impact of INNS on the River Tame and Trent system, and the River Witham, of:

- the existing INNS risks associated with the Minworth WwTW (i.e. the potential for INNS propagules to survive the treatment process) - this element of the assessment was specifically identified as part of the scope following the Gate 1 baseline assessment, due to the apparent prevalence of INNS in the River Tame and surrounding area, and the uncertainty regarding the additional treatment required for the Minworth SRO at that stage;
- the INNS risks associated with the reduction of discharge from Minworth, which currently discharges a dry weather flow of c.450 Megalitres per day (Ml/d); and
- the potential abstraction of up to 300 Ml/d for the SLR SRO from the River Trent to discharge to the River Witham.

4.6.2 The assessment has considered the following:

- A baseline assessment of the hydrological context, the INNS records, and ecological receptors.
- Use of the EA INNS Risk Assessment Tool for:
  - Minworth SRO: the existing INNS risk associated with Minworth WwTW asset; and
  - SLR SRO: the risk of INNS transfers to the River Witham via the RWT.
- EA RWT prioritisation guidance[22] (PR19) for the SLR SRO.
- Further consideration of the INNS risks at Minworth beyond the EA INNS tool:
  - a review of the INNS on the Minworth WwTW site and downstream riparian zone;

[22] Environment Agency (2017). PR19 – Assessing the risks of spread of invasive non-native species posed by existing water transfers

  - an assessment of the existing INNS sources associated with the Minworth WwTW, including potential for INNS to survive the treatment process, based on a literature review and relevant experience, and if these were relevant to the SRO; and
  - an assessment of the potential effects to the River Tame INNS species with reduced flows due to the Minworth SRO transfer.

- Further consideration of the INNS risk at the Trent SLR beyond the EA INNS tool:
  - consideration of the potential reaches of the River Witham that could become colonised by INNS with no mitigation in place; and
  - review of the survivability of the INNS with mitigation in place.

Minworth SRO

4.6.3 The risks associated with Minworth WwTW in relation to INNS were as follows:

- SRO INNS Risk Assessment Tool – Minworth WwTW asset risk score of 38.6%;
- There is existing risk associated with INNS growth within the WwTW; however, it falls outside the scope of the SRO assessment and is covered by an existing BMP. Regardless, this risk will not increase due to the scheme, and may decrease due to proposed tertiary treatment;
- An existing low risk associated with WwTW staff bringing INNS into to site and/or spreading INNS away from site; however, this risk will not increase due to the SRO scheme and is covered by an existing BMP; and
- Low risk associated with the Minworth SRO reduced flows within the River Tame, as, while habitat disturbance could facilitate existing INNS to expand range, the relevant stretch of the River Tame is already very well colonised.

SLR SRO

4.6.4 The risks associated with Trent SLR in relation to INNS were as follows:

- EA SRO INNS Risk Assessment Tool –
  - SLR SRO (Trent to Witham Transfer) INNS RWT risk score of 62.63%;
  - However, it is noted that there is an existing connection between these waterbodies via the Fossdyke Canal, which connects to the River Witham downstream of the proposed SRO at the Brayford pool in Lincoln, which has a higher risk score of 76.25%.
- The EA RWT significance assessment indicates that the transfer is very high significance for the 40 km stretch of the River Witham that, based on this assessment, is not currently connected to the Trent. Downstream of the existing connection (i.e., the Fossdyke Canal) should be reduced to high significance (due to a new connection between catchments being created but taking into account the nature of the existing connection).
- As such, the key area of interest with the SLR is to the approximately 40km reach between the SLR outflow and the downstream existing hydrological connection at Brayford Pool (Fossdyke Canal).
- There is a high risk associated with the SLR SRO transfer, without any mitigation, which reduces to low with mitigation.

Recommendations

4.6.5 The following are recommended for further assessment:

- Identification of catchment level INNS management schemes with the Trent and Witham catchments, so that options for cooperation can be identified that would allow for best outcomes with respect to potential mitigation.
- Complete additional INNS surveys, i.e., of the upper River Witham and River Trent at/near the abstraction point, so that Biosecurity Management Plans (BMPs) can be developed and targeted at high priority species, especially those not already recorded within the Witham.
- Carry out a survey-based barrier assessment of the River Witham (40 km reach discharge to Brayford Pool), to better understand the potential of onward spread should introductions to the Witham occur.
- Assess wider INNS introduction potential to the River Witham, to help better understand the actual likely benefit of implementing INNS mitigation to prevent spread from the River Trent.
- Research impacts of existing water transfers on INNS spread, to better understand resistance of traditional transfer infrastructure to INNS spread, with a focus on impacts of pumps and piping over distance on INNS survival at various life stages.
- Identify the optimal combination of potential mitigations that results in an acceptable risk profile.

4.6.6 The following mitigation measures should be investigated further as the scheme develops and an optimal combination (i.e., the lowest number of mitigations that, combined, results in an acceptable risk profile) implemented:

- The existing Biosecurity Plan at Minworth WwTW, developed by STW, will be implemented over the next few years. This is aimed to mitigate the existing INNS risks at Minworth WwTW and should be checked to ensure it covers the risks identified by this assessment.
- Monitor a buffer downstream of the Minworth WwTW discharge for habitat destabilisation (with the potential to facilitate INNS), following reduction in flow from Minworth and develop a rapid response protocol (i.e., targeted herbicide treatment of relevant INNS, i.e., those not already widespread, until habitats re-stabilise, if destabilisation occurs).
- Integrated treatment system included at the pipeline inlet for the SLR SRO transfer, potentially including, passive screens, deflection, active screens, pumps (assessed for potential to further neutralise INNS), piping over distance, and ‘safety nets’ at discharge, with monitoring and rapid response.
- Enhance catchment level biosecurity implementation (clean check dry), especially in close proximity to the Trent SLR SRO abstraction, to minimise the potential for new INNS to be introduced, or existing INNS to be further spread.
- Collaboration with wider, catchment level, control efforts where control is feasible and/or beneficial to the SLR SRO transfer – once identified by the assessment recommended above – to be explored further in consultation with stakeholders/Regulators beyond Gate 2.

4.7 Sedimentation

4.7.1 Consultation with the Environment Agency for the Gate 1 assessments for the whole of the Tame and Trent to the Humber identified that geomorphology and sedimentation baseline data for the study area were largely unavailable. Instead, indicative data were synthesised by AECOM, to map areas along the River Tame and River Trent channels that are likely to have relatively high risks of sedimentation and are likely to be sensitive to changes around Minworth and the SLR abstraction.

4.7.2 The Gate 2 sedimentation assessment for the Minworth and SLR SROs builds on Gate 1 scoping, to review targeted impact zones using fluvial audit desk-based surveys and field surveys where the river banks are safely accessible.

4.7.3 River geomorphological information has been obtained by direct correspondence with the EA, including through site walkovers guided by local EA catchment officers. Direct liaison with the EA through Gate 2 has also uncovered considerable historic river information that was not available at Gate 1, including records of historic river restoration schemes, especially through the River Tame,

which have been implemented inclusive of sedimentation considerations as a key component of holistic ecological processes. Generally, however, geomorphology studies and especially sediment data are lacking for the River Tame and River Trent.

4.7.4 Sediment monitoring in particular is recommended, since this would provide a quantitative baseline from which the effects of the SROs could be measured, including the performance of mitigation measures.

River Tame Overview

4.7.5 The River Tame is highly urbanised across its upper catchment, and consequently highly modified throughout the study area, including extensive channel straightening, deepening and floodplain disconnection by embankments in more rural areas downstream of Birmingham. Not all River Tame waterbodies are designated Heavily Modified Water Bodies (HMWBs), but all are substantially non-natural, and all fail to meet Good WFD Status / Potential. This is due to intense historic catchment development, physical modifications, and urban (and to a lesser extent agricultural) pollution, across the entire catchment and through the river corridor.

4.7.6 Existing sedimentation risks are generally elevated throughout the river. This has been judged as due to excess sediment delivery from the catchment surface, and channel deepening and embankments that prevent sediment sequestering onto floodplains and concentrate sediment within channels.

4.7.7 The Minworth discharge delivers treated effluent including sediment into the River Tame, which is likely to include a high proportion of organics. Organic and biological substances have an important role in fine sediment flocculation. It is likely that the effluent also contains flocculants added as part of the wastewater treatment process, to increase sediment settling rates for the purposes of separating sediment from water. Sedimentation in the River Tame is therefore likely to be enhanced in the reaches downstream of the discharge, especially where the floodplains are disconnected by embankments, which would concentrate sediment in the channel, rather than allowing it to settle to floodplains. This will have a detrimental impact on local bed habitats, due to increased delivery of physical and bio-chemical pollutants into the channel bed. Reducing the Minworth discharge should therefore have inherent benefits for sediment delivery and sedimentation.

River Trent Overview

4.7.8 The River Trent is generally more rural but is similarly affected by the land use changes across the majority of its catchment. Land use is mainly agricultural, which includes extensive flood embankments to enable farming of large fertile floodplains. The majority of the study area lies within the Trent from Soar to The Beck WFD water body, which is a HMWB due to navigation, urbanisation, and flood protection.

4.7.9 Sediment loads are natural high but are elevated due to anthropogenic activities throughout the catchment and tributaries (including the River Tame). The Trent in the study area is navigable, with a series of weirs artificially raising water levels, and these impoundments also increase sedimentation.

SRO Sedimentation Risk Assessment

4.7.10 Hydraulic modelling is being undertaken to investigate the scale of impact of the SROs on current flow rates and depths. At this stage, model results are preliminary, and as such detailed analysis of implications for sedimentation has not been undertaken.

4.7.11 Sediment transport modelling, based on hydraulic model outputs, is not feasible until hydraulic model results are finalised. Sediment transport modelling is highly complex, but high-level assessments would be informative and could be used to quantify the sedimentation effects of the SROs

4.7.12 It is intended that sediment transport formulae are applied to the SRO hydraulic model results to provide quantitative analysis of sedimentation effects. At this stage, initial results have been reviewed for flow depths and velocities, in order to provide commentary on sedimentation risks.

4.7.13 Modelling presently focusses on baseflow hydraulic properties, and does not include sediment transport, spate or flood events, or floodplain inundation events. Floodplain connectivity is a critical component of sediment systems, since floodplain inundation frequencies, extents, and durations control rates of out-of-channel floodplain sedimentation. Flood and sediment modelling is recommended for Gate 3.

4.7.14 Initial model results at the time of reporting are only available for the River Tame. For the River Trent, flows are controlled by navigation weirs, so any reduction in flow is unlikely to have a significant effect on flow depths and rates, and associated sediment processes.

4.7.15 Flow reductions will clearly have some effect on sedimentation. Less flow will increase sediment concentrations, and reduced flows will have less sediment transport capacity, which will increase sedimentation rates. However, the effects are likely to be negligible in the context of other catchment scale river modifications.

4.7.16 Overall, the model results for the River Tame show small impacts on flow depths. The greatest percentage reductions are typically highest upstream of Lea Marston lakes. However, absolute values of depth reductions are very small, generally 0.15m or less. Depth changes of this magnitude are unlikely to have any significant impact on shear stress, sediment transport capacity, or sedimentation.

4.7.17 The maximum reduction in velocity modelled for the study area is 0.133 m/s. This is a small change and would not necessarily translate to a problematic reduction in sediment transport competence or an increase in sedimentation rates.

4.7.18 The SRO impacts would be on baseflow. It is generally expected for most rivers that 95% of sediment transport takes place within 5% of time, i.e., during spate and flood events. Baseflow reductions are unlikely to significantly affect spate or flood events and are therefore unlikely to significantly affect sediment transport rates.

4.7.19 There will still be significant levels of flows under all modelled SRO scenarios, and the Minworth discharge actually appears to artificially elevate baseflows above natural baseline. In this sense, the depth reduction may even support minor improvements in the hydromorphological character of the Tame. It was noted during the site walkover that in some locations gravel bed features are only intermittently visible or submerged entirely at baseflow. As such, a reduction in depth could expose these features which would benefit bed habitat diversity.

4.7.20 It is important to recognise that excess sediment in the river is due to channel and land use modifications at catchment scale over time, so small changes in baseflows may not have visible or measurable effects on sediment loads.

4.7.21 The SRO effects will be one modification to the hydromorphology of the River Tame and the River Trent of a broad range of far more extensive physical modifications across the entire catchments. Flow characteristics do not appear to be a primary control on sedimentation risks in either river. Excess sediment delivery from catchment land uses, and over-deep channels with embanked and disconnected floodplains appear to be much more significant risk factors.

4.7.22 Floodplain inundation is a critical function in river sediment systems, so in principle, the greatest risk of the SROs is to reducing floodplain inundation frequency, which would reduce floodplain sediment sequestration, and increase channel sediment loads. Model results are not available for peak events or floodplain inundation, but a percentage change in baseflow is not anticipated to have a significant effect on flood peak frequency, depth, or duration.

4.7.23 In conclusion, it is not expected that sedimentation risks would be severely impacted by the SRO options. The SRO effects are likely to be minor, may not be statistically significant in terms of sedimentation, but will undoubtedly contribute to cumulative catchment impacts.

4.7.24 Investments in the SROs should therefore consider river restoration measures to physical river changes in order to mitigate the effects of catchment water uses.

4.7.25 In recognition of severe historic impacts on the morphology, water quality and ecology of the River Tame, and the Environment Agency has invested considerably in mitigation and river restoration

measures over several decades. The SRO may be an opportunity to support this programme of ongoing actions, and the restoration efforts to date are valuable for informing future schemes on the River Tame and the River Trent.

4.7.26 For both rivers and SROs, mitigation in terms of making space for water is critical. Opening out river corridors and setting back or removing embankments to reconnect floodplain wetlands should be considered wherever possible.

4.7.27 Opportunity areas will need to consider flood safety and not increasing flood risks to any development and making space for water would make major contributions to natural flood management at catchment scale. Mitigation opportunities will also need to consider historic land uses, and the potential for re-mobilising legacy contaminants. Large tracts of land especially throughout the Tame valley have historically been used as landfill. Agricultural land ownership and agreements for converting commercially valuable land use to ecosystem services are also important considerations, and this may affect the River Trent more than the River Tame.

4.7.28 Development of effect mitigation measures will require feasibility study and optioneering in Gate 3, and are likely to include techniques such as:

- Barrier removal or modification
- Flood embankment removal or set-back
- Floodplain reconnection
- Margin and riparian enhancements
- In-channel enhancements
- Current deflectors
- Narrowing with aquatic ledges
- Narrowing using groynes
- Stone riffle
- Creation of tiered channels
- Creation of on-line bays
- Installation of large woody materials
- Felling and placing trees for habitat and flow diversity
- Bed raising
- Creation of backwaters and fish refuges
- Floodplain enhancements
- Floodplain scrapes
- Floodplain wetland mosaic
- Set back flood embankments
- Sediment buffer strips
- Sustainable Urban Drainage Systems

Sedimentation Risk Maps

4.7.29 Sedimentation Risk Maps, initially produced from morphological risk modelling in Gate 1, have been updated from field studies including consultation undertaken in Gate 2. The updated sedimentation risk maps are provided in Appendix E: Annex A.1.

4.8 Non-Water Resources Impacts and Benefits

Baseline Natural Capital Account

4.8.1 The baseline natural capital account for the full scheme area obtained through the use of AECOM's BioInstinct (version 0.7) can be summarised with the outputs below:

- The majority of the study area is made up of arable and horticultural land and acid, calcareous, neutral grassland. There are also relatively large area of built-up areas and gardens, broadleaved woodlands, wetlands, and improved grasslands.
- The majority of the biodiversity units are provided by the semi-natural grassland areas followed by the wetlands and woodlands. Farmland also makes up a large part of the biodiversity units although this is because of the large extent of this habitat type. Using a measure of biodiversity units per hectare of each habitat, the bogs and wetlands are the most important habitat types.
- The most significant component of the value of the ecosystem service flows for the study area is generated by biodiversity. This is followed by crops and recreation flows. There are small negative impacts arising from global climate regulation (primarily due to carbon emissions associated with crop land), and water quality regulation (due to the use of fertilisers for crop and livestock management).

Six Capitals Assessment

4.8.2 A six capitals approach is an extension to the standard financial approach to thinking about capital. It is designed to help organisations become more sustainable and resilient by considering value in the broadest sense, through a better understanding, and therefore better potential management of, the economic, environmental, and social impacts of the proposed schemes. AECOM's capitals accounting approach is built around a framework of assets, flows and values, it follows the four stages outlined in the Capitals Coalition's 'Natural Capital Protocol' and 'Social and Human Capital Protocol'. The assessment adopts an integrated six capitals approach which recognises natural, social, human, intellectual, manufactured, and financial capital.

4.8.3 This six capitals assessment has been undertaken to understand the impacts and dependencies across the six capitals and infer multi-capital benefits and costs delivered by the implementation of the SROs. Following the Natural Capital Protocol, the assessment aims to compare the costs and benefits between four scenarios, informing long-term best value solutions in terms of Net Present Value.

4.8.4 In the first instance the scope of the assessment was identified, including defining the spatial and temporal scope of the assessment as well as the four different scenarios to be included:

- Scenario 0 – 'Do nothing': the no-change scenario
- Scenario 1 – Minworth SRO: 230 Ml/d flow reduction diverted from Minworth and associated mitigation actions (as an absolute worst-case scenario for Minworth – refer to Section 2.5);
- Scenario 2 – SLR SRO: abstraction of 300 Ml/d from the River Trent for SLR and associated mitigation actions;
- Scenario 3 – Minworth & SLR SROs: maximum flow reduction caused by the two SROs in combination (530 Ml/d) and mitigation actions.

4.8.5 In order to determine the impacts and/or dependencies on the six capitals to be included in the assessment, a materiality assessment was undertaken, which was informed by Gate 1 data and reports as well as working closely with other disciplines, incorporating the results of their respective assessments. The qualitative materiality assessment resulted in the following six capitals components being taken forward through the measure and value stage:

Natural Capital

– Global climate regulation
– Water Quality
– Recreation
– Biodiversity

Financial Capitals

– OPEX

4.8.6 Given the limited data availability, ongoing environmental assessments and limited detailed design of scenarios 1, 2 and 3, at this stage, overall monetary values by quantitative assessment have not been feasible. The results of the assessment have been set out in Table 4 below. All values are presented in terms of a 30-year Present Value in 2020 prices and discounted with a 3.5% declining discount rate. In total, given the metrics included within this assessment, all of the scenarios are estimated to lead to a decrease in value relative to the '0 – Do-nothing' scenario aside from '1 – Minworth SRO'. This is due to the fact that the increases in biodiversity and recreation value are generally smaller than the expected OPEX costs, except for from '1 – Minworth SRO' which has a much lower operational cost.

Commercial information redacted

Table 4-3: Breakdown of results from the assessment (£2020, millions)

Option		0 - Do-nothing	1 - Minworth SRO	2 - SLR SRO	3 - Minworth & SLR SROs		
Code	**Natural Capital**	**PV**	**PV**	**PV**	**PV**	**Value Type**	**Confidence**
NC 13	Global climate regulation	[redacted]				External	Moderate
NC 16	Water quality					-	-
NC 21	Recreation					External	Low
NC 25	Biodiversity					External	Moderate
FC 2	OPEX					Private	High
	Net Present Value (£2020 millions)						
	Change in value relative to Do Nothing						

4.8.7 As discussed above and demonstrated in Table 4 it is not possible to present an overall summary of the value of all scoped in components as they could not all be assessed quantitatively based on the current level of available data and information. The findings therefore feed into recommendations for further assessment for Gate 3. Data from the ongoing surveys and assessments and a more detailed knowledge of the scenario outcomes will provide input that will allow the six capitals assessment to be re-run in Gate 3 to provide a more accurate, detailed assessment of the four scenarios.

Biodiversity Net Gain

4.8.8 DEFRA's 25-year Environment Plan seeks to 'embed an environmental net gain principle for development, including housing and infrastructure.' It is also government policy that planning decisions should seek to minimise impacts on, and provide net gains for, biodiversity. The Environment Act 2021 includes provisions to mandate the delivery of Biodiversity Net Gain in England. Secondary legislation, anticipated in late 2023, will require all relevant developments to achieve a minimum 10% net gain in biodiversity units relative to the site's baseline biodiversity value.

4.8.9 Therefore, a preliminary BNG Assessment has been undertaken using DEFRA's Biodiversity Metric 3.0, in accordance with the metrics accompanying guidance and industry accepted best practice principles.

4.8.10 The approach to the Biodiversity Net Gain Assessment has also been informed by further guidance set out in both the All Company Working Groups (ACWG) 'WRMP environmental assessment guidance and applicability with SROs' and RAPID (2022) 'Strategic regional water resource solutions guidance for gate two'.

4.8.11 Following a review of the designated sites and water-dependent wetland habitats identified during the Gate 1 desk-top assessment a total of 26 floodplain locations within 500m of the Rivers Tame and Trent, were identified for inclusion in the Gate 2 BNG Assessment.

4.8.12 A combination of open-source habitat data combined with ground-truthing surveys of wetland habitats identified as being particularly sensitive to the potential impacts arising from the SRO schemes was used to define the baseline habitat data set. Habitat distinctiveness was then used as a proxy for habitat condition and a baseline habitat value was calculated. Due to the low levels of impacts predicted from hydrological and hydraulic modelling, post-impact habitat enhancement was forecast across all habitats of a medium to high distinctiveness value.

4.8.13 This forecasting has identified that, through a series of modelled habitat enhancements across the 26 floodplain locations, a net gain of 11.16% is achievable. At this stage the predicted benefit is 11.16% across both Minworth and SLR SROs, but it is expected that each scheme would look to achieve a minimum 10% net gain through local biodiversity opportunities.

4.8.14 At Gate 3, in order to demonstrate a more accurate Biodiversity Net Gain for the proposed scheme, it is recommended that the calculation is updated to use DEFRA Metric 3.1 and opportunities to create and enhance wetland habitats within the Study Area are identified through a combination of habitat opportunity mapping and stakeholder engagement. The creation of new wetlands within the Study Area will particularly benefit those species associated with those habitat types. The selection of candidate wetland habitat creation and enhancement sites will need to be discussed with local biodiversity groups and will aim to benefit key habitats and the species they support.

5. Scoping Checklist

5.1.1 This section summarises the requirements for further assessment and mitigation beyond Gate 2. Table 5 summarises the outcome of each topic assessment, including recommendations for further assessment and appropriate mitigation options, further context and detail of which is presented in each technical appendix report.

Table 5-1: Tame and Trent Strategic Resource Options – Scoping Checklist for post-Gate 2 assessment and mitigation

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
SSSI Interaction – refer to Appendix A						
Donington Park	National	Minor impact from Minworth SRO felt in River Trent levels, superficial Secondary aquifer, and bedrock Principal aquifer. SSSI has no hydraulic connection to changing water levels related to River Trent.	Neutral	Low	None required	None required
Whitacre Heath SSSI	National	Minor impact from Minworth SRO felt in River Tame levels, and superficial Secondary aquifer. SSSI water features have no hydraulic connection to changing water levels related to River Tame. Ponds supported by rainfall and flooding. No significant change in high flows to affect inundation by flooding. Change in flow from Minworth discharge a small component of high flows.	Neutral	Low on the basis of groundwater interactions; refer to Ecology recommendations for mitigation.	None required	None required

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
Attenborough Gravel Pits SSSI	National	Minor impact from Minworth SRO felt in River Trent levels, and superficial aquifer. SSSI water features disconnected from river by flood embankments, weirs, sluices. Superficial Secondary aquifer groundwater levels supported by River Erewash as well as River Trent. Impact on superficial Secondary aquifer groundwater levels not significant compared to seasonal variation and with River Trent levels controlled by nearby weir.	Neutral	Low	None required	None required
Holme Pit	National	Minor impact from Minworth SRO felt in River Trent levels, and superficial Secondary aquifer. SSSI water features at higher elevation than River Trent, no backing up in surface water levels caused by the River Trent that would support surface water features, Impact on superficial Secondary aquifer groundwater levels not significant compared to seasonal variation.	Neutral	Low	None required	None required
Lockington Marshes	National	Minor impact from Minworth SRO felt in River Trent levels, and superficial Secondary aquifer.	Neutral	Low	None required	None required for SRO. Breach in flood embankments would

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
		SSSI water features disconnected from river by flood embankments, sluices. Superficial Secondary aquifer groundwater levels supported by River Soar as well as River Trent. River Trent levels controlled by nearby weir. Impact on superficial Secondary aquifer groundwater levels not significant compared to seasonal variation.				potentially improve SSSI condition. SSSI at risk from proposed new quarrying
Lea Marsh	National	Minor impact from Minworth and SLR SROs felt in River Trent levels, and superficial Secondary aquifer. SSSI water features at higher elevation than River Trent, no backing up of River Trent levels that would support surface water features. Impact on superficial Secondary aquifer groundwater levels not significant. Cromwell Weir controlling flow into lower River Trent reaches. Tidal variation is a significant control on water levels. Change in level expected to be not significant compared to tidal range.	Neutral	Low	None required	None required
Humber Estuary	International	Minor impact from Minworth and SLR SROs felt in River Trent levels, and superficial Secondary aquifer. Cromwell Weir	Neutral	Low	None required	None required

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
		controlling flow into lower River Trent reaches. Tidal variation is a significant control on water levels. Change in level not significant compared to tidal range.				
River Mease	International	Minor impact from Minworth SRO felt in River Tame and River Trent levels, and superficial Secondary aquifer. River Mease found not to gain flow from superficial aquifer at expense of River Tame. Change in River Trent levels will not lower groundwater levels in the lower Mease area significantly to cause loss of flow to superficial Secondary aquifer.	Neutral	Low	None required	None required
River Blythe	National	Minor impact from Minworth SRO felt in River Tame levels, and superficial Secondary aquifer. Impact on superficial Secondary aquifer groundwater levels not significant. Groundwater levels in superficial Secondary aquifer supported by River Cole levels, River Blythe levels and aquifer recharge.	Neutral (for groundwater interactions effect on SSSI) See other topic areas for other effects (Aquatic Ecology Appendix B(ii)).	Low (for groundwater interactions effect on SSSI) See other topic areas for other effects.	None required (for groundwater interactions effect on SSSI) See other topic areas for other effects.	None required (for groundwater interactions effect on SSSI) See other topic areas for other effects.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
		May reduce backing up on lower River Blythe caused by abstraction. Influence on river levels from weirs.				
Terrestrial Ecology – refer to Appendix B(i)						
River Tame LWS	County	Direct impacts to the River Tame due to reductions in flow, hydrological regime, sedimentation, fish passage, etc. as assessed throughout the environmental assessments.	Negative	High	Refer to recommendations across the environmental assessments, as summarised in the Overall Report.	Potential for wetland creation along the river and riparian habitats; connectivity of the River Tame to designated sites and habitats.
E.ON Meadows (Whitacre Flood Meadow LWS & Whitacre Pool LWS)	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment recommended to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Ladywalk LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Medium	Further assessment recommended to assess connectivity of existing channels to the River Tame, and to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Whitacre Heath SSSI	National	Impact on wetland habitats and the species they support, due to reduction in discharge	Neutral	Medium	No significant effects predicted, but if through further modelling reduced	Site visit to assess the potential for wetland habitat creation and/or

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
		from Minworth lowering baseflows adjacent to this site.			summer flooding is predicted, risk would be elevated to Medium. Further assessment recommended to assess connectivity of existing channels to the River Tame, and to inform potential mitigation options for BNG.	enhancement opportunities at this site.
Lea Marston LWS & Coton Pools LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. In relation to the current mitigation proposals for Lea Marston [and Coton Pools], further assessment will take into account potential impacts on the proposed mitigation. Further assessment recommended to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Kingsbury Wetlands (Water Park) LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Medium	Further assessment recommended to assess connectivity of existing channels to the River Tame, and to inform	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
					potential mitigation options for BNG.	
RSPB Middleton Lakes (Fisher's Mill Meadow LWS and Dosthill Pit & Middleton Hall Pit LWS)	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Medium	Further assessment recommended to assess connectivity of existing channels to the River Tame.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Tameside LNR	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Medium	Further assessment recommended to assess connectivity of existing channels to the River Tame, and to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Broad Meadow LNR	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment recommended to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Drakelow Reserve LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
					potential mitigation options for BNG.	
Sports Ground Marsh LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Stanton Barn Marsh LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Trentside Ponds LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Trent Fleet LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
					potential mitigation options for BNG.	
River Derwent Mouth Lock LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Sawley Carr LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Lockington Marshes SSSI	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Lockington Confluence Backwater LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
					potential mitigation options for BNG.	
Attenborough Gravel Pits SSSI	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Clifton Grove, Clifton Woods, and Holme Pit Pond LNR (including Holme Pit SSSI and Trent Carr LWS)	National	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Netherfield Lagoon LNR Netherfield Pits LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Shelford Carr LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
					potential mitigation options for BNG.	
Besthorpe Meadows SSSI	National	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth and abstraction for SLR lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Fledborough Holme LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth and abstraction for SLR lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Lea Marsh SSSI	National	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth and abstraction for SLR lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Alkborough Flats LWS	County	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth and abstraction for SLR lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
					potential mitigation options for BNG.	
Humber Estuary SPA, SAC, Ramsar site & SSSI	International	Impact on wetland habitats and the species they support, due to reduction in discharge from Minworth and abstraction for SLR lowering baseflows adjacent to this site.	Neutral	Low	No significant effects predicted. Further assessment may be required to inform potential mitigation options for BNG.	Site visit to assess the potential for wetland habitat creation and/or enhancement opportunities at this site.
Otter	District/borough	Impact on wetland habitats that support otter due to reduction in discharge from Minworth and abstraction for SLR lowering baseflows at adjacent sites across the Study Area.	Neutral	Low	No significant effects predicted. Targeted otter surveys where areas of suitable habitat may be impacted, e.g., connecting channels to designated sites.	Site visits to assess the potential for wetland habitat creation and/or enhancement opportunities for otter.
Water vole	County	Impact on wetland habitats that support water vole due to reduction in discharge from Minworth and abstraction for SLR lowering baseflows at adjacent sites across the Study Area.	Neutral	Low	No significant effects predicted. Targeted water vole surveys where areas of suitable habitat may be impacted, e.g., connecting channels to designated sites.	Site visits to assess the potential for wetland habitat creation and/or enhancement opportunities for water vole.
Waterbirds	Up to international	Impact on wetland habitats that support waterbirds due to reduction in discharge from Minworth and abstraction for SLR	Neutral	Low	No significant effects predicted.	Site visits to assess the potential for wetland habitat creation and/or

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		lowering baseflows at adjacent sites across the Study Area.			Requirement for further surveys dependent on assessment of connectivity of sites designated for wetland bird interest to Tame and Trent.	enhancement opportunities for waterbirds.
Aquatic Ecology – refer to Appendix B(ii)						
Site 1 Orton Weir	National	The Environment Agency advised that achieving improved fish passability at this site at low flows (Q70 or lower) is not critical. In addition, it is also located just upstream of the main Minworth discharge. As such it can be screened out.	Neutral	Low	N/A	None required
Site 2. Water Orton Lane road bridge	National	Site visit determined that this was not a barrier to fish passage, given it is a bridge with flowing river beneath it. It is also located just upstream of the main Minworth discharge. As such it can be screened out.	Neutral	Low	N/A	None required
Site 3. Lea Marston Weir	National	There are no fish passes present at this site. The current head drop and hydraulics makes fish passage difficult. Modelling results indicate that the SRO (Scenario B) will negatively affect fish passability. It should be noted that the restoration plan of Lea Marston includes a bypass from upstream of Site 3 to the downstream lake. if	Negative	Medium	The suitability of the bypass design should be investigated in order to assess fish passability at this site, informed by 2D modelling of normal situation and with SRO occurring.	Bypass as part of Lea Marston lakes restoration

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		suitably designed, should improve fish passage at this site			This will be undertaken along with other restoration options downstream (e.g., removal of Sites 4 and 6). Hydraulics and fish passability at the barriers present at Lea Marston Lakes should be assessed considering the system (from site 3 to site 8) as a whole to evaluate the impact of the restoration plan.	
Site 4 and 6. Coton Weirs (E) & (W)	National	There are no fish passes present at these sites. Similar to Site 3, the current conditions at this site are challenging for fish passage and the reduction of flows (Scenario B) will have negative effects. It should be noted that the restoration plan of Lea Marston includes removal of these weirs which might highly improve fish passage	Negative	Medium	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site. Lea Marston restoring plans should be evaluated in order to assess fish passability impacts.	TBC – awaiting results of further hydraulic modelling
Site 5. Coton Weir (Central)	National	There are no fish passes present at this site. Although the head drop at this site is relatively low, the current hydraulics at this site are deemed too difficult for fish	Negative	Medium	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site.	Removal of Coton Weir (E) in particular & Coton Weir (W) might allow fish pass upstream, therefore no fish pass or other mitigation

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		passability. Modelling results indicated that reduction in flow will negatively affect fish passability. It should be noted that the restoring plan of Lea Marston includes removal of Coton Weir (E) & (W) which will improve fish passability upstream			Lea Marston restoring plans should be evaluated in order to assess fish passability impacts.	option would be required at this site Otherwise, the installation of Larinier technical fish pass will improve passability
Site 7. A4097 Weir	National	There are no fish passes present at this site. The head drop could be passable by salmonids. Nonetheless, upstream elver and lamprey passage may find this more challenging. Modelling results predict reduction in levels which will negatively affect fish passability.	Negative	Medium	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site. Fish could also make its way upstream previous this barrier, through Site 8. Also bypassing this barrier through the northern channel that flows the northern area which encounters Site 6. Lea Marston restoring plans should be evaluated in order to assess fish passability impacts.	TBC – awaiting results of further hydraulic modelling. Notching the weir Standalone fish passes (e.g., elver pass)
Site 8. Nether Whitacre Weir	National	There are no fish passes present at this site. The hydraulics at the weir apron are no uniform. Without 2D modelling it is difficult to determine impacts on fish passage.	Negative	Uncertain	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site.	TBC – awaiting results of further hydraulic modelling

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					Fish could also make its way upstream through Site 7. Also, through the northern bypass which encounters Site 6. Fish passage improvements at the site should be sought as part of the wider restoration (noting that attractant flow seems to be up to this weir, based on observed aerial imagery) or firefighters rescue works planned at the site (e.g., the removal of dragon's teeth to enable personnel training should consider fish passability).	
Site 9. Broad Meadow LNR Upstream Weir	National	There is a Larinier and eel pass on the LHB	Negative	Medium	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site.	Bypass New fish pass
Site 10. Broad Meadow LNR Upstream Weir	National	There are no fish passes present at this site	Negative	Low	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site, when considered in combination with Site 9.	None may be needed at this site, but if mitigation at Site 9 is difficult then achieving it at Site 10 may be worth considering.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
Site 11. Meadow Weir	National	There is a rock ramp fish pass on the LHB	Negative	Medium	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site.	Fish pass adaption New fish pass
Site 12. Newton Weir	National	There are no fish passes present at this site.	Negative	Medium	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site.	Larinier Other new fish pass
Site 13. Sawley Weir	National	There are no fish passes present at this site.	Negative	Low	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site.	Weir notch Fish pass
Site 14. Thrumpton Weir	National	There are no fish passes present at this site.	Negative	Low	Further modelling (2D) will be necessary to assess the impact of SRO on fish passability at this site.	Assessment cannot be fully completed until modelling results for the lower Trent are available.
Site 15. Beeston Weir	National	The main weir has a defunct denil fish pass near the RHB. There is a vertical slot fish pass between the HEP and the side weir.	Negative	Low (anticipated)	2D modelling will be necessary to assess the impact of SRO on fish passability at this site.	Fish pass adaption or new fish pass
Site 16 Holme Sluices Colwick	National	There are no fish passes present at this site. Although to date, conduction works for the installation of a twin vertical slot fish pass have started	TBC	TBC	Assessment cannot be fully completed until modelling results for the lower Trent are available.	Assessment cannot be fully completed until modelling results for the lower Trent are available.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
Site 17. Stoke (Bardolph) Weir	National	There are no fish passes present at this site.	TBC	TBC	Assessment cannot be fully completed until modelling results for the lower Trent are available.	As part of a HEP scheme, it is proposed the installation of a two stage Larinier fish pass for coarse and salmonids on the LHB and eel and lamprey pass. Assessment cannot be fully completed until modelling results for the lower Trent are available.
Site 18. Gunthorpe Weir	National	A triangular pool and traverse fish pass comprising three pools and four traverses is located at the LHB although is sub-optimal.	TBC	TBC	Assessment cannot be fully completed until modelling results for the lower Trent are available.	As part of a HEP scheme, it is proposed the installation of a dual flight Larinier fish pass on the RHB. In case the HEP application does not come to fruition, the Environment Agency has a strong interest on installing a fish pass on this weir.
Site 19. Hazelford Weir (South)	National	There are no fish passes present at this site.	TBC	TBC	Assessment cannot be fully completed until modelling results for the lower Trent are available.	As part of a HEP scheme, it is proposed the installation of a dual flight Larinier fish pass proposed on the LHB, a lamprey tile pass and a separate

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
						gravity-fed eel pass on the LHB. Assessment cannot be fully completed until modelling results for the lower Trent are available.
Site 20. Hazelford Weir (North)	National	There is an eel pass installed on the canoe footprint on the RHB.	TBC	TBC	Assessment cannot be fully completed until modelling results for the lower Trent are available.	As part of a HEP scheme, it is proposed the installation of a dual flight Larinier fish pass on the LHB. Assessment cannot be fully completed until modelling results for the lower Trent are available.
Site 21. Averham Weir	National	There are no fish passes present at this site.	TBC	TBC	Assessment cannot be fully completed until modelling results for the lower Trent are available.	The Environment Agency are working on fish pass concepts with landowners, with a Larinier or vertical notch pass being considered possible. Assessment cannot be fully completed until modelling results for the lower Trent are available.
Site 22. Newark Weir	National	There are no fish passes present at this site.	TBC	TBC	The weir can be bypassed by fish that migrate	Assessment cannot be fully completed until

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					through the left-hand (north-westerly) channel; however, these fish will encounter the Averham weir. Assessment cannot be fully completed until modelling results for the lower Trent are available.	modelling results for the lower Trent are available.
Site 23. Nether Lock Weir	National	There is a fish pass installed as part of the HEP on the LHB.	TBC	TBC	The weir can be bypassed by fish that migrate through the left-hand (north-westerly) channel; however, these fish will encounter the Averham weir. Assessment cannot be fully completed until modelling results for the lower Trent are available.	Assessment cannot be fully completed until modelling results for the lower Trent are available.
Site 24. Cromwell Weir	National	There is a pool and traverse fish pass located on the LHB although considered sub-optimal.	TBC	TBC	Assessment cannot be fully completed until modelling results for the lower Trent are available.	Along with a HEP scheme it is proposed the installation of a Larinier fish pass on the RHB. In addition, it has been proposed the installation of two eel passes.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
						Assessment cannot be fully completed until modelling results for the lower Trent are available.
Site 25. Weir in the lower Blythe	National	Additional potential barrier identified through stakeholder consultation. Hydrological investigations indicated that water depths over the weir are higher than 0.1m during all flows. Therefore, it is not considered this is a barrier for fish passage. In addition, the AMP6 indicated no further action is needed on the River Blythe. As such it can be screened out.	N/A	Low	N/A	Not required.
River Mease SAC – refer to Appendix C						
River Levels	National	Impact from Minworth SRO. Reduction in river levels within the River Trent at confluence with River Mease may reduce river levels within lower reaches of River Mease. In combination with proposed diversion of discharge from Packington and/or Measham WwTW.	Neutral	Low	Review full report of the River Mease hydrological assessment study when available.	Focussed hydraulic model on the lower reaches of River Mease and interaction with River Trent. Refinement of scenarios for Minworth SRO reduction in flows.
River Mease (HRA)	National	Impact from Minworth SRO. Reduction in river levels within the River Trent at confluence with River Mease may reduce river levels within lower reaches of River Mease. In combination with proposed	Neutral	Low	Review full report of the River Mease hydrological assessment study when available. Determine the requirement for Appropriate Assessment.	Mitigation options to be informed by Appropriate Assessment, if required.

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		diversion of discharge from Packington and/or Measham WwTW.				
Invasive Non-Native Species – refer to Appendix D						
Minworth / River Tame	National	New tertiary treatment at Minworth WwTW, which would reduce the existing INNS risk associated with potential for INNS propagules or seeds to be blown into the treated water prior to discharge, or to be introduced to/from site via staff. No increased risk, or potential positive effect, due to Minworth SRO. Existing Biosecurity Plan will reduce the risk further.	Neutral	Low	None	Checking and implementation of existing Biosecurity Strategy
Minworth / River Tame	Local	Impact from Minworth SRO. Reduction in river levels within the River Tame may allow INNS species to further colonise	Negative	Low	Identification of catchment wide INNS schemes	Monitor a 1 km buffer downstream of the discharge for habitat destabilisation (with the potential to facilitate relevant INNS, i.e., those not already widespread), following reduction in flow. Develop a rapid response protocol (i.e., targeted herbicide treatment aimed at keeping INNS down until habitats restabilise, if destabilisation occurs).

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
SLR / River Witham	Local	Trent SLR pipeline could provide pathway for INNS to access the upper reaches of the River Witham (primary concern is the 40 km reach upstream of Lincoln to the discharge point), resulting in colonisation of reach by additional INNS.	Negative	Low residual risk (with mitigation)	Complete INNS surveys of the upper River Witham and Treat at/near abstraction Barrier survey of the River Witham Identification of catchment wide INNS schemes Assess wider INNS introduction potential to the River Witham Research (empirical – to augment theoretical studies) impacts of existing water transfers on INNS spread, to better understand resistance of traditional transfer infrastructure to INNS spread. Focus on impacts of pumps and piping over distance on INNS survival at various life stages. Identify optimal mitigation combination that results in an acceptable risk profile.	Integrated treatment system included at the pipeline inlet, potentially including: • Passive screens. • Deflection. • Active screens. • Pumps (assessed for potential to further neutralise INNS). • Piping over distance. • 'Safety nets' at discharge, with monitoring and rapid response. Implement BMP to remove all INNS from abstraction point and high priority species (i.e., primarily those not identified in the Witham) from 500m upstream and downstream of SLR on River Trent. Implement actions with local environmental groups to reduce INNS from the wider River Trent and River Witham catchments.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
						Enhance catchment level biosecurity implementation (clean check dry)
Sedimentation – refer to Appendix E						
Tame – R Rea to R Blythe (GB104028046841)	Regional	Minworth	Neutral	Low	Sediment and turbidity monitoring. Analysis of hydraulic modelling results for SRO sedimentation risks. Hydraulic modelling for SRO floodplain inundation effects. Optioneering and feasibility for targeted mitigation areas.	River restoration measures specific to detailed impact assessment, likely to focus on techniques such as SUDS and in-channel enhancement
Rea from Bourn Brook to River Tame (GB104028042550)	Regional	Minworth	Neutral	Low	Sediment and turbidity monitoring. Analysis of hydraulic modelling results for SRO sedimentation risks. Hydraulic modelling for SRO floodplain inundation effects.	River restoration measures specific to detailed impact assessment, such as floodplain reconnection and in-channel enhancement.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
					Optioneering and feasibility for targeted mitigation areas.	
Tame from R Blythe to River Anker (GB104028046440)	Regional	Minworth	Neutral	Low	Sediment and turbidity monitoring. Analysis of hydraulic modelling results for SRO sedimentation risks. Hydraulic modelling for SRO floodplain inundation effects. Optioneering and feasibility for targeted mitigation areas.	River restoration measures specific to detailed impact assessment, such as floodplain reconnection and in-channel enhancements.
Trent from Soar to The Beck (GB104028053110)	Regional	SLR	Neutral	Low	Sediment and turbidity monitoring. Analysis of hydraulic modelling results for SRO sedimentation risks. Hydraulic modelling for SRO floodplain inundation effects. Optioneering and feasibility for targeted mitigation areas.	River restoration measures specific to detailed impact assessment. In this area, likely to focus on floodplain reconnection and geomorphological enhancements.

Receptor or Feature under Assessment	Significance	Impact Pathway and Source (Minworth and/or SLR)	Scale of Impact (Positive / Neutral / Negative)	Red/Amber/Green Risk of SRO affecting the receptor (High / Medium / Low)	Recommendations for Further Assessment	Mitigation Options
Trent Bifurcation Pingley Dyke to Winthorpe (GB104028053390)	Regional	SLR	Neutral	Low	Sediment and turbidity monitoring. Analysis of hydraulic modelling results for SRO sedimentation risks. Hydraulic modelling for SRO floodplain inundation effects. Optioneering and feasibility for targeted mitigation areas.	River restoration measures specific to detailed impact assessment. In this area, likely to focus on floodplain reconnection and geomorphological enhancements.
Non-Water Resources Impacts and Benefits – Refer to Appendix F						
Natural Capital Assessment						
Tame and adjacent habitats	Local	Impacts from Minworth SRO on fisheries. Barriers to fish migration are unlikely to be exacerbated by the drop in water levels, meaning access to areas that are essential for key fish life stages are maintained (Refer to Aquatic Ecology assessment, Appendix B(ii)). Sedimentation accumulation at the riverbed is unlikely to be worsened, meaning that there will be no detriment for fish spawning, feeding and nursery habitats as well as for invertebrates and macrophytes, upon which fish depend (Refer to Sedimentation assessment, Appendix E).	Neutral	Low	Further assessments on fish passage, migratory species, and sedimentation to correlate with and understand the wider impacts on fish, looking at changes in stock and characteristics for each impacted species	Consider mitigation options to improve fish passage, as informed by further assessments.

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Trent, Humber estuary, and adjacent habitats	Local	Impacts from SLR SRO on fisheries. Same as above	Negative or Neutral	Low	Same as above	Same as above
Tame and adjacent habitats	Local	Impacts from Minworth SRO on water quality regulation. Minworth effluent is already treated to a good standard and may currently improve water quality in the Tame. However, not discharging the effluent from Minworth into the River Tame would remove residual phosphates and contaminants, contributing to water quality improvement.	Neutral or Positive AWAITING MODELLING	Low	N/A	Not required
Tame and adjacent habitats	Local	Impacts from Minworth SRO on disease and pest control. At Minworth, there is a very low risk of spread in margins widened by the flow reduction. However, given existing flow fluctuation and the prevalence of INNS in this location, this is not considered a significant impact.	Neutral or Negative	Low	Refer to Appendix D INNS	See mitigation options in Appendix D INNS
Trent, Humber estuary, and adjacent habitats	Local	Impacts from SLR SRO on disease and pest control. For SLR, there is a minor risk of INNS being transferred from the River Trent to the River Witham, but mitigation should be	Neutral or Negative FURTHER ASSESSMENT REQUIRED	Low	Same as above	Same as above

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		incorporated to prevent this.				
Trent, Humber estuary, and adjacent habitats	Local	Impacts from SLR SRO on recreation. It is not considered that there will be any loss of connectivity or fragmentation of aquatic habitats, and therefore there will be no negative impacts on fish of socio-economic importance, and no corresponding decrease in the value of angling activities. Mitigation options to obtain wider benefits and achieve 10% net gain in terms of habitat creation/enhancement are likely to provide recreation benefits.	Positive	Low	ORVal could be used for Gate 3 quantitative assessment but more accurate data on the exact locations of recreation sites and on the number of visits is recommended for more truthful results.	The overall recreational value will be improved by targeted mitigation actions. Grassland and wet woodland enhancement, wetlands and reedbeds creation, and access path restoration will increase opportunities for walking, bird watching, water sports, picnic, and pond dipping facilities for the local communities, etc.
Tame and adjacent habitats	Local	Impacts from Minworth SRO on trust and reputation. The potential negative impacts on INNS spread and on fish/angling clubs could erode public's trust in Affinity Water although this could be remediated with appropriate mitigation measures. Anglian Water, Affinity Water and Severn Trent customers views on the two SROs collected as part of a programme of customer engagement in the approach to Gate 1, showed a global support for 'sharing' water. However, for Minworth SRO, customers were concerned over a change in taste and water hardness.	Negative/Positive	Low	Collect customers and public feedback from further surveys that would aim to ask whether they are satisfied with decisions over SROs, considering the potential impacts and measures to address them. Assess the number of satisfied customers.	A potential decrease in public's trust would be mitigated with actions undertaken to minimise impacts on INNS spread and on recreation (c*aptured above*).

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Trent, Humber estuary, and adjacent habitats		Impacts from SLR SRO on trust and reputation. Same as above. Although SLR is largely accepted as recreation and environmental benefits are seen to be outweighing the localised impacts, customers want to be informed in the context of other schemes.	Negative/Positive	Low	Same as above	Same as above
Tame and adjacent habitats		Impacts from Minworth SRO on engagement and networks. Minworth SRO has a key role in wider regional water resources plans bringing together stakeholders from various sectors, including energy, retail, land management and agriculture. Discussions around concept design, construction planning and policies, risks and issues, and mitigation actions, involve engaging with key stakeholders such as water companies, the Environment Agency, Natural England, DEFRA, trusts and local authorities. Community and customers were engaged early through a research programme developed to ensure transparency, build understanding, and gather feedback. (*Captured within Trust and Reputation*)	Positive	Low	Assess the number of partnerships created.	Not required
Trent, Humber estuary, and adjacent habitats		Impacts from SLR SRO on engagement and networks.	Positive	Low	Same as above	Not required

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		Same as above. SLR SRO ties in working closely with the South Lincolnshire Water Partnership (SLWP) and Integrated Adaptation Partnership				
Tame and adjacent habitats		Impacts from Minworth SRO on engagement and networks. Given the nature of the potential mitigation actions around the river Tame (biodiversity improvement and natural spaces enhancement), it is possible that it would lead to slight positive impacts on the local economy due to a potential increase in recreational activities and the number of visitors.	Positive	Low	Assess visitor expenditure	Develop plans to include facilities and amenities in the design of mitigation options to convert the created/enhanced sites into visitor destinations.

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