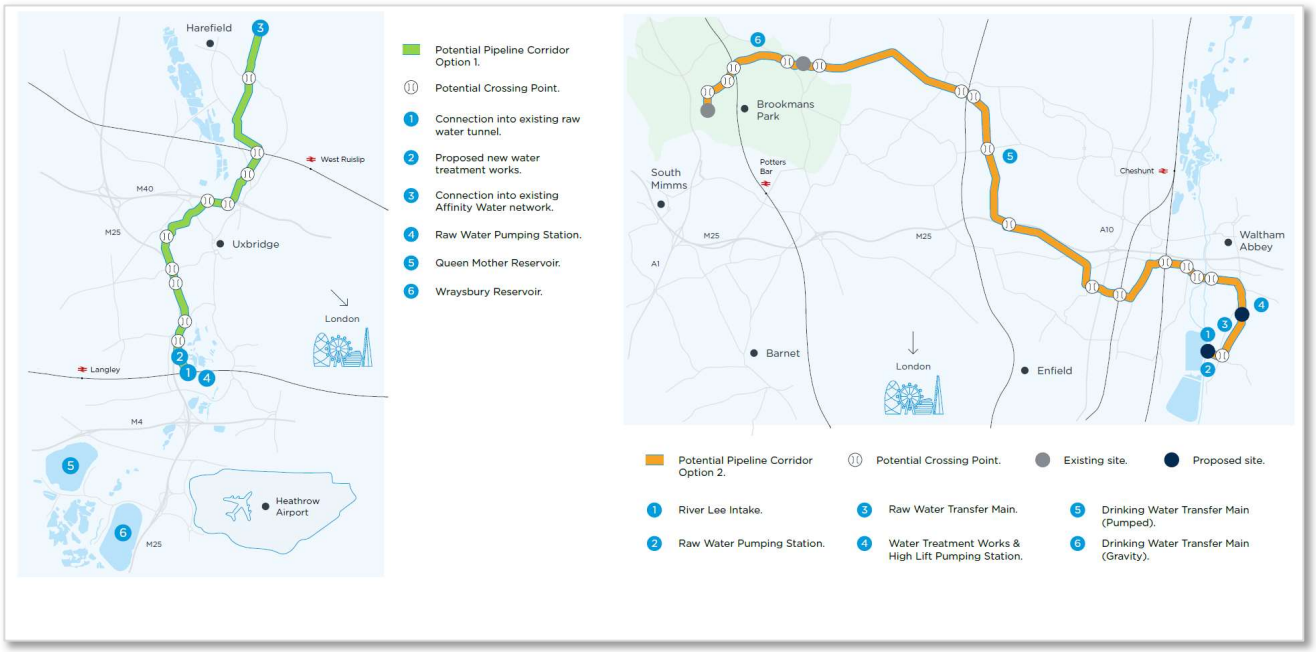
Strategic regional water resource solutions: detailed feasibility and concept design

Standard gate two submission for Thames to Affinity Transfer (T2AT)

Date: 14th November 2022



Notice

Position Statement

- This document has been produced as the part of the process set out by RAPID for the development of the Strategic Resource Options (SROs). This is a regulatory gated process allowing there to be control and appropriate scrutiny on the activities that are undertaken by the water companies to investigate and develop efficient solutions on behalf of customers to meet future drought resilience challenges.
- This report forms part of suite of documents that make up the 'Gate 2 submission.' That submission details all the work undertaken by Thames Water and Affinity Water in the ongoing development of the proposed SROs. The intention of this stage is to provide RAPID with an update on the concept design, feasibility, cost estimates and programme for the schemes, allowing decisions to be made on their progress and future funding requirements.
- Should a scheme be selected and confirmed in the companies' final Water Resources Management Plan, in most cases it would need to enter a separate process to gain permission to build and run the final solution. That could be through either the Town and Country Planning Act 1990 or the Planning Act 2008 development consent order process. Both options require the designs to be fully appraised and in most cases an environmental statement to be produced. Where required that statement sets out the likely environmental impacts and what mitigation is required.
- Community and stakeholder engagement is crucial to the development of the SROs. Some high level activity has been undertaken to date. Much more detailed community engagement and formal consultation is required on all the schemes at the appropriate point. Before applying for permission Thames Water and Affinity Water will need to demonstrate that they have presented information about the proposals to the community, gathered feedback and considered the views of stakeholders. We will have regard to that feedback and, where appropriate, make changes to the designs as a result.
- The SROs are at a very early stage of development, despite some options having been considered for several years. The details set out in the Gate 2 documents are still at a formative stage and consideration should be given to that when reviewing the proposals. They are for the purposes of allocating further funding not seeking permission.

Disclaimer

This document has been written in line with the requirements of the RAPID Gate 2 Guidance and to comply with the regulatory process pursuant to Thames Water's and Affinity Water's statutory duties. The information presented relates to material or data which is still in the course of completion. Should the solution presented in this document be taken forward, Thames Water and Affinity Water will be subject to the statutory duties pursuant to the necessary consenting process, including environmental assessment and consultation as required. This document should be read with those duties in mind.

Contents

Glossary of Acronyms and Abbreviations

Term	Explanation
Scheme Partners	Affinity Water and Thames Water
AA	Appropriate Assessment (under the Habitats Regulations Assessment)
ACWG	All Company Working Group
AFW	Affinity Water
AIC	Average Incremental Cost
AOD	Above Ordinance Datum
AONB	Area of Outstanding Natural Beauty
BNG	Biodiversity Net Gain
BNL	Biodiversity Net Loss
BRI	Beckton Reuse Indirect – one of the T2AT working solutions for Gate 2
CCW	Consumer Council for Water
CPO	Compulsory Purchase Order
DAF	Dissolved Air Flotation
DC	District Council
DCO	Development Consent Order
DNO	Distribution Network Operator
DPC	Direct Procurement for Customers
ECI	Early Contractor Involvement
ENCA	Enabling a Natural Capital Approach
GAC	Granular Activated Carbon
GUC	Grand Union Canal
HRA	Habitats Regulations Assessment
ICA	Instrumentation, Control and Automation
IP	Infrastructure Provider
IPA	Infrastructure and Projects Authority
IP	Infrastructure Provider
LPA	Local Planning Authority
LTR	Lower Thames Reservoir – one of the T2AT working solutions for Gate 2
LWS	Local Wildlife Site
M&E	Mechanical and Electrical
MCC	Motor Control Centre
MEICA	Mechanical, Electrical, Instrumentation, Control and Automation
Ml/d	Mega (million) Litres Per Day
NAU	Environment Agency, National Appraisal Unit

Term	Explanation
NCA	Natural Capital Accounting
NEUB	Non-Essential Use ban
NPS	National Policy Statement (on Water Resources)
NPV	Net Present Value
OA	Operational Agreement
OBC	Outline Business Case (for a DPC process)
Ofwat	Water Services Regulation Authority
PA2008	Planning Act, 2008
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PMB	Programme Management Board
PPA	Planning Performance Agreement
PS	Pumping Station
RGF	Rapid Gravity Filter
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SESRO	South East Strategic Reservoir Option
SIPR	The Water Industry (Specified Infrastructure Projects) Regulations 2013
SoR	Statement of Response
SoS	Secretary of State for Environment, Food and Rural Affairs
SRO	Strategic Regional water resource Option
SSSI	Site of Special Scientific Interest
STT	Severn to Thames Transfer
SWS	Southern Water Services
TPO	Tree Protection Order
T2AT	Thames to Affinity Transfer
TUB	Temporary Use Ban
TW	Thames Water
WFD	Water Framework Directive
WRMP	Water Resources Management Plan
WRSE	Water Resources South East
WRW	Water Resources West
WRZ	Water Resource Zone
WTW	Water Treatment Works

1. Executive summary

1.1 Overview

1.1 The Thames to Affinity Transfer (T2AT) remains a viable solution for a transfer of water from proposed sources available to Thames Water's (TW) London WRZ to Affinity Water's (AFW) Central Region.

1.2 The feasible options outlined at Gate 1 have been further refined and optimised collaboratively by the partner companies to create two working solutions for the variants that were selected in the WRSE emerging regional plan in January 2022. These schemes can be implemented at the same time and provide transfers to AFW from either the London Effluent Reuse SRO or from additional resources created in the upper River Thames. These two solutions are:

- **Lower Thames Reservoir (LTR)** – A transfer from TW's Lower Thames Reservoir system to AFW, supported by new water resource from the SESRO SRO.
- **Beckton Reuse Indirect (BRI)** – A transfer from a new abstraction on the River Lee flood relief channel to AFW, dependent on recycled water being fed into the river from either the Beckton effluent reuse option or Teddington DRA option of the London Effluent Reuse SRO[1].

1.3 The LTR solution (100 Ml/d) is selected for implementation in 2040 by the WRSE draft Regional Plan and by the draft WRMP24. On this basis, we recommend that this variant of the scheme proceeds to Gate 3. The BRI solution is not selected in the reported future pathway of the draft plans; it is therefore considered only as a future back-up scheme should an issue arise with the current plan. Therefore, no additional work is currently proposed on this solution.

1.2 Key Facts, "At a Glance"

Parameter	Response for SRO	Section
Deployable Output (DO)	The different solutions could deliver a dry year annual average DO during a 1 in 500 year drought of between 50 and 100 Ml/d. Modelling of the optimal combined operation of TW and AFW's supply systems indicates that if the LTR solution were to be linked to SESRO, only approximately 50% of the DO gained by AFW is 'lost' from Thames Water in London as a result of the transfer, making this a very efficient way to share resources. The LTR scheme uses existing Lower Thames storage that is effectively replaced by SESRO, with the shared benefit driven by the differences in timing and magnitude of demand peaks between the two systems.	4.2
Earliest delivery date	Excluding any source water constraints, the options could theoretically be commissioned by January 2034 at the earliest.	3
Cost	The larger capacity options have an AIC of £0.54 – 57/m^3 based on the expected utilisation. The overall NPV for the two working solutions are £423m for the LTR option and £441m for the BRI option. The base capex values for both schemes has been updated. The capex costs for the two 100 Ml/d options has increased since Gate 1, in large part due to updated, site	8.1

[1] This solution was originally conceptualised to be linked to Beckton effluent recycling scheme only (hence the 'BRI' acronym), but it has subsequently been revised to link to either the Beckton effluent reuse option or Teddington DRA option of the London Effluent Reuse SRO.

Parameter	Response for SRO	Section
	specific, land acquisition and compensation estimates, with brownfield, industrial sites being selected due to planning constraints on alternative greenfield sites. The WTW site selection work will be reviewed and reconsidered at the next stage, to ensure the most appropriate site is identified taking account of the trade-offs between cost, planning constraints and environmental impacts. The indicative nature of the working solutions means that current costs are considered an 'upper-end' estimate of the expected delivery costs for both solutions.	
Environmental Impacts	The environmental impacts of the construction of each option would be similar across all options, with some negative but largely temporary impacts expected. There are opportunities for habitat creation and enhancement at Water Treatment Works (WTW) sites. There are not expected to be any compliance issues under either WFD or HRA legislation and no 'show-stopping' environmental impacts have been identified during the Gate 2 studies.	6.1
Water Quality Risks	Water quality risks highlighted in the Gate 2 WQRAs have supported the concept treatment design. The only modification identified is the requirement for a UV process in the BRI working solution to adequately treat cryptosporidium. From the data available, the WQRA has identified no drinking water quality parameters that pose a risk to consumers in the Affinity Water region once treatment has occurred.	5
Preferred option	The 100 Ml/d LTR solution is selected in the WRSE draft regional plan and draft WRMP24 for both partner companies, for delivery by 2040.	8.3
Planning Issues	The recommendation is to secure consent for the T2AT project through a Development Consent Order (DCO) pursuant to the Planning Act (PA)2008 process. Direction from the Secretary of State to designate the SRO as a Nationally Significant Infrastructure Project (NSIP) would be required if the smaller capacity variants of T2AT is promoted or if T2AT were considered wholly a drinking water transfer. The current assumption is that the T2AT SRO and any associated new source water SRO would be consented as separate projects.	7.2
Procurement	There may be potential to deliver lower cost to customers under a fully competitively tendered delivery model for T2AT such as Direct Procurement for Customer (DPC) or as under the Specified Infrastructure Projects Regulations (SIPR). At this stage, and based upon the current legislation, it is considered unlikely that the value and complexity of either of the T2AT options would pass the SIPR 'size and complexity' test, or that the additional effort required to apply SIPR would be justified. The defining factor between In-house or DPC delivery for T2AT will be value for money, which requires more detailed assessment to conclude. This will be commenced during the next stage of the project, alongside a review of any relevant changes to the SIPR regulations.	7.5
Key Risks	The key risks identified for the scheme include programme risks associated with the integration of the WRSE, WRMP24 and subsequent DCO processes, risks associated with land acquisition costs and environmental risks with scheme consenting and planning risks linked to the draft NPS for Water resources. Mitigation has been identified for all and further work to reduce uncertainty is planned for Gate 3.	7.3

1.3 Conclusions

1.4 The LTR solution of the Thames to Affinity Transfer is selected in the WRSE draft Regional Plan and by the draft WRMP24 for both partner companies, linked to the development of SESRO, for use by 2040. The larger capacity option is preferred, transferring up to 100 Ml/d annual average DO to Affinity Water.

1.5 We propose to maintain the partnership between Thames Water and Affinity Water, maintaining the current solution partnership at least until Gate 3, but with Affinity

Water taking a more lead role in the day-to-day management of the SRO and accountability for the delivery of the next stage of work.

1.6 Our Boards have signed the Board Statement and recommend that development of the LTR working solution of the T2AT should continue onwards towards Gate 3, but via a proposed deferral of work between 2024 and 2028, to ensure efficient project delivery.

2. Background and objectives

This Gate 2 submission consists of a main technical report and a wide range of technical supporting documents, in order to provide RAPID with the evidence required to assess the robustness and completeness of the analysis completed to Gate 2. The documents that make up the submission, along with a short synopsis of the contents may be found in Table 2.1 below.

Table 2.1: Summary of documents within Gate 2 submission

Document	Synopsis of contents
Gate 2 Technical Report *(i.e. this document)*	Overview of all technical and commercial assessments completed, as required by RAPID Gate 2 guidance
A1a and A1b, Concept Design Reports for LTR and BRI	Summary of all engineering design and delivery details associated with the working solutions, including the water resources assessment
A2a and A2b, Cost Report for LTR and BRI	Summary of the costs of the working solutions and associated options (capex, opex, costed risk and optimism bias)
A3a and A3b, Carbon Report for LTR and BRI	Summary of the estimated carbon footprint of the working solutions and strategy to mitigate such emissions
A4, Options Appraisal methodology	Summary of options screening process applied for Gates 1 and 2
A5, Options Refinement Report	Summary of the analysis completed to refine the shortlisted options from Gate 1 into the two preferred working solutions for Gate 2
B1a and B1b, Environmental Appraisal Report for LTR and BRI	Presenting the findings of the appraisal of environmental impacts from the working solutions
B2, Habitats Regulations Assessment (HRA)	Results and discussion on the assessment of the scheme completed under the requirements of the Conservation of Habitats and Species Regulations (2017) as amended (Habitats Regulations)
B3, Water Framework Directive Assessment	Results and discussion on the assessment of the scheme options completed under the requirements of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
B4, Inputs into WRSE and WRMP24 Strategic Environmental Assessment (SEA)	Presentation of the strategic assessment of the scheme options against the environmental objectives for the WRSE regional water resources plan and WRMP24 and consideration of in-combination assessment with other local plans and programmes.
Ca and Cb, Drinking Water Risk Assessment for LTR and BRI	Outputs and discussion of the drinking water risk assessments completed for the working solutions
D, Stakeholder Engagement Strategy	Overview of stakeholder engagement completed since Gate 1, integrated with that initiated as part of the WRSE regional plan and WRMP24,

Document	Synopsis of contents
	discussion of customer engagement undertaken to support the SRO and strategy for future stakeholder and community engagement
E, Procurement Strategy	Discussion of future procurement strategies to deliver the SRO, value for money analysis and recommended commercial delivery models for future development
F-1, Project Delivery Plan	Overview of proposed scope and costs beyond Gate 2 looking forwards towards submission of consent application(s), future programme overview, key risks and proposed mitigation strategy
F-2, Efficiency of Spend	Discussion of cost efficiencies in delivery of Gate 2 submission and forecast costs for Gate 3
G, Planning and Consents Strategy	Overview of different consent strategies and recommended approach, overview of River Thames consenting strategy and secondary consents and environmental permits required

2.1 Background

2.1 The T2AT feasible options are part of a wide range of options considered by the WRSE Regional Plan and by Affinity Water, to meet their future demands for water supply.

2.2 In July 2021, Thames Water and Affinity Water submitted their Gate 1 report to RAPID. The Gate 1 assessment (December 2021) included the following actions and recommendations, which are all addressed by this Gate 2 submission[2].

Table 2.2 Gate 1 Actions and Recommendations from RAPID

RAPID Requirement	T2AT Response at Gate 2 (and cross-reference)
Actions	
Include resilience metric scores associated with the solution and options and clarify how resilience risks and benefits are captured within the regional best value plan.	Section 4: Resilience scores using the WRSE framework are provided for leading options, although (for transfer schemes) these have not been used by WRSE in subsequent 'Best Value Planning' analysis, as they were considered to double count the resilience benefit that is provided by the source feeding the transfer. The assessment of resilience also included the impacts of the scheme on resilience risks within the existing Affinity supply system, where it was identified that the storage provided by the LTR scheme would be a major benefit to support the Iver treatment works, which currently does not have bankside storage and hence is vulnerable to outages from pollution incidents in the River Thames. This is referenced in the Affinity Water dWRMP.
Ensure climate change impacts are included in the water resource benefits.	Section 4: Water resource benefits for T2AT do not explicitly include climate change. Climate change impacts have been built into the source water option DO values (e.g. South East Strategic Reservoir Option - SESRO - or Severn to Thames Transfer - STT) and hence incorporated into the conjunctive use analysis of DO, but should not impact transfer scheme base DO value directly.
Assess conjunctive use benefits.	Section 4: Full conjunctive use analysis of T2AT in conjunction with Thames Water's London system has been completed and the resulting regional benefits built into the WRSE options set.

[2] An overview of the Gate 2 submission and all supporting documents may be found in document Supporting Document H – Orientation Report. This also includes an extensive glossary for the submission.

RAPID Requirement	T2AT Response at Gate 2 (and cross-reference)
Further consider operational issues as the solution could be considered low utilisation.	Section 4: Utilisation profile has been created, taking account of likely operational use of the T2AT. This profile is then used for all commercial, cost and engineering analysis for Gate 2.
Ensure and provide evidence that PAS 2080 and a science-based approach have been used to guide the carbon assessment.	Section 6: Carbon assessment and mitigation analysis has been updated for Gate 2, aligned with PAS2080 approaches.
Complete a detailed assessment of interdependencies and in-combination impacts with other strategic resource solutions and other solutions following the output of regional modelling.	Section 6: In-combination assessment of environmental impacts has been completed Section 8: Discussion of T2AT position in draft WRSE Regional Plan *(note: WRSE and WRMP documents contain further information on regional alternatives and combinations as part of the WRSE best-value planning sensitivity work and this is not discussed within Gate 2 submission to avoid duplication).*
Recommendations	
Ensure lead times are consistently included across all options.	All feasible option lead-times were reviewed and re-confirmed to WRSE as part of February 2022 data upload, for consistency with other supply-side options. Detailed programme developed for Gate 2, which integrates T2AT delivery programme with other SROs.
Clarify and state where solution responsibilities lie between Thames Water and Affinity Water.	No change to partnering arrangements are proposed at Gate 2. Exact delivery and operational responsibilities will be confirmed during subsequent project stages, once the need and timing of the T2AT schemes is confirmed in the final WRMP.
Use regional modelling outputs to inform utilisation.	Section 4: Utilisation profile has been created, taking account of likely operational use of the T2AT, using WRSE Regional System Simulation (RSS) model
Reference key methodologies and associated relevant frameworks used to calculate operational and embodied carbon and to guide the carbon assessment.	Section 6: Carbon assessment and mitigation analysis has been completed for Gate 2. Complete report available as Technical Supporting Document A3: Carbon Strategy.
Check all designated site features and potential impact pathways have been identified, undertake in-combination assessments, and reroute any options to avoid SSSIs where this has not already been done.	Option routes were reassessed as part of detailed option refinement process and all known constraints and designated features taken into account. The working solutions for the two preferred options were developed taking into account local environmental, land and planning constraints such as designated sites. Further details in Technical Supporting Document A5: Options Refinement Report.
Thoroughly consider the CSF proposal for flow recovery at gate two and engage with RAPID and interested stakeholders on how this might best be accomplished.	All T2AT options enable the CSF proposals. The modelling of conjunctive deployable output takes account of streamflow recovery from reduced groundwater abstraction at key sources to ensure that any additional available water can be incorporated into TW or AFW's supply network through existing abstractions.

2.2 Water Resource Objectives

2.3 The primary drivers for the need for additional water supply (as provided by this SRO) are summarised in Table 2.3 below; these are used by WRSE companies to determine the amount of additional water they will need to supply customers in the future. Further details of the contributions of each driver may be found in the WRSE draft Regional Plan.

Table 2.3 Primary water resource drivers

Driver	WRSE Implication
Future Population Growth	Results in the need to supply water to more customers. Forecast methodologies are prescribed by the UK Government's Water Resources Planning Guidance[3]. The impacted companies have a statutory duty to plan for this level of future growth. WRSE uses the latest regional forecasts produced by the Office of National Statistics, local authority housing plans and potential growth in the area between Oxford and Cambridge.
Impacts of climate change	May reduce available flows in rivers or groundwater recharge thereby reducing the amount of water that can be supplied from existing water sources.
Impacts of existing abstractions	Taking water from rivers, streams and underground sources can cause damage to the environment. Water companies need to reduce how much they take from some of their most sensitive water sources to prevent damage in the coming years and help improve them. This reduces available supply. Under the Environment Agency's National Framework for Water Resources[4], regional water resource groups are required to explore and implement the steps required to achieve a shared Environmental Destination to reduce the most environmentally unsustainable abstractions.
Improved drought resilience	The Environment Agency's National Framework for Water Resources[4], requires companies to plan for a higher level of resilience to drought, so that restrictions such as rota cuts and standpipes will be needed no more than once every 500 years on average.

2.4 These drivers for additional water supply are considered after the implementation of reductions to leakage and to water consumption, as prescribed by the Environment Agency's National Framework for Water Resources[4]. These aspects are all adopted by WRSE and the partner companies, contributing to the overall future demands for water supply. There is a high level of risk and uncertainty associated with the effectiveness and timing of government led water efficiency measures, on which the WRSE draft Regional Plan is based. These will add pressure to demand if they are not delivered in line with WRSE assumptions.

3. Solution design, options and sub-options

3.1 Solution description

3.1 The Thames to Affinity Transfer (T2AT) is a scheme to enable the transfer of raw water from TW in London to AFW's Central supply region (WRZs 1-5) via intermediate treatment. The scheme requires additional resource development in the Thames catchment to provide a new source of water to be transferred, hence is linked to either storage or transfer options in the fluvial River Thames or else recycling options in the lower Thames.

3.2 Options have been developed for the transfer, to enable an average deployable output (DO) during a 1 in 500 year drought of either 50 Ml/d or 100 Ml/d.

3.2 Options considered

3.3 At Gate 1, eight shortlisted options were identified. These included options that used new resource from the fluvial Thames (STT or SESRO SROs) as well as separate options linked to the London Effluent Reuse SRO. It was noted in the Gate 1

[3] Environment Agency, April 2022, Water Resource Planning Guideline v10
[4] Environment Agency, March 2020, Meeting our future water needs: a national framework for water resources

submission that to continue to develop all 8 shortlisted options would be inefficient and cause abortive costs. Consequently, we proposed a scope of work for Gate 2 that balanced these conflicting pressures between multiple, geographically disparate options and very different environmental and engineering challenges. In order to develop the preferred option to a suitable level of detail for Gate 2, we committed to focus on the evolution of the single option that was expected to emerge from the initial WRSE regional modelling. In the absence of the WRSE plan, we proposed to follow the preference from WRMP19 and develop the leading T2AT option linked to the River Thames, namely the Existing Thames Reservoir option. This approach was accepted by RAPID at Gate 1.

3.4 The options appraisal methodology was updated for Gate 2, to reflect additional feasibility, environmental and planning constraints. A detailed summary can be found in Technical Supporting Document A5: Options Refinement Report. No changes to the shortlisted options were made, but the analysis concluded a preference for the following two transfer solutions:

- LTR option – Lower Thames Reservoir option in West London, linked to SESRO and
- BRI option – New abstraction from the River Lee flood relief channel in East London, linked to either the Beckton effluent reuse option or Teddington DRA option of the London Effluent Reuse SRO.

These two options showed overall better performance across the feasibility, carbon, environmental impact and planning constraint criteria.

3.5 However, to identify the optimal solution and whether or not the T2AT should form part of the best value regional strategy for the South East, the outputs from the WRSE best value planning process needed to be considered. The emerging regional plan, published for public consultation in January 2022, identified the need for two separate T2AT schemes in the preferred plan – the BRI option early in the planning period (2034/35), and then the LTR option slightly later (in 2039/40). This was, therefore, the basis on which the Gate 2 submission has been developed, as the best available information at the time. Consequently, two solutions for the T2AT needed to be developed in parallel to Gate 2, in different catchments and with different engineering challenges and environmental impacts.

3.6 We decided not to seek the designation from RAPID of the BRI option as a new SRO at this stage, due to the expected limited financial implications of the additional work required for Gate 2 (see Section 11.1) and also the uncertainty associated with the ultimate inclusion of both solutions in the WRSE draft Regional Plan and draft WRMP24.

3.7 The WRSE draft Regional Plan has subsequently re-adjusted the regional strategy relevant to T2AT, as follows:

- The LTR option is selected in the WRSE draft Regional Plan and draft WRMP24, required by 2040, linked to the development of SESRO.
- The BRI option is <u>not</u> selected in the preferred (reported pathway) best value plan, as Affinity Water's needs before 2040 would be met using the GUC SRO.

The WRSE draft Regional Plan is discussed further in Section 8.3.

3.8 To enable the concept design and environmental assessment to be completed at the required level of detail and in time for Gate 2, we have had to analyse the different site and routing options for both solutions, in terms of engineering feasibility, environmental impacts and planning constraints, to identify a single preferred working solution[5] for each. The intention would be to further refine the working solution design for the preferred solution (LTR option), via technical analysis, ground investigation and survey and stakeholder engagement and consultation, during subsequent project development phases under the existing T2AT SRO project. If both solutions are retained in the final WRMP24, then we would seek to designate the additional BRI solution as a new SRO.

3.9 The identification of the working solution for each of the two options included in the emerging WRSE draft regional plan is detailed in Supporting Technical Document A5: Options Refinement Report.

3.3 Option configuration, operation and assets required

3.10 Further details of the concept design of the two preferred options may be found in Supporting Document A1a and A1b: Concept Design reports.

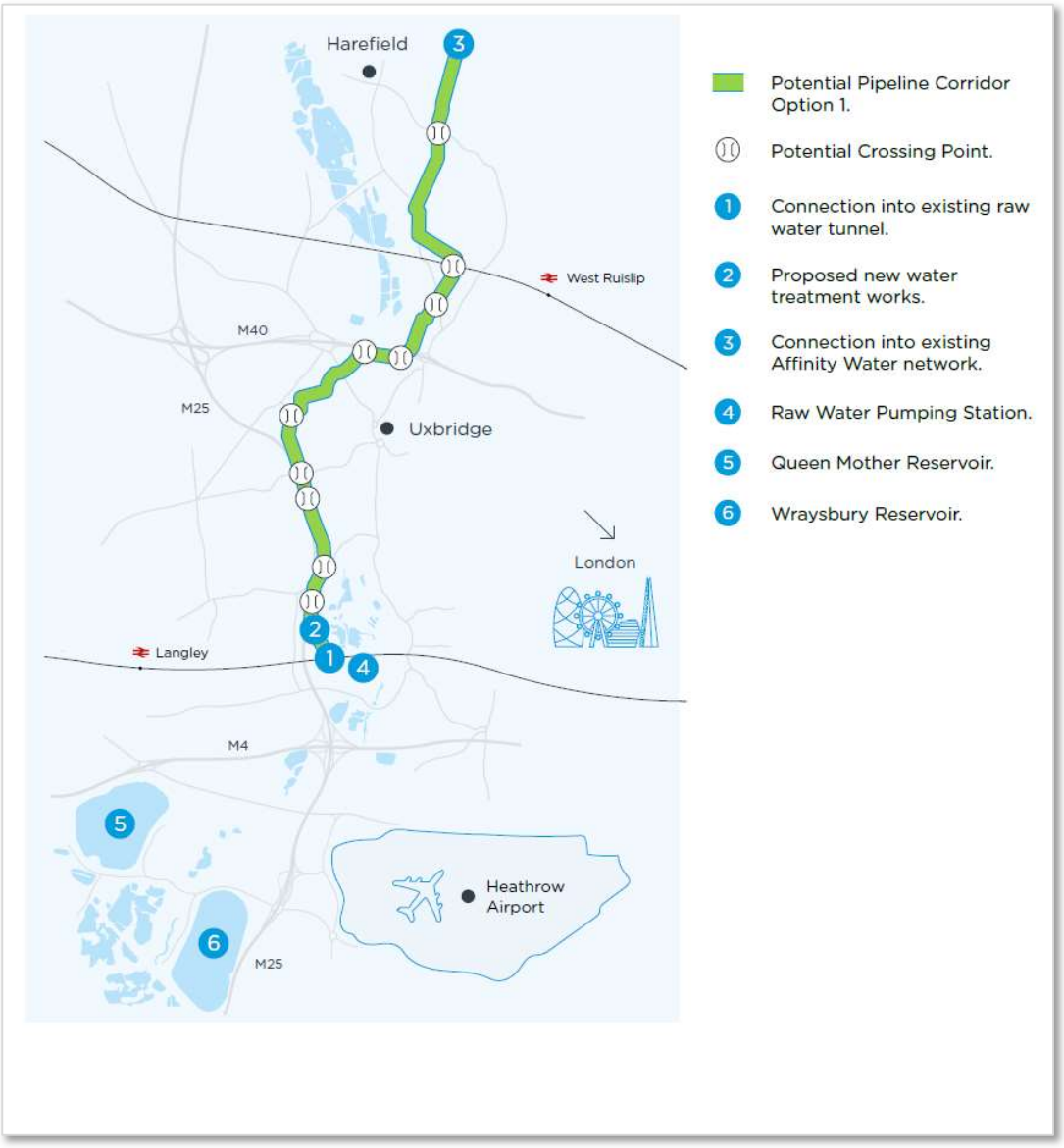
3.3.1 Lower Thames Reservoir (LTR) Option

3.11 The source of water for the LTR option is the River Thames. The natural flow in the river will need to be supported, especially during drought years, by the South East Strategic Reservoir (SESRO) SRO or the supported Severn to Thames Transfer (STT) SRO. A schematised view of the working solution may be found in Figure 3.1 below.

3.12 Raw water for the LTR option will be abstracted using the existing Thames Water intake to the Queen Mother and Wraysbury bankside storage reservoirs. There is an existing tunnel which allows these reservoirs to currently provide an alternative source of water to AFW's existing Iver WTW in abnormal circumstances or for blending. A new connection is proposed into this tunnel, with an adjacent shaft and pumping station located within the boundary of the existing Iver WTW site.

Figure 3.1 LTR Option, schematic map

[5] This is not intended to be the final scheme configuration; however it does represent the currently preferred site for the permanent river intake and water treatment works and the preferred corridor for the raw water and potable water mains.



3.13 The raw water will be conveyed in a new buried transfer main to a new water treatment works; the working solution for the potential new WTW site is in the vicinity of the existing Iver WTW. A conventional WTW process is proposed with:

- Clarifiers
- Rapid gravity filters
- Ozone
- Granulated activated carbon filters
- Chlorine disinfection
- Treated water storage
- Sludge thickeners and dewatering plant

3.14 The drinking water produced would be conveyed via a 14km long buried transfer pipe to an existing Affinity Water service reservoir (SR) in the vicinity of Harefield. The pipe material selected at this stage is cement lined ductile iron.

3.15 The drinking water pipeline corridor would be routed to the west side of the Colne Valley, crossing it in the vicinity of the A40 corridor. There are several major crossings along the route including the A40, the HS2 railway, the Chiltern line railway

and the Grand Union Canal and other major watercourses that follow the Colne Valley.

3.16 The delivery point for the LTR option is the existing SR in the vicinity of Harefield which is a distribution hub within the AFW network. The working solution makes use of existing, unused SR capacity to provide the necessary strategic storage.

3.17 The LTR option is designed to be operated in accordance with an assumed utilisation profile, derived from long-term water resources modelling (see Section 4.1). It is assumed that the system will operate at a minimum 25% capacity at all times, acting as a baseload supply, ramping up to peak capacity as required. On average, the scheme would be utilised at approximately 40% capacity as a minimum.

3.18 The operating philosophy developed for Gate 2 is built upon the following principles:

- Raw water will be drawn from the existing tunnel into the new WTW by using variable speed pumps within the new raw water pumping station.
- The speed of the raw water pumps will vary automatically to control the delivery flow, monitored on a local flowmeter.
- Fluctuations in the output of the treatment works arising from filter backwashing and other events will be buffered by the storage volume in the treated water tank.
- In line with instructions received from Affinity Water's control centre, the WTW operator will set the required flowrate from the (drinking water supply) high lift pumping station to meet the demand for water into the SR.
- The speed of the high lift pumps will vary automatically to control the delivery flow and would be integrated with existing control systems governing the current inflow into the SR.

3.3.2 Beckton Reuse Indirect (BRI) Option

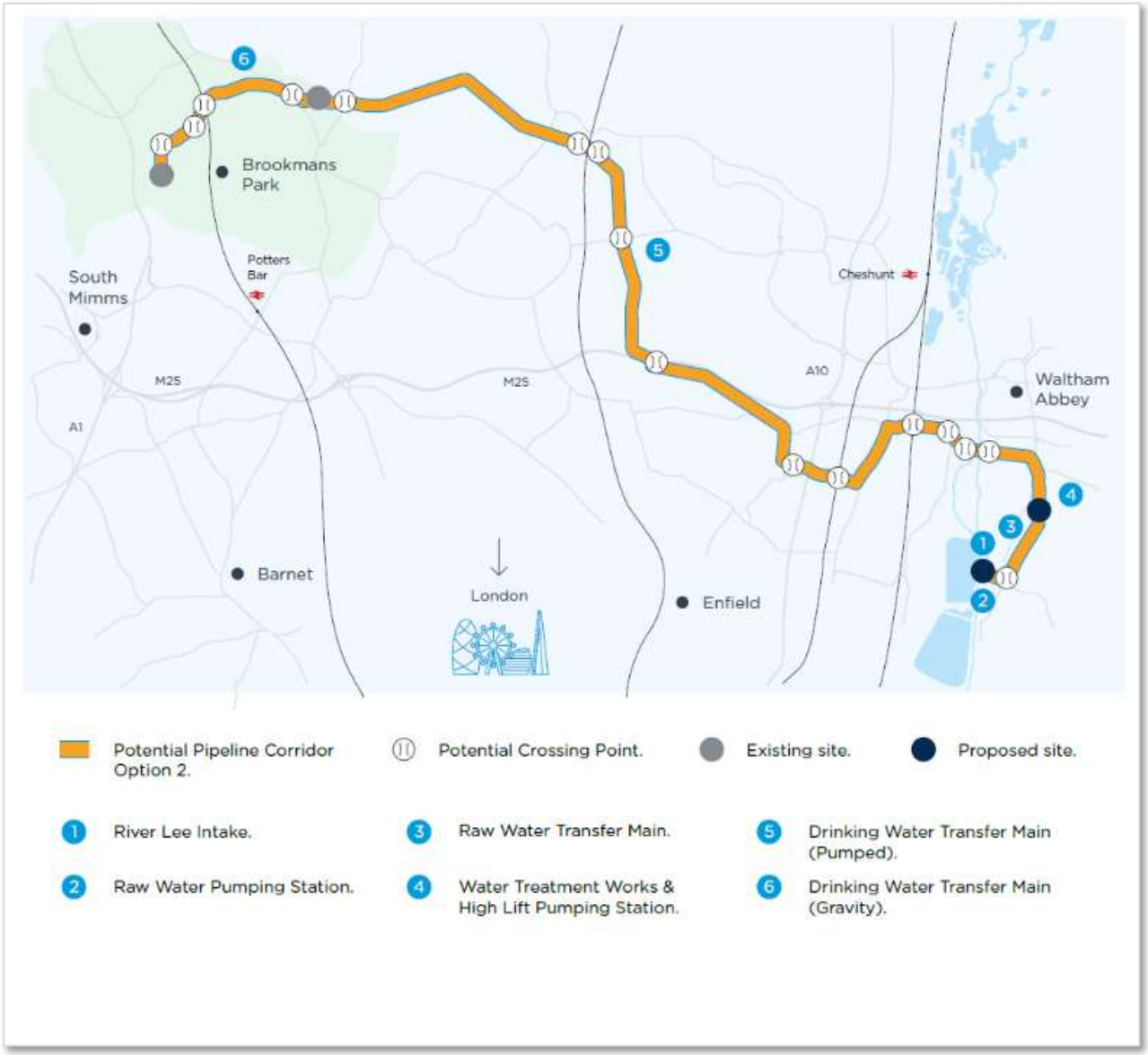
3.19 Raw water would be abstracted from a new intake on the River Lee flood relief channel. As the natural flow in the river is insufficient, the operation of the scheme will be dependent on recycled water being fed into the river from either the Beckton effluent reuse option or Teddington DRA option of the London Effluent Reuse SRO. Implementation of either of these options is therefore a pre-requisite. A schematised view of the working solution may be found in Figure 3.2 below.

3.20 The recycled water would be pumped into the River Lee upstream of the T2AT abstraction point.

3.21 At the new intake, we are proposing a passive wedge wire screen located in the riverbed. Water would flow by gravity from the intake, within buried pipes, to a new raw water pumping station set back from the riverbank.

3.22 The raw water will be conveyed in a new buried transfer main to a new WTW. Drinking water produced by the WTW will pass through a storage tank before entering a high-lift pumping station, from where it will be conveyed via a buried drinking water transfer main to an existing SR in the vicinity of Brookmans Park. A proportion of the water will then be able to flow under gravity to the existing booster pumping station in the vicinity of North Mymms. A conventional WTW process is proposed (see above for the LTR option), but with the inclusion of UV treatment for the BRI working solution, as noted previously.

Figure 3.2 BRI Option, schematic map



3.23 There are several major crossings along the indicative route of the drinking water pipeline including the M25 motorway, various railway lines and three major watercourses within the Lee Valley. However, the main technical challenge to constructing the selected pipeline route is that it passes through the dense urban area of Enfield.

3.24 The BRI option would also operate in accordance with the same assumed utilisation profile, as detailed previously.

3.25 The operating philosophy developed for Gate 2 is built upon the following principles:

- The source of water will be the River Lee flood relief channel, supported by recycled water from one of the London Effluent Reuse SRO options, feeding into the river upstream of the abstraction point.
- The concept design is based on two passive wedge wire screens, each of which can abstract the full plant flow, operating in parallel.

- Raw water would gravitate from the river to the raw water pumping station, which would pump flows at a controlled rate to the WTW using variable speed pumps.
- The control philosophy between the WTW and the downstream SR are the same as for the LTR option.
- At this stage, it is envisaged that the BRI option would always require a supply of recycled water into the River Lee in order to comply with the abstraction licence. Therefore, the WTW will need to be in communication with the reuse plant that is supplying the recycled water.

3.4 Interactions with existing assets and other SROs

3.4.1 Lower Thames Reservoir (LTR) Option

3.26 The LTR option is dependent on additional water resource being made available for abstraction from the River Thames. In the WRSE draft Regional Plan and draft WRMP24, the additional resource availability would be created by implementing the SESRO SRO.

3.27 SESRO is a pre-requisite for the LTR scheme because without the new reservoir, the scheme would leave Thames Water with an unacceptable reduction in the volume of strategic raw water storage available to supply London.

3.28 Should the supported STT option be implemented instead of or ahead of SESRO, then one of the alternative feasible configurations for T2AT could apply, using additional abstraction from the existing AFW offtake at Sunnymeads. This configuration of options is feasible and available within the options appraisal process, but does not provide the same level of strategic storage to Thames Water and Affinity Water. It is not currently chosen within either the WRSE draft Regional Plan or the draft WRMP24 as part of the best value solution for the south-east.

3.29 The anticipated date for completion of the SESRO project is 2040. It is anticipated that the time required to plan, develop, construct and commission the transfer scheme would be 11 years. This means that the next stage of development of T2AT does not need to start until 2028. This aspect of the project is covered in more detail in Technical Supporting Document F-1, the project Delivery Plan.

3.4.2 Beckton Reuse Indirect (BRI) Option

3.30 The earliest possible water available for use (WAFU) date for the Beckton Effluent Reuse option would be 2031[6]. It is anticipated that the time required to plan, develop, construct and commission the T2AT scheme would be 11 years.

3.31 The BRI option will deliver additional drinking water into the existing SR in the vicinity of Brookmans Park. The BRI option will make use of existing SR capacity. However, a risk has been included in the risk register should modifications to the network downstream from the SR be required.

[6] Gate 1 Submission for: London Effluent Reuse SRO – July 2021

3.4.3 Wider interactions

3.32 In order to distribute the additional water to customers, further enhancements to the existing network downstream from Harefield and Brookmans Park are likely to be required. The nature and timing of these enhancements will be dependent on the implementation of other schemes, such as the Grand Union Canal (GUC) SRO. Investments required to implement this strategy, referred to as 'Connect 2050', will be included in AFW's WRMP24.

3.33 Both LTR and BRI options could be compatible with the water resources management concept proposed by Chalk Streams First initiative. The organisation highlights that a proportion of the flow increase in chalk streams surrounding London, that will arise due to planned reductions in groundwater abstraction, will be available for abstraction as a water supply resource further downstream. AFW are currently determining what that proportion would be under different scenarios but, although it will provide some benefit, it would not be sufficient on its own to reliably meet the full requirements of T2AT, especially under drought conditions. This additional future flow has been considered in the water resources benefit assessment for T2AT (see Section 4.2.2).

4. Water resource assessment

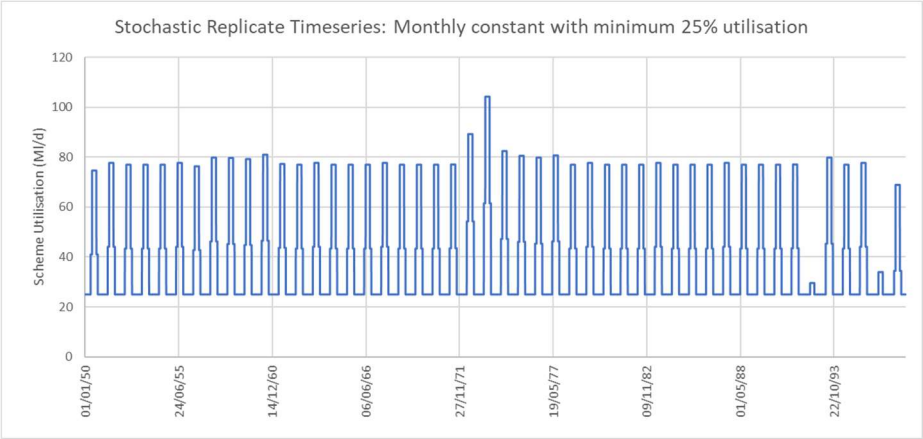
4.1 Utilisation

4.1 The long-term utilisation of the T2AT scheme variants has been established using the WRSE Regional System Simulation (RSS) model. Further details may be found in Supporting Document A1: Concept Design Report.

4.2 A number of adjustments were made to the Affinity Water demand profiles in the model, to better reflect the operational reality of this type of transfer scheme. Of particular note is that it is very unlikely that the proposed T2AT working solutions could be operated on a complete on/off basis during the year. For the utilisation analysis, it is assumed that a 'minimum turnover' of 25% will apply, to maintain a reasonable level of operational throughput and enables timely 'ramp up' of treatment and pumping capacity during a drought event. This minimum operation also enables the T2AT to be used as part of AFW's 'baseload' supply, as required to meet supply shortfalls from future sustainability reductions under different Environmental Destinations.

4.3 Based on the full stochastic analysis, the timeseries of expected daily usage of the scheme is as shown in Figure 4.1 below, analysed from the outputs of the WRSE RSS model. This shows that outside of the May to September period, expected use is likely to be dictated by operational turnover. Typical utilisation is expected to be in the order of 80% in summer, only increasing with significant droughts beyond 1 in 50 years. The average annual utilisation is approximately 40%.

Figure 4.1 Final T2AT operationally realistic utilisation profile



Note: this represents one of the 400 stochastic hydrological replicates modelled to provide the long-term utilisation duration curve, but is considered representative of the long-term range of conditions expected.

4.2 Water Resource Benefit

4.2.1 Deployable Output Assessment

4.4 The Deployable Output (DO) of the options have been calculated using the WRSE Regional System Simulation model. The same approach and methodology developed and adopted by WRSE, as detailed in their published method statement[7], has been used by the SRO. The DO identifies the amount of water that could be delivered by each of the options during a 1 in 500 year return period drought, with demand restrictions applied to meet agreed levels of service. The stated minimum levels of service applied for Affinity Water DO analysis are:

- Level 1 restrictions: Not more often than once every 5 years
- Level 2 restrictions: Not more often than once every 10 years
- Level 3 restrictions: Not more often than once every 40 years
- Level 4 restrictions: Not more often than once every 200 years after 2024

4.5 With TUBs and NEUBs in place, peak demands for AFW tend to be higher than the dry year annual average. The 30 day rolling average demand during a 'dry year' (2018) summer is around 10% - 14% higher than the annual average. This is reflected in the modelling as a dry year annual average DO that is approximately 15% lower than peak transfer capacity. Essentially, this means that the capacity of the transfer needs to be approximately 15% higher than the effective dry year annual average DO to meet this higher peak demand.

4.6 As a result, the infrastructure capacity of the T2AT working solutions that are required to deliver an average DO of 50 and 100 Ml/d are set approximately 15% higher, at 57.5Ml/d and 115 Ml/d respectively. These capacities are used as the basis of costing the schemes for WRMP24 and Gate 2.

[7] https://www.wrse.org.uk/media/sbblilys/method-statement-depolyable-output-aug-21.pdf

4.2.2 Conjunctive Use Benefit Assessment

4.7 Analysis was undertaken to explore the combined or conjunctive use impact of supplying the T2AT transfer from Thames Water's London WRZ, sharing the available raw water storage between the two companies.

4.8 The results take account of two main factors, that help to support the transfer and minimise the DO losses to TW through operating the transfer scheme from London:

- Effluent returns from increased water supply, which result in increases to river flows in the Colne, Lee and Thames catchments during drought periods and
- Increased river flows as a result of the reduced groundwater abstraction under the Company Alternative Environmental Destination scenario. For London, the Environmental Destination scenarios are modelled as increases in the river flows in the Lee (at Lee Fieldes Weir) and the Colne.

4.9 Overall, the modelling shows that operating the 100 Ml/d T2AT transfer scheme during a 1 in 500 year drought results in a very small loss of DO to Thames Water.

4.10 The impact on London DO is very low because the duration of deficit tends to be very small as there is surplus groundwater availability outside of the summer period, and because droughts are not necessarily consistent between the two companies. Hence, the two systems do not generally need to supply peak demands at the same time during a drought event.

4.11 Overall, the modelling suggests a net benefit to London could be up to 70% of the transfer DO. Based on the above, in order for supply to be resilient it would be necessary for AFW to reserve enough storage to support at least a 50% utilisation. This amounts to approximately 18,250 Ml / year. Effectively that water becomes unavailable to Thames during a drought (it is reserved by contract), so the operationally realistic reduction for TW is equal to half the DO gained by AFW. We have therefore modelled this within the WRSE and WRMP24 modelling systems as a 50% coincident and conjunctive use benefit to the London WRZ when the T2AT is operated using any new resource in the upper Thames catchment. This means that if 100 Ml/d is transferred to AFW from the London WRZ, using new resources from the upper Thames catchment, then this only results in a net loss of 50 Ml/d to the London DO.

4.3 Long-term Opportunities and Scalability

4.12 The two leading T2AT options are sized in accordance with the requirements of the WRSE regional plan and WRMP24. However, due to the nature of these schemes, they could be designed and constructed to enable future scalability. This need for scalability is not currently built into the scheme costs as it is not identified as being required by the draft WRMP24 plans. However, such aspects could include:

- For the BRI option[8], oversizing the river intake with additional intake screens / channels to enable additional intake pumping capacity to be relatively easily added in the future, abstraction licensing allowing;
- Implement the Water Treatment Works as a more modularised design, enabling future capacity to be integrated more easily in the future;
- Increase the capacity of critical crossing points along the pipeline route; this could facilitate new pipeline to be laid within the initial scheme easement in the future, to increase capacity, but without the need for costly future crossing work.

These aspects can be explored during subsequent design stages, as the design of the working solution is progressed and further refined.

4.4 Infrastructure Resilience

4.13 The different options have been assessed by WRSE using a series of standard resilience metrics. However, these metrics (for transfer schemes) have not been used in subsequent 'Best Value Planning' analysis to derive the WRSE draft Regional Plan, as this was considered by WRSE to double count the resilience benefit that is provided by the source feeding the transfer. For the purposes of comparison with other options, however, the resilience metrics calculated for the leading T2AT options are shown in Table 4.1 below. The assessment of resilience also included the impacts of the scheme on resilience risks within the existing Affinity supply system, where it was identified that the storage provided by the LTR scheme would be a major benefit to support the Iver treatment works, which currently does not have bankside storage and hence is vulnerable to outages from pollution incidents in the River Thames. This is referenced in the Affinity Water dWRMP.

Table 4.1 T2AT, resilience metrics from WRSE (0 = lowest resilience, 5 = highest resilience)

Resilience Metric	LTR Option	BRI Option
Reliability (R) – reflects resilience to transient shocks and stresses		
R1 – uncertainty of option benefit	4 for transfer; 5 for WTW	4 for transfer; 5 for WTW
R3 – vulnerability to physical hazards	4	3
R7 – risk of failure to exceptional shocks	3	3
Evolvability (E) – reflects the ability to respond to unplanned, longer-term or chronic stresses		
E1 – modularity and scalability	2 for transfer; 4 for WTW	2 for transfer; 4 for WTW
E3 – reliance on external bodies	2	2
Adaptability (A) – reflects resilience to transient shocks and stresses		
A3 – operational complexity	3	2

[8] For the LTR option, the existing Lower Thames Reservoir intakes would be used, hence this scalability option is not so easily available without reconfiguring existing assets.

4.4.1 Asset flood resilience

4.14 The leading T2AT schemes include only two key assets which would need to be located in an area currently at risk of flooding, within Flood Zones 2 and 3: the inlet structure on the banks of the River Lee is within Flood Zone 3 and part of the Indicative Raw Water Pumping Station Site is within Flood Zone 2. The Indicative WTW locations are both in flood zone 1. The working solution for the pipeline routes will involve some major watercourse crossings, most notably the River Colne and the River Lee, which will involve construction work within flood risk environments. Appropriate flood risk assessment, mitigation and construction methodologies will need to be developed, but have not yet been considered in detail at this stage.

4.15 For the BRI option, the indicative locations for the Intake and WTW Site are at low risk of surface water flooding. However, the Indicative Raw Water Pumping Station site is within a medium surface water flood risk area. A closed loop sustainable drainage system would be required for the Raw Water Pumping Station and new WTW to capture potential contaminants from the treatment process.

5. Drinking water quality considerations

5.1 Introduction

5.1 The Water Quality Risk Assessment (WQRA) has been drafted in the All Companies Working Group (ACWG) approved spreadsheet tool and reviewed in a collaborative strategic WQRA workshop, with technical water quality representatives from both Partner Companies. Throughout the WQRA process, the list of limiting hazards for each option has been reviewed and refined to give a representative, high-level view of the parameters which are likely to need treatment at this early stage of design. The WQRA process has also identified data gaps and residual risk considerations that can now be addressed moving forward into the next phase of works, and through the development of a Drinking Water Safety Plan (DWSP) for any option to be progressed to scheme promotion. This will ensure a more detailed overview of the water quality risks associated with each option and therefore enable a more informed treatment process design as the scheme develops.

5.2 Once the relevant limiting hazards had been reviewed at the collaborative strategic WQRA workshop and agreed between all parties, the draft likelihood scores of all parameters were reviewed. Where necessary, scores were updated based on attendees' expert opinions. Appropriate control measures were discussed for each limiting hazard. Where applicable, residual risk considerations were noted, and actions listed. These actions detailed the treatment technologies to be included in the option design and where further information was required for WQRA analysis in subsequent project stages. Further details of the risk assessment may be found in Supporting Technical Document Ca and Cb: Drinking Water Risk Assessment Report.

5.2 Lower Thames Reservoir (LTR) Option

5.3 For the LTR option, the recommendations from the workshops and collaborative WQRA process were:

- Further water quality data is required for the Gate 3 WQRA and the development of the DWSP, particularly from the Wraysbury Reservoir abstraction location or possibly from other locations within the lower Thames reservoir system
- The SRO water quality monitoring programme should be updated after Gate 2 to include data gathering at Wraysbury reservoir
- The SRO water quality monitoring programme should be extended to include additional data gathering at Datchet intake (for PFAS, *E-coli* and emerging hazards)
- Customer engagement would be key in reducing the risk of acceptability issues. Consumer research for changes in source type is ongoing and the results will tie into the next RAPID gated stage of the drinking water quality assessment process
- Chloride, sulphate, and alkalinity need to be considered in the risk analyses as they are foundational in understanding the Larson-Skold index
- 4-log removal or inactivation of Cryptosporidium must be considered in the LTR option treatment design. Wraysbury Reservoir will provide sufficient attenuation of cryptosporidium in conjunction with the conventional treatment process outlined in the Gate 2 concept design to achieve 4-log removal.
- According to the distribution DWSPs around the Harefield area, dirty/discoloured water risks associated with iron and aluminium deposits increase in the distribution network. These existing risks are currently monitored and managed and would not change with the addition of the LTR option. They are reflected in the medium scores given to aluminium, iron, and dirty/discoloured water in the distribution stage through to the consumer stage.

5.4 In summary, the Gate 2 WQRA for the LTR option re-confirmed the concept treatment design proposed and from the data available, has identified no drinking water quality parameters that pose a risk to AFW consumers. It should be noted however that there are still data gaps, particularly with emerging hazards and therefore further analysis is required as the scheme progresses. Further work will be undertaken during subsequent project stages to confirm the current source(s) water for Harefield SR and to update the WQRA, once the exact source(s) of water for the T2AT from within the Lower Thames Reservoir system are confirmed. This will help confirm the scale of likely taste or water quality changes that might affect customers.

5.3 Beckton Indirect Reuse (BRI) Option

5.5 For the BRI option, the recommendations from the workshops and collaborative WQRA process were:

- Site 15 monitoring at the River Lee upstream of the King George V (KGV) reservoir intake as part of the multi-SRO water quality monitoring programme should continue, including addition of emerging parameters to reflect latest ACWG

guidance. A longer data set will capture seasonal fluctuations in water quality and provide a better indication of parameter concentration trends going forward.

- Bromate and bromide pollution is present in the River Lee, however a decision was made to not add in bespoke treatment to the BRI-WTW Gate 2 concept design as there are existing management techniques in place. This management should continue to be effective and if it is no longer possible, it is expected more comprehensive abstraction/river management would be an appropriate response due to the large-scale impact the contamination would have on other sites.
- Customer engagement would be key in reducing the risk of acceptability issues. Consumer research for changes in source type is ongoing and the results will tie into the next RAPID gated stage of the drinking water quality assessment process
- Chloride, sulphate, and alkalinity need to be considered in the risk analyses as they are foundational in understanding the Larson-Skold index
- 4-log removal or inactivation of cryptosporidium must be considered in the BRI option treatment design. A direct surface water abstraction to WTW design will not provide an opportunity for attenuation of cryptosporidium before treatment. Therefore, UV treatment in conjunction with the conventional treatment process outlined in the Gate 2 concept design should be included.
- According to the distribution DWSPs around the North Mymms area, risks associated with iron, lead, benzo(a)pyrene and aluminium increase in the distribution network. These existing risks are currently monitored and managed and would not change with the addition of the BRI option.

5.6 Water quality risks highlighted in the Gate 2 BRI WQRA have supported the need for concept treatment design proposed. The only modification identified is the requirement for a UV process to adequately treat cryptosporidium. From the data available, the WQRA has identified no drinking water quality parameters that pose a risk to AFW consumers once treatment has occurred.

5.7 In October 2021, the DWI set out the requirements for Poly and Perfluorinated Alkyl Substances (PFAS) monitoring by water companies in England and Wales. Following this guidance and pursuant to the risk assessment completed for Gate 2, we have identified the need to add PFAS to the SRO water quality monitoring programme. The list identified by the DWI consists of 47 individual PFAS parameters, which have all been added to the standard monitoring suite collected monthly across this SRO. This monitoring will continue through the next phase of works.

5.4 Customer acceptability of proposed water quality changes

5.8 Further details of the customer engagement undertaken to establish acceptability of changing water source as a result of this SRO may be found in Section 9.2 and in Supporting Document D: Stakeholder and Customer Engagement Strategy.

6. Environmental assessment

6.1 Environmental 'Desk-Based' Appraisal

6.1.1 Introduction

6.1 Following the options appraisal and refinement process (Section 3.2), desk-based appraisal of key environmental aspects was carried out on the two working solutions. Further details can be found in Supporting Documents B1a and B1b – Environmental Appraisal Reports.

6.1.2 Summary conclusions

Lower Thames Reservoir Option

6.2 A number of constraints and issues for further investigation and work have been identified (see Table 6.1 below). However, the assessments did not identify any environmental risks that should prevent the LTR Option from progressing, if required.

Table 6.1 Summary of environmental appraisal, LTR Option

Assessment / Topic	Environmental Appraisal Summary
Biodiversity, flora and fauna	• No direct impacts on statutory designated sites. • Potential for indirect effects on statutory designated nature conservation sites during construction, some of which are Groundwater Dependent Terrestrial Ecosystems. • Direct and indirect negative effects identified for non-statutory designated nature conservation sites, including Local Wildlife Sites and Sites of Nature Conservation Importance. • Potential loss of deciduous woodland priority habitat and potential impacts on protected species.
Soils	• No direct or indirect impacts on designated geological sites. • No permanent loss of best and most versatile agricultural land • Potential for temporary loss of Grade 2 and 3 (including 3a) agricultural land • Potential for contamination due to construction works
Water	• The majority of identified effects considered likely to be either negligible or result in minor effects that are unlikely to affect the overall ecological integrity of affected reaches. • Flow augmentation changes within the River Thames to support the T2AT have the potential to be both beneficial and adverse (at different times and for different species) for the existing baseline ecology. However, flow effects are ameliorated with distance from the discharged source the abstraction point for LTR is significantly further downstream than the associated discharge and would not result in WFD deterioration. • The potential impacts associated with the new or increased surface water abstraction will not be of a magnitude to result in the potential to deteriorate the WFD elements of the Thames (Cookham to Egham), Queen Mother Reservoir and Wraysbury Reservoir or prevent them from the attainment of Good status in the future. • Various watercourse crossings, with risk of direct impacts, but suitable construction phase mitigation available[9]. Sections of pipeline pass through SPZs, with potential risk of pollution during construction.
Air	• Majority of option is within AQMAs. • Certain objectives may be exceeded during construction in areas that are located within AQMAs although exceedances of the PM10 and PM2.5 objectives are not expected to occur.

[9] Main rivers would be crossed via micro-tunnel. Where watercourses not micro-tunnelled, it is assumed they will be flumed during construction. This will be a short term construction activity (i.e. less than seven days), which will ensure the watercourse is returned to its natural function following installation of the pile section.

Assessment / Topic	Environmental Appraisal Summary
	• Construction dust assessment to be undertaken and methodology to mitigate established. • Air quality impacts associated with vehicle traffic during the construction phase are unlikely to be significant but should be assessed once further details of these activities are available. • Operational effects associated with traffic and standby generators for the new WTW are unlikely to be significant.
Climatic factors	• Climatic risks include exacerbation of flood risk, higher temperatures and drought affecting ground conditions, and possible exceedance of operational temperature limits. • Construction carbon emissions associated with the transfer pipelines and WTW • Operational carbon emissions primarily associated with power consumption for pumping.
Landscape	• Potential for permanent change in landscape character where vegetation is lost during construction and cannot be replaced because it falls within the pipeline easement. • Indicative WTW Site is proposed on a site of existing industrial use and provides an opportunity to reduce the extent of hardstanding in comparison to the existing land use. • Potential impacts on protected trees within pipeline corridor including within Harefield Village Conservation Area and TPOs in the Ickenham area. • Opportunities to enhance landcover value and strengthen the blue-green network, for example through use of mitigation planting to link existing green infrastructure elements across the wider Colne Valley landscape.
Historic environment	• No permanent impacts on designated heritage assets with exception of a Grade II Listed Building, which, depending on layout of Indicative WTW Site, could be directly impacted. • Construction of the new WTW could also adversely affect the setting of the Grade II listed building however there is an opportunity to enhance the setting of this listed building. • High potential for archaeological remains, particularly prehistoric. Excavation during construction could severely truncate, or remove, potential archaeological remains.
Noise	• Construction noise impacts from the Wraysbury Tunnel Connection and indicative WTW Site are likely to be minimal due the distance from noise sensitive receptors. • Pipeline alignment should be chosen to be at least 85m from noise sensitive receptors (130m where trenchless techniques occur) in order to minimise significant adverse noise impacts. This can be achieved along the vast majority of the Drinking Water Transfer Main Route Corridor and should be factored into refinement of the pipeline route alignment.
Population and human health	• Community and human health impacts affecting housing and private property, businesses and open space and recreation during both construction and operation, including land requirements for the Indicative WTW Site. No permanent loss of housing and private property, community facilities or recreational assets.
Material assets	• It is not considered that the vehicles volumes generated during construction and operation would present additional constraints to the road network. The majority of roads provide practical options for construction access. • Major infrastructure crossings including A40, Chiltern Line, HS2 Phase 1 route and Grand Union Canal would require further investigation and agreement with stakeholders. • Opportunity for a closer access and egress from the M25, which could provide a more direct route to construction sites. • Potential impacts on existing utilities and minerals and waste sites.
INNS Risk Assessment	• LTR Option would not introduce a new hydrological connection between previously isolated catchments. Very low risk that LTR option would facilitate INNS spread as water transfer is via tunnel and / or pipeline rather than open watercourse. • Main risk identified is raw water movement between the source / intake and the new WTW. Minimal benefit from implementation of biosecurity measures and implementation of these measures may be considered disproportionate in relation to the risk. • Negligible risk of INNS transfer in drinking water and further biosecurity/mitigation measures would have no tangible benefit. • Low risk associated with the new assets as they are designed to move water within a sealed system; unlikely that additional biosecurity measures would reduce risk further.

Note: mitigation for the negative impacts identified is considered available for all impacts identified, through both project specific and industry standard measures. Further work will be undertaken to develop these initial proposals as the environmental baseline, scheme design and environmental assessment are developed during subsequent project stages

Beckton Indirect Reuse Option

6.3 A number of constraints and issues for further investigation and work have been identified (see Table 6.2 below). However, the assessments did not identify any environmental risks that should prevent the BRI Option from progressing, if required.

Table 6.2 Summary of environmental appraisal, BRI Option

Assessment / Topic	Environmental Appraisal Summary
Biodiversity, flora and fauna	• Potential for direct impacts on Chingford Reservoir SSSI as a result of construction of the River Lee Intake. • Potential for indirect effects on other statutory designated nature conservation sites, although none of these are Groundwater Dependent Terrestrial Ecosystems. • Direct and indirect negative effects on various non-statutory designated nature conservation sites, including Local Wildlife Sites and Sites of Nature Conservation Importance. • Potential for impacts on ancient woodland although temporary construction compounds could be sited and the pipeline aligned to avoid these areas. • Potential loss of coastal and floodplain grazing marsh and deciduous woodland priority habitat and potential impacts on protected species.
Soils	• No direct or indirect impacts on designated geological sites. • Potential for permanent loss of Grade 3 agricultural land at the Indicative Intake Location, Indicative Raw Water Pumping Station Site and Indicative WTW Site • Potential for temporary loss of Grade 3 (including 3b) agricultural land in pipeline corridor. • Potential for contamination due to construction works
Water	• No statutory designated sites directly impacted. The only designated site which includes aquatic communities as the qualifying/notifiable features is the Cornmill Stream and Old River Lea SSSI. The site is located upstream of the proposed transfer corridor and will not be affected by the construction activities. • During construction there is a risk of impacts on the aquatic communities associated with the transfer corridor. The risk related to construction impacts such as pollution incidents, local increases in sediment/siltation, temporary disturbance as a result of noise and vibration, etc. Construction phase mitigation has been identified. Various watercourse crossings, with risk of direct impacts, but suitable construction phase mitigation available10. • Any impacts on the aquatic communities are therefore expected to be short term and reversible. As such, no or negligible change in aquatic ecological community receptors are expected. • Various aspects of the indicative working solutions are located within areas defined as SPZ1 and SPZ2, with potential risk of groundwater pollution during construction. • The Indicative Intake Location is within Flood Zones 2 and 3 and part of the Indicative Raw Water Pumping Station Site is within Flood Zone 2, and therefore are at risk of fluvial flooding. The Indicative WTW is in Flood Zone 1. Fluvial flood risk would need to be managed during construction. • The Indicative Intake Location and Indicative WTW Site are at low risk of surface water flooding. However, the Indicative Raw Water Pumping Station Site is within a medium surface water flood risk area. A closed loop sustainable drainage system would be required for the Raw Water Pumping Station and new WTW to capture potential contaminants from the treatment process.

[10] Main rivers would be crossed via micro-tunnel. Where watercourses not micro-tunnelled, it is assumed they will be flumed during construction. This will be a short term construction activity (i.e. less than seven days), which will ensure the watercourse is returned to its natural function following installation of the pile section.

Assessment / Topic	Environmental Appraisal Summary
Air	• Majority of BRI option is not within AQMAs. However, certain objectives may be exceeded during construction in areas that are located close to the roadside within Enfield AQMA. • Construction dust assessment to be undertaken and methodology to mitigate established. • Air quality impacts associated with vehicle traffic during the construction phase are unlikely to be significant but should be assessed once further details of these activities are available. • Operational effects associated with traffic and standby generators for the new WTW are unlikely to be significant.
Climatic factors	• Climatic risks include exacerbation of flood risk, higher temperatures and drought leading to change in ground conditions, and exceedance of operational temperature limits. • Construction carbon emissions associated with the transfer pipelines and WTW. • Operational carbon emissions primarily associated with power consumption for pumping.
Landscape	• Potential for permanent change in landscape character along the pipeline route where vegetation is lost during construction. • Construction of the new WTW site would involve the removal of existing vegetation, hence localised, adverse landscape effects. Indicative WTW Site is proposed on existing industrial/commercial use site, hence not considered a notable landscape change. • Potential impacts on protected trees within proximity to the pipeline corridor. • Opportunities to enhance landcover value and strengthen the blue-green network, for example through use of mitigation planting to link existing green infrastructure elements across the wider Lee Valley landscape.
Historic environment	• No direct impacts on designated heritage assets. • Potential for above ground structures associated with the River Lee Intake and the Raw Water Pumping Station to permanently and adversely alter the setting of Grade II* Listed Building, through visual intrusion. Mitigation would be required to reduce impacts. • Expected to be minimal changes to the setting of Grade II Listed Building whilst in operation, but constraints on WTW building height may be necessary. • High potential for archaeological remains, particularly prehistoric period. Excavation during construction could severely truncate, or remove, potential archaeological remains.
Noise	• Pipeline alignment should be chosen to be at least 85m from noise sensitive receptors (130m where trenchless techniques occur) in order to minimise significant adverse noise impacts. This can be achieved for the majority of the working solution, but there are areas within Enfield where this may not be possible and temporary noise effects may occur. • Construction and operational noise impacts from the River Lee Intake, Raw Water Pumping Station and Indicative WTW are possible due the proximity of noise sensitive receptors and would require mitigation.
Population and human health	• Community and human health impacts affecting housing and private property, businesses and open space and recreation during both construction and operation, including land requirements for the Indicative WTW Site. No permanent loss of housing and private property, community facilities or recreational assets.
Material assets	• It is not considered that the vehicles volumes generated during construction and operation would present additional constraints to the road network. • The majority of roads provide practical options for construction access. • Major infrastructure crossings including M25, West Anglia Main Line, Lee Valley Line, East Coast Main Line and River Lee Navigation would require further investigation and agreement with stakeholders. • Potential impacts on existing utilities and strategic mineral resources.
INNS Risk Assessment	• Option would not introduce a new hydrological connection between previously isolated catchments. Very low risk that the option would facilitate INNS spread as water transfer is via pipeline rather than open watercourse. • Main risk identified is raw water movement between the source / intake and the new WTW. Minimal benefit from implementation of biosecurity measures and implementation of these measures may be considered disproportionate in relation to the risk. • Negligible risk of INNS transfer of drinking water and further biosecurity/mitigation measures would have no tangible benefit. • Low risk associated with the new assets as they are designed to move water within a sealed system; unlikely that additional biosecurity measures would reduce risk further.

Note: mitigation for the negative impacts identified is considered available for all impacts identified, through both project specific and industry standard measures. Further work will be undertaken to develop these initial proposals as the environmental baseline, scheme design and environmental assessment are developed during subsequent project stages

6.2 Informal Water Framework Directive Assessment

6.4 A project-specific, informal Water Framework Directive (WFD)[11] assessment has been completed for Gate 2, based on the enhanced level of design detail available compared to Gate 1 and incorporating the findings of additional studies. As such, it provides greater confidence and certainty on the likely WFD impacts of T2AT than was available at Gate 1. Details of the informal WFD assessment may be found in Supporting Technical Document B5.

6.5 The initial impact screening that was applied has identified four waterbodies that have an 'activity impact' score of greater than 1 (i.e. they should progress for level 2, more detailed appraisal), all based upon new or increased surface water abstraction':

- BRI: Lee Navigation Enfield Lock to Tottenham Locks (GB106038027950)
- LTR: The Thames (Cookham to Egham) (GB106039023231), The Queen Mother Reservoir (GB30642334) and Wraysbury Reservoir (GB30642417).

6.6 The Level 2 WFD assessment provides an outline of the potential impacts associated with the scheme, in accordance with the ACWG, Level 2 – detailed screening assessment methodology. It is worth noting that this is still very early in the development process and thus we would expect the design and any associated mitigation requirements to be further developed over time.

6.7 Based on the design assumptions outlined for Gate 2, and utilising both the numerical scoring from the prescribed methodology and professional judgement, there will be no potential for deterioration of any WFD elements in any of the four water bodies listed previously as a result of either the BRI or the LTR option; passing Objective 1 of the WFD Regs, which is No Deterioration. There will be no potential for either the BRI or the LTR option to result in any WFD status not achieving their objectives, therefore also passing Objective 2 of the WFD Regs.

6.8 Therefore, for all WFD water bodies screened into the Level 2, detailed screening assessment confirms that they would be compliant with the WFD once the scheme was operational.

6.3 Informal Habitats Regulations Assessment

6.9 We have undertaken an informal Habitats Regulations Assessment (HRA) Stage 1 screening of the leading T2AT options. Following the principles of HRA, this sets out the potential for likely significant effects (LSE), during construction and operation of T2AT, on European Sites. Stage 2 Appropriate Assessment (AA) has been undertaken for those European Sites screened in at Stage 1. Further details may be found in Technical Supporting Document B2: Habitats Regulations Assessment.

[11] The WFD is an EU Directive which, as of 31/12/2020, is no longer applicable to the United Kingdom. The Water Framework Directive has been translated into UK legislation as the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 in England and Wales). From this point forward "WFD" refers to the legislation applicable to England and Wales, not the EU Directive.

6.3.1 LTR Option

6.10 The Gate 1 HRA Stage 1 Screening undertaken for the LTR option was reviewed in light of design development for Gate 2. Potential LSEs were identified for the South West London Waterbodies SPA and Ramsar site. Consequently, only these two sites are subject to a Stage 2 AA.

6.11 The subsequent HRA Stage 2 AA did not identify adverse effects on the integrity of the South West London Waterbodies SPA and Ramsar either alone or in-combination with other projects or plans. It should be noted however that the assessment for the Lower Thames Reservoir Option is based on the conclusion that there will be no change to the current abstraction regime at Wraysbury Reservoir. This assessment must be revised if further investigations lead to a different conclusion in relation to possible impacts to surface water levels and flows at the reservoir. A formal HRA will be completed at Gate 3 pursuant to the consenting stage.

6.3.2 BRI Option

6.12 The Gate 1 HRA Stage 1 Screening undertaken for Beckton Reuse Indirect Option was reviewed as a result of design changes for Gate 2. LSE were concluded from the revised Stage 1 Screening on Lee Valley Ramsar and SPA (due to potential hydrological connection and risk of pollutions events during construction), and Wormley Hoddesdonpark Woods SAC (due to changes in quality and/or dust during construction).

6.13 The HRA Stage 2 AA for these sites concluded that with the use of best practice control measures there would be no adverse effects on the integrity of Lee Valley Ramsar and SPA or Wormley Hoddesdonpark Woods SAC.

6.14 Therefore, no effects adverse effects on the integrity of these sites are anticipated either alone or in-combination with other projects and plans. This assessment must be revised if further design iterations result in changes to potential impact pathways and potential significant effects upon Habitats Sites, as part of a formal HRA to be completed at Gate 3, pursuant to the consenting stage.

6.4 Biodiversity Net Gain (BNG) study

6.15 The T2AT SRO is committed to achieving 10% BNG, which would be reviewed when the precise regulatory and legislative requirements are known (e.g. under the Environment Act 2021, the provisions of which are expected to be in force when the T2AT is consented). BNG calculations were carried out on the pre-mitigation working solutions. Opportunities were identified to achieve the required 10%, however specific habitat mitigation and enhancement proposals will be set out in the next phases of design.

6.16 The options are likely to result in a loss of BNG habitat units due to the temporary and permanent loss of habitats during construction. Mitigation and enhancement opportunities have been identified to reduce the loss of biodiversity. Such measures are shown in

Table *6.3* below and it is recommended that these be developed during the next phase of the project, as the design progresses.

Table 6.3 Summary of Potential Net Gain Mitigation and Enhancement Opportunities

Component	Mitigation Opportunity	Enhancement Opportunity
Raw Water and Treated Water Transfer Main Route Corridors	Scheme layouts, including the aboveground infrastructure and pipeline alignment, to be amended to avoid the permanent loss of habitats, wherever possible.	Creation of higher value habitat within grassland, arable and pasture natural capital assets onsite to achieve an increase in Biodiversity Units (BU) and work towards a 10% uplift in BNG.
	Schemes to identify area for the creation and/or reinstatement of Priority Habitats, including: • Floodplain grazing marsh • Lowland fens • Lowland raised bog • Reedbeds • Blanket bog • Hay meadows • Dwarf shrub heath • Broadleaved, mixed and yew woodland • Coniferous woodland	Habitat creation work within the adjacent priority habitats. Scheme falls within and is in proximity to habitat network zones[12]: • Habitat restoration-creation • Restorable habitat • Fragmentation action zone • Network enhancement zones 1 and 2 • Expansion zone These areas identify specific locations for a range of actions to help improve the ecological resilience for each of the habitats/habitat networks. The scheme should look to identify habitat network zones and priority habitats within the near vicinity and look to improve/create/restore habitats which would help to work towards increasing BU and work towards a 10% uplift in BNG.
	Construction practices to be considered to reduce the amount of clearance required for, especially in areas that include high value habitats (see above for list).	Increase the quality/quantity of freshwater habitats, including lakes, ponds located in designated SSSIs, pending detailed assessment of local conditions and available space.
	Trenchless techniques to be used where possible to avoid loss of high value habitats (see above for list).	Scheme to identify suitable areas offsite for the creation, enhancement and/or restoration in order to develop off-site net gains, working towards achieving a 10% uplift in BNG.
Indicative WTW Site and other scheme elements that contain above ground infrastructure	N/A	Creation or re-instatement of grassland within footprints of the above ground infrastructure, where possible.

6.5 Analysis of carbon

6.17 An assessment of whole-life carbon for the two options has been developed for the Gate 2 submission and consideration of the opportunities to reduce this through the life-time of the assets. Further details may be found in Supporting Document A3: Carbon Strategy.

6.18 The T2AT SRO has followed PAS2080 principles in its carbon management approach. The carbon footprint of the options has been calculated without mitigation, to understand the baseline carbon impact, and then quantified assessment has been used to establish carbon hotspots, which enables prioritised design mitigation

[12] Edwards J, Knight M, Taylor S & Crosher I. E (May 2020) 'Habitat Networks Maps, User Guidance v.2', Natural England.

efforts to be focused on these hotspot areas. We have followed the IEMA emissions reduction hierarchy to identify carbon mitigation opportunities. This aligns well with the carbon reduction hierarchy from PAS2080 and helps focus efforts on reducing emissions rather than offsetting them.

6.5.1 Assessment of capital carbon

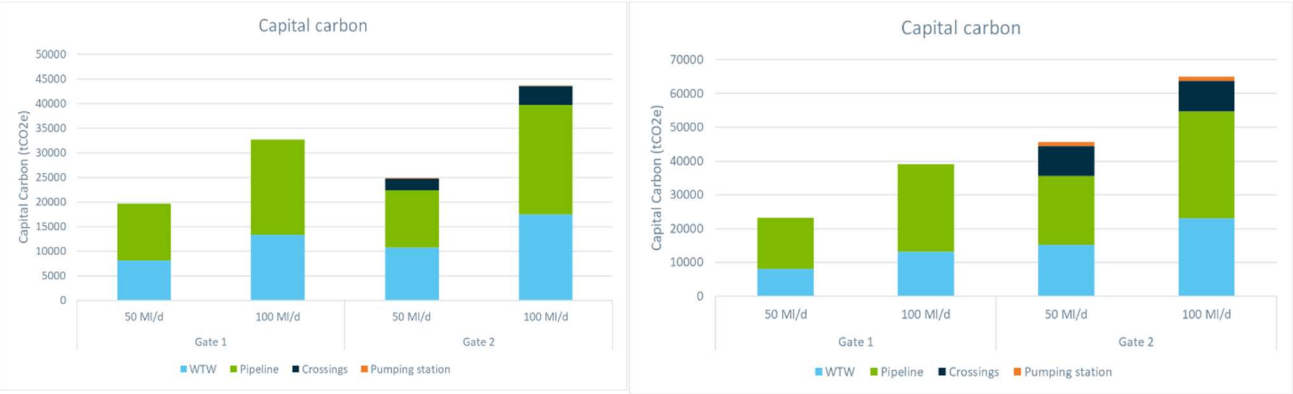
6.19 Figure 6.1 shows the total capital carbon for the T2AT options, compared to Gate 1 values. The capital carbon emissions have increased from Gate 1 to Gate 2, predominantly due to the further design details of the treatment works and crossings. Most notably, the increase in the capacity of the treatment works and pipeline following additional DO modelling (see Section 4.2.1), which has a direct impact on increasing carbon emissions at Gate 2.

6.20 The capital carbon 'hotspots' identified by the Gate 2 analysis are summarised in Table 6.4 below.

Table 6.4 Capital carbon hotspot summary

Element	Summary at Gate 2
Transfer pipeline	Largest proportion of the capital carbon emissions at between 40 and 45%. Predominantly made up of large diameter ductile iron pipe installed via open cut trenches through fields. Carbon emissions result predominantly from the pipe material itself (65% for 800mm pipe and 71% for 1200mm pipeline in roads, and over 80% for both sizes when installed in fields).
Water Treatment Works	Accounts for the next carbon hotspot at 33 – 44%. Driven by aspects of the treatment process that comprise predominantly civil components such as potable water storage, clarifiers and filtration. These assets are dominated by concrete and steel reinforcement in these structures. There will be further opportunities to seek alternative construction materials, such as optimising concrete mix choices and reinforcement types, closer to the detailed design and delivery stages.
Pipeline crossings	Pipeline crossings of watercourses, major roads and railways account for 10% – 20% capital carbon emissions. Crossings include excavated shafts connected by concrete tunnels and hence require substantial amounts of excavation and reinforced concrete driving the high emissions.

Figure 6.1 Total Capital Carbon – LTR option (left) and BRI option (right)



6.5.2 Assessment of operational carbon

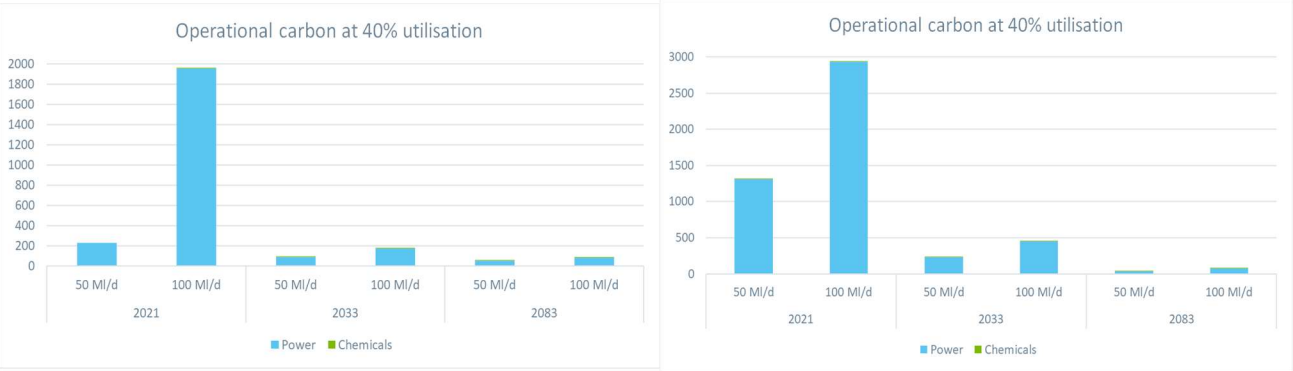
6.21 Figure 6.2 displays the total operational carbon emissions for each of the scheme options, at three different time frames. These include:

- Present day using DEFRA's 2021 emission factor for grid power consumption
- 2033 using BEIS grid carbon intensity forecasts

- 2083 using BEIS grid carbon intensity forecasts

6.22 The operational carbon for this SRO is dominated by the power requirements. Over time, the 2083 emissions from electricity reduce significantly to 33% of operational emissions post-commissioning, in 2033, and around 3% of emissions from present day values. This is because of the decarbonisation of the power grid rather than reduction in power usage.

*Figure 6.2 Total Operational Carbon – LTR (left) and BRI (right)**



** based upon utilisation profile summarised in section 4.1 (i.e. average utilisation of approximately 40%)*

6.5.3 Assessment of whole-life carbon

6.23 To align with costing[13], the whole-life carbon assessment has also been assessed over the same timeframe. A summary of the whole life carbon emissions and costs for the two variants of each of the T2AT options, including the (albeit relatively minor) estimated effects of the net change in carbon sequestration due to the change in landuse, is presented in Table 6.5 and

Table 6.6 below. The LTR option is much more carbon efficient than the BRI option.

Table 6.5 Summary of the whole life carbon emissions and costs – 50 Ml/d options

Emissions type (tCO2e)	LTR 50 Ml/d	% total emissions	BRI 50 Ml/d	% total emissions
Capital	25,800	46%	45,700	56%
Capital replacements	18,400	33%	25,500	31%
Operational power	10,500	19%	9,700	12%
Operational chemicals	160	0.3%	160	0.2%
Land use change	880	1.6%	860	1%
Total	**55,740**		**81,920**	
Carbon costs (£m)				
Total (central estimate)	**£11.6M**		**£14M**	

[13] Whole life costs have been assessed over 80 years, to include a 6-year planning and development period followed by a 5-year construction period ending in 2038. This is followed by 69 years of operation, assuming the long-term average utilisation profile presented in Section 4.1 and Supporting Document A1a (Section 4).

Table 6.6 Summary of the whole life carbon emissions – 100 Ml/d options

Emissions type (tCO2e)	LTR 100 Ml/d	% total emissions	BRI 100 Ml/d	% total emissions
Capital	43,700	45%	65,000	40%
Capital replacements	35,500	37%	38,200	24%
Operational power	16,000	17%	57,100	35%
Operational chemicals	340	0.4%	340	0.2%
Land use change	880	0.9%	860	0.5%
Total	**96,420**		**161,500**	
Carbon costs (£m)				
Total (central estimate)	**£13.2M**		**£20.6M**	

6.5.4 Opportunities for carbon reduction

6.24 The mitigation efforts have been split into two areas:

- Opportunities directly under the control of the design team, including areas which can reduce emissions through design decisions.
- Longer term opportunities where the scheme and sector may influence external systems and supply chains to decarbonise major components of the scheme.

6.25 The two T2AT options have varying opportunities for carbon reduction in the design of the scheme. The key aspects identified at this stage are discussed in Table 6.7.

Table 6.7 T2AT, Opportunities for carbon mitigation through design

Characteristic	Opportunity
Capital carbon	
Material selection	Accounting for approximately 50% of capital carbon emissions. At Gate 2, the pipe material has been assumed as Ductile Iron (DI), which has a relatively high carbon intensity compared to steel and composite pipes, such as glass fibre reinforced plastic (GRP). The material selection has predominantly been driven by its reliability and the diameter of the pipe required, with ductile iron considered typical at the required diameters and reliable. Whilst PE pipes can feasibly be used and manufactured at this diameter, they would need to be made bespoke and would require substantial wall thicknesses to provide similar performance. Steel and GRP pipes are an option that will be further explored at later design stages (including the different bedding requirements needed), and would need careful consideration by the Water Companies in reviewing their assets standards, to inform specification preparation for the construction contract.
Water treatment works	Processes have been optimised from Gate 1 to reduce the land footprint, such as use of lamella clarifiers from dissolved air flotation. However, there is further opportunity to optimise the design of chosen processes to reduce use of high carbon materials such as concrete or allow for lower carbon materials as the design of the scheme progresses.
Pipe size (diameter)	The pipeline diameter has been calculated and optimised based on 100% utilisation at 100% capacity. Optimisation to more operationally realistic utilisation schedules during subsequent design phases could result in a smaller diameter pipe, leading to capital carbon savings through both material and installation savings.
Infrastructure crossings	As part of the pipeline route, the number of open cut crossings has been minimised predominantly to reduce disruption to the traffic network and the riverine environment. The major crossings construction has been determined to be trenchless (micro-tunnelling) with shafts at either side. There are deemed to be no feasible alternative installation methods at

Characteristic	Opportunity
	present due to the pipe diameter and disruption to the transport network. Consideration could be given at Gate 3 to not installing dual tunnels at every trenchless crossing.
Backfill and reinstatement	Another aspect of pipeline installation is the backfill material. Where possible, use of as-dug material will be used for backfilling which reduces carbon emissions. To not overstate the carbon savings, the Gate 2 carbon assessment assumes imported backfill for the pipe surround and as-dug material for the remaining trench, except where traversing through contaminated ground (where all backfill is assumed to be imported). Once further detail is known at later Gate stages, an updated assessment of the imported material required for the pipeline can be made and could potentially lead to carbon savings.
Power supply provision	A further design optimisation opportunity would be to reduce the electricity supply infrastructure for pumping stations. At Gate 2, pumping stations have been designed to have dual supply. There is the opportunity to optimise this to a single supply for the high and low-lift pump stations. This can be explored at Gate 3 where discussions need to account for the risk to the operation of the SRO and the balance of carbon emissions associated with standby generators.
Waste Minimisation	Adopting construction techniques, e.g. modular or off-site manufacture options can help reduce the amount of waste associated with construction projects, whilst potentially reducing carbon emissions, improving health and safety and overall operational performance of assets. Having a robust waste management plan and engaging other potential users of surplus excavations can help reduce emissions associated with waste disposal, but is an activity likely to be implemented post Gate 3.

6.26 To drive down emissions on specific schemes it is important to engage and challenge the supply chain to deliver products that meet performance specifications at the lowest carbon intensities possible. Key actions to be taken through future design development include engaging with the supply chain to understand the carbon intensities of different products and alternative pipe materials, developing appropriate material carbon intensity specifications based on materials and products available in the market and ensuring the procurement process for the scheme has steps in place to ensure that materials and products meet carbon intensity specification requirements. We currently estimate that whole life carbon savings of up to 40% could be realised compared to the Gate 2 estimate. We estimate that these potential savings could be worth over £3M in terms of carbon costs. Further work is proposed after Gate 2 to compare the capital costs of the required mitigation with the resulting carbon cost savings to determine which measures provide the most cost efficient carbon reductions.

6.27 Opportunities to reduce operational carbon will be explored during subsequent project stages, based on the hotspot analysis completed. These include optimising energy efficiency and maintenance activities to prolong asset life/performance, low carbon power and decarbonised electricity procurement choices including procurement of green electricity, adjusting operational minimum flow scenarios, if possible, and, if feasible, renewable energy generation (e.g. installation of solar panels on the process units of the water treatment works or small-scale wind turbines at the service reservoirs since they are on elevated ground).

6.6 Changes to inputs into WRMP24 Strategic Environmental Assessment

6.28 As noted by RAPID's guidance on Gate 2 submissions, Strategic Environmental Assessment (SEA) is implemented at the strategic scale and applies to plans and programmes. The T2AT options have been previously subjected to a strategic level appraisal against a set of environmental objectives, the results of which were presented at Gate 1 and feed into the SEAs that have been undertaken for the WRMPs and Regional Plans. An SEA is not completed for T2AT alone, as it is a single scheme or project. However, the environmental appraisal completed for Gate 2 has fed into the Regional Plans and WRMP decision-making processes to ensure that options are correctly represented. This has been done through a review of the previous SEA assessment, and resulting impact matrix, to reflect the Gate 2 concept design. This approach has been discussed and agreed with Environmental Regulators.

6.29 Therefore, the inputs to the WRMP24 SEA act to update and refine the findings of previous regional SEA work. This assessment also benefits from and incorporates findings from concurrent investigations and a full assessment table may be found within Supporting Document B4. In summary, at Gate 2, there are very minimal changes from the Gate 1 appraisal, but the minor changes noted include:

- For the LTR option, reduced severity of negative impacts (from major / medium negative to minor negative) on biodiversity, flora and fauna due to a better understanding of the sensitivity of baseline environment and more informed assessment of possible mitigation.
- For BRI option, minor increased severity of operational negative impacts (from neutral to minor negative) on biodiversity, flora and fauna and on water (flood risk) due to better definition of the scheme and expected operation.

6.6.1 In-combination Assessment

6.30 An initial cumulative effects assessment has been undertaken as part of the SEA option update for the Gate 2 submission, in accordance with the cumulative effects assessment methodology (version 3, 27 April 2022, Mott MacDonald). It should be noted that this assessment cannot take full account of the timing of the scheme (and therefore which other schemes it could or would be coincident with) until the WRMP24 planning process is complete.

6.31 The following plans, programmes and projects have been considered within the cumulative effects assessment:

- Other Strategic Resource Options (SROs),
- Other water company schemes,
- Local Development Frameworks,
- Relevant planning applications and
- NSIP/DCOs (none identified as relevant within the study area).

6.32 In summary, this assessment concludes that:

- Both schemes have the potential to have cumulative effects, of differing levels of significance, with various local development frameworks during the construction phase. None of these are considered to undermine the fundamental feasibility of either scheme, but additional construction phase mitigation may be required. This will need to be confirmed during later project delivery phases, once the timing and scale of the scheme(s) is confirmed. Assessment of any such effects would be undertaken within the cumulative effects assessment within any supporting Environmental Impact Assessment (EIA), should the scheme be submitted for formal consent.
- No cumulative effects are anticipated during operation.

6.33 The HRA AA conducted for both options identified no likely adverse effects on the integrity of European Sites, if appropriate mitigation is implemented, therefore no adverse effects are considered likely either alone or in-combination.

7. Programme and planning

7.1 Project Plan

7.1 An overview project plan has been developed to plan the delivery of T2AT from Gate 2 through to commissioning. This plan conceptualises the project into a series of linked phases, with key objectives set for each phase (see Table 7.1 below).

Table 7.1 T2AT, Generic Project Phasing

Phase	Name	Outcome required
1	Gate 1	RAPID Gate 1 submission
2	Gate 2	RAPID Gate 2 submission
3	Gate 3	• RAPID Gate 3 submission • PINS provide EIA Scoping Opinion • Undertake initial non-statutory engagement(s) on the DCO project • Ofwat Control Points B and C (for DPC) approved
4	Gate 4	• RAPID Gate 4 submission • Complete Preliminary Environmental Information Report (PEIR) • Complete Statutory Public Consultation on the DCO project • Ofwat Control Points D and E (for DPC) approved
5	DCO submission and approval	• Partner company approval to submit DCO application • Secretary of State's award of DCO
6	Contract award	• Ofwat Control Point F (for DPC) approved • CAP awarded contract for delivery • Land acquisition contracts completed
7	Construction	Scheme commissioned and operational

7.2 The theoretical earliest start date for water to be available from either of the leading schemes is 2034/35. This constraint is incorporated into the WRSE and WRMP24 option information. Under this programme, unconstrained by risk, the construction start date for either scheme would be in 2030.

7.3 The two leading T2AT schemes would need to run on different future timelines, as they are not required to deliver water into supply at the same time. In accordance with the WRSE draft Regional Plan and draft WRMP24 (see Section 8.3):

- The T2AT LTR option needs to deliver water by 2040, meaning that the scheme only needs to be consented by approximately 2033 and mobilised to site by 2035. The consenting does need to be linked to the consenting process for the ultimate source, either SESRO or another resource in the upper Thames catchment, which is not expected to be resolved until 2028. Limited interaction is required between the T2AT project and the design or consenting of the physical works for the source water. Also, baseline data collected for the EIA will need to coincident with the DCO application, hence environmental baseline data collection needs to occur 2028 – 2031. Therefore, the programme for this scheme shows a deferral period until 2028, to enable the consenting for the new source of water to progress first. This scheme would be taken forwards under the T2AT SRO project.
- The T2AT BRI option is not selected in the WRSE draft Regional Plan nor in the draft WRMP24 reported pathway. Therefore, this option is considered a 'back-up' and no further work is proposed on this option after Gate 2 as this is not considered an efficient use of customer's money in AMP7. The scheme remains feasible, however, but further work will be deferred. There is, however, a possibility that this option may be required in the future, should the delivery of the Grand Union Canal (GUC) or SESRO SRO experience problems during consenting or subsequent procurement or delivery stages. Should this scheme need to be re-started, then we would seek to designate it as a new SRO, running in parallel to the T2AT (Lower Thames Reservoir) SRO.

7.4 The programmes outlined here is based upon a number of critical assumptions and dependencies, which guide the development of the detailed project plan. These dependencies are tabulated in Supporting Document F-1: Project Delivery Plan. As the BRI solution is to be deferred indefinitely after Gate 2, only the future programme for the LTR is included here, illustrated in Figure 7.1 below.

7.5 At this relatively early stage in the project life-cycle, it is difficult to accurately predict programme risk elements that might cause delay. Therefore, in line with the recommendations of the Treasury Green Book (supplementary guidance, Optimism Bias[14]), the schedule for the LTR option[15] has been adjusted to account for unknown risks in the delivery of future activities and to account for such optimism bias. As before, further details may be found in Supporting Document F-1: Project Delivery Plan. The effect is to potentially delay the construction start date until 2035 which would delay the theoretical completion date, but the scheme could still be commissioned by late 2040. The proposed mitigation measures to manage the

[14] HM Treasury, 2013, "Green Book supplementary guidance: optimism bias", Green Book supplementary guidance: optimism bias - GOV.UK (www.gov.uk)

15 The programme for the BRI option is not adjusted for delay risk, as there are no timebound plans to remobilise the project after deferral.

known programme risks will be developed in further detail as the scheme progresses.

7.6 Our proposed target dates for future RAPID gates are shown in Table 7.2 below. Our recommendation is that Gate 3 is based upon the achievement of the outcomes listed in Table 7.1. Should a programme delay cause any of these outcomes to be delayed, then we would propose the Gate 3 target date be adjusted accordingly. We would seek to discuss this approach with RAPID.

Table 7.2 T2AT, Proposed target dates for future RAPID gates

Scheme	Gate 3 Checkpoint 1	Gate 3 Checkpoint 2	Gate 3 target date	Gate 4 target date
T2AT LTR option	June 2024	Early 2028 (tbc)	December 2029 (tbc)	October 2031 (tbc)
T2AT BRI option	N/A – no further work proposed after Gate 2, indefinitely deferred			

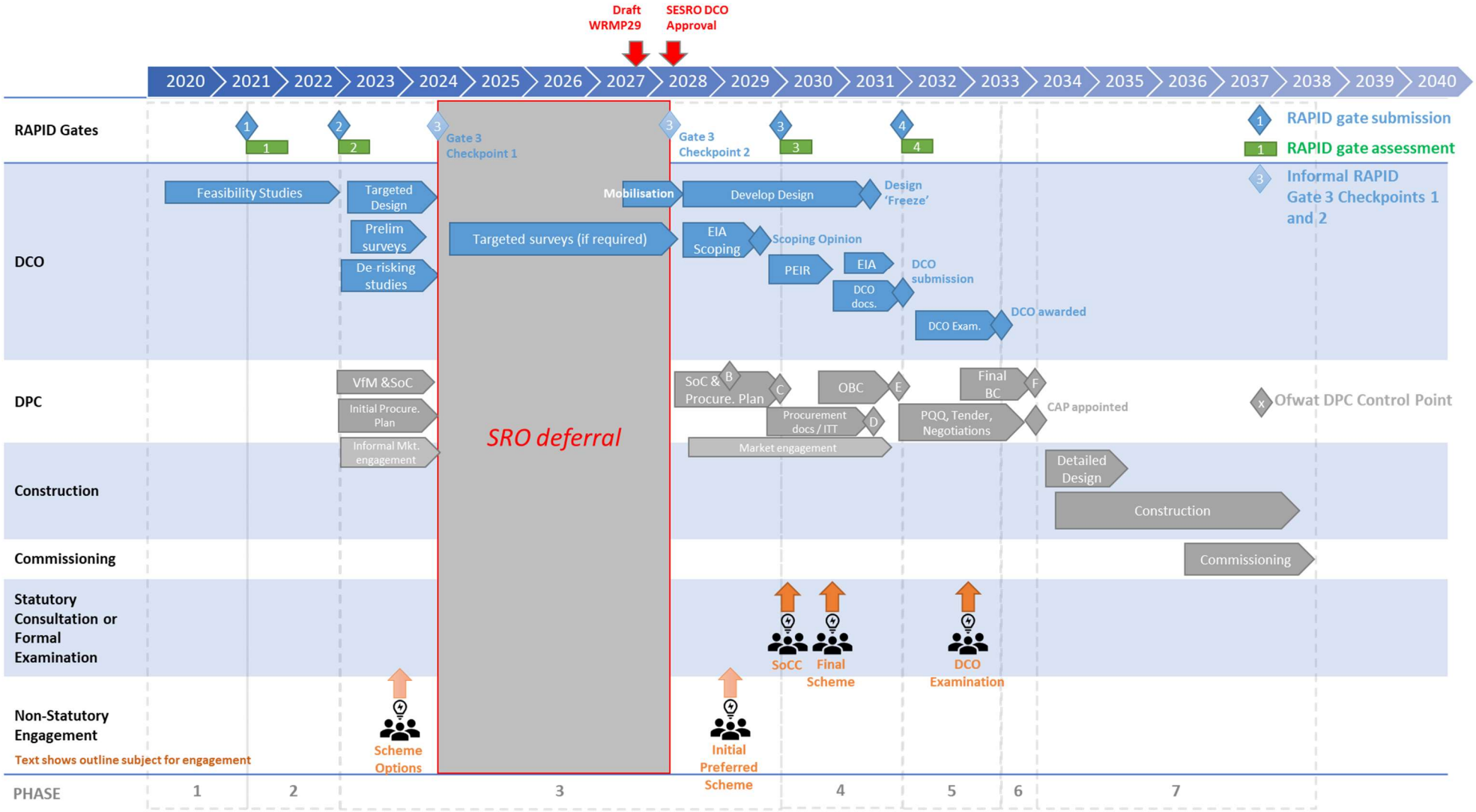
7.7 We propose an interim update for the LTR option of the T2AT – we refer to this as a "Gate 3 Checkpoint 1". This is based upon commencing further feasibility studies and investigations to de-risk future delivery, as would be the case for all SROs after Gate 2, but only to address areas of risk and uncertainty with the scheme rather than delivering all of the required Gate 3 outcomes. Consequently, the duration and scope of this work will be less than a standard Gate 3 process. This checkpoint would reflect any material changes that will have occurred since Gate 2. It will not be a detailed or extensive document submission. It is simply intended to be a 'checkpoint' to enable the scheme to be confidently parked until later remobilisation.

7.8 We are also proposing that a second checkpoint be held, at the start of the proposed remobilisation of the scheme. This would reconfirm the need for the scheme and agree the scope and programme for Gate 3 with RAPID. We would expect this to be in early 2028, informed by three main factors: the development of the draft WRMP29 (confirming the need and timing of the scheme), the approval of the DCO or other consent for the new resources in the upper Thames catchment and a review of the project delivery programme for the T2AT solution, to confirm when work needs to re-start. We would keep this proposal under regular review, as part of the annual review of the WRMP24 and accelerate Gate 3 Checkpoint 2 if required to better manage expected future delivery risks.

7.9 For LTR option, the formal Gate 3 submission would take place once the scheme has remobilised in AMP8, following completion of the consenting process for either SESRO or the STT. We note that this places Gates 3 and 4 within AMP8 (after 1st April 2025) and would seek to discuss with RAPID the regulatory and funding arrangements that may need to be associated with this extension of the development timescales.

7.10 For BRI option, formal Gate 3 would only take place if the scheme was restarted for delivery, possibly due to a critical issue with a part of the reported pathway strategy within WRMP24 (for example, failure to secure consent for either the Grand Union Canal (GUC) or SESRO SROs). At present, we are not proposing any further work or cost associated with the BRI solution after Gate 2 and it will be indefinitely deferred.

Figure 7.1 T2AT Lower Thames Reservoir, Overview Project Plan



7.2 Overview of planning and consenting strategy

7.2.1 Planning consents

7.11 Three consenting routes have been considered – planning permission under the Town and Country Planning Act 1990 (TCPA1990), Development Consent Order (DCO) under the Planning Act 2008 (PA2008) and a Private Act of Parliament. The preferred route to consent is via a DCO under the PA2008.

7.12 The Private Act of Parliament has been discounted at Gate 2. Private Bills are promoted only exceptionally, and it would need to be demonstrated that other available consenting routes are unsuited to the task. This is not considered to be the case for T2AT. For qualifying projects, the PA2008 affords a proven consenting route capable of delivering a DCO for major infrastructure on a timely basis. The application process is well established and provides extensive opportunities for community and stakeholder engagement. In the event that a T2AT option falling below the 80 Ml/d threshold for an NSIP failed to secure NSIP status through an application to the Secretary of State for a section 35 direction, it would be all the more unlikely that the project – having already been judged not to be of national significance - could be promoted by means of a Private Bill. Based on this assumption the Private Bill option receives no further consideration for T2AT.

7.13 Table 7.3 summarises the respective advantages and disadvantages of the TCPA planning application and DCO consenting routes. Further discussion may be found in Supporting Document G: Planning and Consents Strategy.

Table 7.3 Comparison of the planning application and DCO application consenting routes

	Planning application TCPA1990	DCO application PA2008	Summary for SRO
Administrative complexity	▪ TW&AW would retain considerable discretion over the extent, nature and timing of pre-application public consultations. ▪ At least two planning applications would be made for the LTR and at least four for the BRI, due to the number of LPAs affected ▪ Potential for residual risk of inconsistency in the planning conditions required by LPAs. ▪ Risk of Public Inquiry due to refusal or 'call-in' by SoS	▪ Comprehensive pre-application public consultations would be required, undertaken in accordance with a published Statement of Community Consultation. ▪ A single DCO application would be made for the LTR or BRI options, with a single set of DCO Requirements applying to the entire project. ▪ Clearly prescribed and timetabled programme for examination	Overall, DCO provides greater level of certainty and provides lower risk
EIA	▪ EIA scoping opinions would need to be sought from each local authority through whose area the project would pass.	▪ A single EIA scoping opinion would be requested from the Secretary of State in each case.	DCO provides simpler, single consenting authority, lower risk of challenge
Demonstration of project need	▪ The NPS for water would be a material consideration, but need would need to be proven as part of application	▪ Need would not need to be demonstrated anew if the project is included in a WRMP (*assuming NPS on water resources has been published, currently in draft*).	DCO provides lower risk of challenge to case of need during consent application process

	Planning application TCPA1990	DCO application PA2008	Summary for SRO
		▪ Automatic positive weight to the need if included in WRMP.	
Additional consents required	▪ A wide range of other consents would need to be sought to enable implementation. ▪ Local agreements would need to be sought for certain other works (e.g. third party utilities)	▪ A wide range of supplementary consents and rights could be included in the DCO.	DCO simpler to manage and coordinate; fewer third party interfaces
Land rights and supplementary consents	▪ A CPO would be required and, as part of that process, protective provisions would need to be negotiated separately with third party utilities	▪ The DCO could include rights to acquire land and secure land rights and to undertake street works and works affecting third party utilities.	DCO provides simpler and streamlined acquisition process, greater levels of certainty, lower risk
Project coordination	▪ Local authorities would be encouraged to adopt a cooperative and coordinated approach to T2AT consenting, expected to be via PPA	▪ Local authorities have a clearly prescribed role in the DCO application process, also expected to be via PPA.	DCO provides clear framework of roles and responsibilities
Post-consent	▪ A range of relatively simple locally-administered procedures are available to accommodate design amendments. ▪ If planning permission is refused, the applicant has a right of appeal.	▪ Amending a DCO is an arduous and time-consuming process, although the risk of having to seek amendments can, with foresight, be minimised. ▪ If the SoS declines to make a DCO there is no right of appeal, but Judicial Review can apply.	DCO needs to be 'right first time' which front-loads engagement and design, but provides programme surety after submission

7.14 Each consenting approach has its merits but Planning Act 2008 process is the preferred consenting route for T2AT.

7.15 T2AT only assumes NSIP status if its output exceeds 80Ml/d and is not wholly a drinking water transfer. If required, it would be the Partner Companies' intention to apply to the Secretary of State for a direction under section 35 of the PA2008 to designate a lower capacity T2AT scheme as an NSIP. However, as the T2AT option (LTR) that is selected in the draft WRMP24 has a capacity of >80 Ml/d, such direction may not be required.

7.16 T2AT forms a significant part of the wider WRSE strategy for future water supply in the south-east England. In the event that the 80Ml/d threshold is not met, the Partner Companies will refine the case for securing NSIP status through a s.35 direction request during RAPID phase 3.

7.2.2 Secondary Consents

7.17 A wide range of secondary licenses and consents will be required to deliver the T2AT, alongside the DCO. The list of these licences may be found in Supporting Document G: Planning and Consenting Strategy along with details of how each would integrate with the primary consenting route (i.e. DCO). It should be noted that the list, which is not exhaustive at this stage of design development, will be retained under active review as the project progresses.

7.2.3 Environmental Permitting

7.18 The current arrangements for permitting and managing abstraction and discharges on the River Thames are complex, with multiple large surface water abstractions and river regulation arrangements.

7.19 The development of strategic resource options (SROs) will increase the current complexity of management and operation of the River Thames. A summary of the abstraction and discharge permitting strategy may be found in Supporting Document G: Planning and Consents Strategy.

7.20 The two T2AT schemes would require a number of environmental permits:

- **LTR Option:**
  - The additional transfer to AFW would be supported through SESRO regulation of the River Thames and abstraction at existing Thames Water offtake points. Logically this would not require any licence change, although this will be explored further with regulators during Gate 3.
  - If the T2AT was sourced from the STT scheme, then direct abstraction by AFW from the River Thames would be supported through STT regulation of the River Thames. This could require variation of the existing AFW Sunnymeads licence or through a new licence, where a new intake is developed.
- **BRI Option:**
  - A new abstraction licence at the new offtake location, volumetrically and temporally linked to the discharge of treated effluent into the River Lee from either Mogden or Beckton STW.

7.3 Risk Management

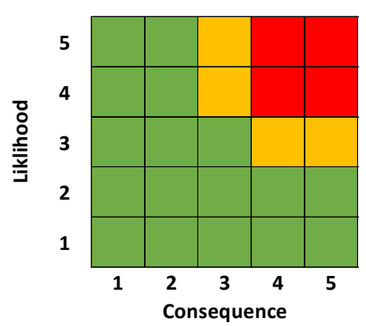
7.21 As at Gate 1, we have continued to consider risk across the project at two levels. We have a qualitative risk register, which is used to record, track and manages pre-construction phase risks, mostly associated with consenting and delivery programme. This risk register informs the quarterly reporting to RAPID. We have also developed a detailed, quantified costed risk register, which has been used to help derive estimates of construction phase financial risks for Gate 2. This section summarises the qualitative risk register only, with details of the costed risk register being provided in Supporting Document A2: Cost Report. The latest view of the critical highest qualitative project risks and associated mitigation measures are shown in Table 7.4 below.

Table 7.4 Summary of highest (pre-mitigation) risks within qualitative risk register and associated mitigation proposals

Risk Theme	Details	Pre-Mitigation Risk	Proposed Mitigation	Post-Mitigation Risk
Programme	Dependency between Final WRMP24 publication and statutory DCO consultation – Final WRMP24 should be published (or direction to publish received from SoS) before statutory consultation progressed for subsequent DCO.		Mitigated via proactive stakeholder engagement for WRMP24 and close alignment of the scheme need, timing and scale to Regional (WRSE) Plan and WRMP24. Current critical path programme analysis suggests that delay on final WRMP24 to March 2025 will not delay subsequent DCO submission due to proposed deferral.	
Environmental	Abstraction impacts from T2AT might have impacts on fish habitat and migration habits in the affected reaches in the River Thames or Lee.		Ongoing water quality and aquatic ecology monitoring; Hydrological and water quality assessment and modelling;	
	Abstraction activities/licencing will require impact assessment in accordance with EA guidance		Commence licensing / consenting strategy work, including assessment of required abstraction and discharge licences and collaborative review of Lower Thames Operating Agreement (LTOA) in close liaison with the Environment Agency (including joint scoping).	
	Loss of watercourse habitat and species, hedgerows and terrestrial habitats/impacts on species which provides challenge to achieve 10% Biodiversity Net Gain		Continued ecological survey of River Thames plus initial targeted Phase 1 habitat survey of potential sites and key areas along pipeline corridors	
Planning and Land	Failure to demonstrate a compelling case for the need of compulsory acquisition purposes through a reliable site selection process.		Site and scheme selection will be justified at the scale of the project overall and for the individual acquisition or land rights sought. This work will be supported by the options appraisal undertaken for Gate 2.	
	Failure to secure the Section 35 to treat the project as a NSIP. This may significantly extend the programme due to the large number of third parties involved in TCPA application.		Early engagement with Defra regarding nature and extent of development to include in s35 application and supporting evidence required after Gate 2. Liaising with stakeholders, including affected LPAs and GLA, to obtain support for s35 direction.	
	The DCO application is not accepted for examination.		Extensive pre-application consultations will be undertaken to pass the 'adequacy of consultation' test at the DCO acceptance stage. The DCO application will comprise a comprehensive array of documentation produced by experienced practitioners in accordance with relevant regulations including the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 and the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.	

* Assessment of risk in accordance with a standard 5 x 5 matrix of likelihood and consequence (red = high risk, amber = medium risk and green = low risk):
Score of 1 is lowest for each category. Indicative definitions of likelihood and consequence listed below:

Score	Consequence	Likelihood
1	Negligible impact on project	Unlikely
2	Low or limited impact on project delivery or cost	Possible
3	Medium impact on project delivery or cost	Probable
4	High impact on project delivery or cost	Expected
5	Major impact on project delivery or cost	Definite



7.4 Gate 3 Proposals

7.4.1 Gate 3, proposed objectives and timeline

7.22 As noted in Table 7.1 above, there are several key outcomes that we would propose to achieve by Gate 3. These are intended to ensure key initial decision points by the principal regulators and consenting authorities have been passed, thereby ensuring that the scheme is more clearly defined with a greater level of confidence in the residual issues to be resolved during subsequent stages. These initial decision points include:

- A Scoping Opinion under the Environmental Impact Assessment Regulations, provided by the Planning Inspectorate. This will define the scope, methodology and timeline for the subsequent Environmental Impact Assessment.
- The initial non-statutory engagement(s) will have been completed, in order to confirm the balance of public opinion on the scheme. This will help inform the residual design and environmental mitigation issues that require further consideration and development.
- Ofwat will have approved Control Points B and C, under their standard DPC approval process. This will ensure that the initial Value for Money assessment, Procurement Plan and the Statement of Case have been approved.

7.23 For the T2AT LTR option, the need to defer the scheme drives a different set of outcomes and objectives for the next stage of work. The same objectives would apply to Gate 3 in due course, but for the proposed Gate 3 Checkpoint 1 in 2024, a different set of (interim) outcomes are proposed, as follows:

- Increased confidence sufficient to confirm an initial preferred scheme, based upon further appraisal of critical choices and collection of initial site-based data (if required and land access allowing).
- If possible, alongside the consultation on WRMP24, initial informal non-statutory engagement will ideally have been undertaken, to provide increased confidence in stakeholders' reactions to and position on the options studies and initial preferred scheme. This aspect is not critical, as engagement will be required when the project is re-started after Gate 3 Checkpoint 2.
- Initial contact and negotiations will have been held with critical landowners affected by the scheme, particularly those at the permanent sites and at critical pipeline pinch-points, and (if possible) sites and routes will be safeguarded within Local Plans.
- Initial value for money assessment will have been completed, sufficient to confirm the procurement strategy for the scheme and agreement in principle with Ofwat (but not necessarily formal DPC control point submissions).

7.4.2 Gate 3 Checkpoint 1, proposed work breakdown structure

7.24 In order to deliver these outcomes, we are proposing work across a number of technical workstreams. A detailed work breakdown structure may be found in Supporting Document F-1: Project Delivery Plan, and an outline of the proposed work

packages is provided in Table 7.5. These tasks are costed and profiled in accordance with the detailed Gantt chart to help provide the overall project cost estimates shown in Section 11.

Table 7.5 T2AT Lower Thames Reservoir, Proposed work packages for Gate 3 Checkpoint 1

Workstream	Key activities
Environmental Assessment	• Complete remaining options environmental appraisal for key aspects of the project, to integrate with feasibility assessment
Data Collection, Sampling, and Pilot Trials	• Subject to land access constraints, commence environmental and engineering baseline data collection and survey, targeting those areas of critical uncertainty or risk with concept design
Feasibility Assessment and Concept Design	• Undertake options technical appraisal to de-risk key aspects of the project particularly around the WTW site appraisal and pipeline route • Further design refinement to reflect technical studies, survey data collection and stakeholder feedback at consultation
Option benefits development and appraisal	• Alignment of scheme need, timing and scale to Revised Draft WRMP24 (or Final, if available)
Procurement Strategy	• If considered appropriate ahead of Gate 3 Checkpoint 1, draft initial Value for Money Assessment, produce initial draft Procurement Plan and agree in principle with Ofwat.
Stakeholder Engagement	• Further public engagement on WRSE and WRMP24 strategic water resource plans • Undertake Non-statutory engagement(s) on options and initial preferred scheme
Planning Strategy	• Initial liaison and negotiation with affected landowners, particularly for permanent sites and critical pinch-points along the pipeline route • Secure planning permissions for baseline survey work, as required • Proactive engagement with CCs and LPAs throughout; if possible, secure safeguarding in Local Plans
Legal support	• Ad hoc support as required on legal issues and review of key documents
Project Management and Governance	• Day-to-day management and coordination of all tasks and activities to ensure compliance with safety, quality, time and cost requirements

7.5 Procurement, ownership and operational strategy

7.5.1 Introduction

7.25 Both of the T2AT solutions have capex[16] of approximately £450m, construction periods of approximately 4 - 5 years each, and an operating life of around 100 years based on the lifetime of the pipelines, the dominant contributor to the overall scheme cost. This means that selecting the appropriate delivery route is important to achieving the best outcome for customers and other stakeholders. The procurement strategy considers a range of potential options, including the Direct Procurement for Customers (DPC) model[17] and the Specified Infrastructure Projects Regulations (SIPR) model. Both are compared to the traditional In-house delivery route. Further details of the work completed may be found in Supporting Technical Document E: Commercial and Procurement Strategy.

[16] All costs in this report are presented in a 20/21 base year.
[17] For the avoidance of doubt, this report is based on the DPC model characteristics as set out by Ofwat at PR19, which we refer to as the 'Standard Form' DPC model.

7.26 This report builds upon the Gate 1 conclusions, by undertaking a more detailed assessment of each scheme in relation to Ofwat's DPC size, discreteness and value-for-money (VfM) criteria. We have also assessed whether each scheme meets the criteria for SIPR procurement, and developed a procurement plan and commercial strategy that aligns with the wider programme and reflects the latest WRSE modelling, as required under RAPID's Gate 2 guidance.

7.27 We have also considered and evaluated the potential options for the role of Promoter[18].

7.5.2 Preferred procurement option(s)

7.28 In summary, the Gate 2 procurement strategy concludes that competitively tendered models such as DPC could offer better value for money than in-house delivery in some circumstances. However, for this to be true, DPC models would need to offer significant levels of capex and opex savings (c.10-15%) and comparable finance costs to in-house delivery. Given the relatively low complexity of construction for both T2AT schemes, it is unclear whether these opex and capex savings are realistic. In addition, the 'standard form' DPC model displays some characteristics (for example, no revenue during construction) that indicate that low finance costs may be challenging to achieve. We recommend that market testing, and the exploration of 'enhanced' DPC models[19] that are more likely to drive low finance costs, is undertaken post-Gate 2 to validate whether the DPC model does drive better value for money than in-house delivery for the T2AT schemes.

7.29 In relation to SIPR, we conclude that neither T2AT scheme passes the current SIPR 'size or complexity'[20] test.

7.5.3 Operating and commercial arrangements

7.30 The key driver for the T2AT schemes is to provide water supply resilience for Affinity Water customers in times of drought. The operational requirement is driven by Affinity Water – including both regular, 'business-as-usual' flow and additional flow during drought conditions. Therefore, we recommend that under all but the most extreme conditions, the operation of the scheme is defined and controlled by Affinity Water.

7.31 The ultimate water source for the LTR scheme is expected to be either the SESRO or STT SROs, or a combination of both. Commercial arrangements for the LTR can be broken down into two main elements – arrangements covering the supply and payment for raw water (supplied from SESRO and/or STT), and arrangements covering the T2AT SRO assets themselves. Commercial arrangements covering the supply and payment for raw water from SESRO and/or STT are likely to include a capacity charge element and a volumetric charge element, with the capacity charge element being divided between Thames Water, Affinity Water and Southern Water based mainly on the relative resilience benefits provided to each company. Details of

[18] The company/ies that own and drive activity to prepare the scheme for delivery from Gate 2 to Gate 5
[19] Including modifications to the standard DPC model, for example allowing milestone payments during construction.
[20] That the '*project is of a size or complexity that threatens the incumbent undertaker's ability to provide services for its customers*'

indicative SESRO and STT commercial arrangements are set out in the SESRO and STT Gate 2 Procurement Strategy Reports respectively.

7.32 The water source for the BRI scheme would be the River Lee, but the operation of the scheme is dependent on abstracted water being replaced by recycled water from one of the London Effluent Reuse SRO options. Therefore, commercial arrangements would need to include charges for the operation of the associated London Effluent Reuse scheme.

7.33 Commercial arrangements covering the T2AT assets themselves are relatively straightforward – these assets are created for the benefit of, and as such will be funded solely by, Affinity Water customers.

7.5.4 Forward plan

7.34 We recommend that market engagement with investors and the construction supply chain takes place before Gate 3, to further understand key commercial risks (including how they would be treated and priced under different models) and gain further insight into the potential structure of the DPC model. This would include details of how investors might structure a 'standard form' DPC model (such as gearing), as well as potential enhancements to the standard form DPC (such as offering milestone payments during construction) that might offer improved value-for-money. This should be used to inform more detailed financial modelling to provide robust evidence for the comprehensive value for money assessment required at Control Point C, which would confirm the preferred procurement model and associated plan.

7.5.5 Partnering Arrangements

7.35 We are not proposing any change to funding arrangements after Gate 2, which should continue to reflect PR19 assumptions for the remainder of AMP 7, including joint funding from both Thames Water and Affinity Water. However, as Affinity Water customers are the main water resource beneficiaries of the T2AT schemes, it is proposed that Affinity Water take a lead role in the day-to-day delivery and management of T2AT after Gate 2, including taking accountability for delivery of Gate 3 (and any associated delivery incentives), and are ultimately expected to be the counterparty to a future CAP agreement. From AMP 8 onwards, Thames plans to exit from funding of T2AT, but would continue to maintain an interest in the scheme as supplier of water, subject to the detailed commercial arrangements.

8. Solution costs and benefits

8.1 SRO Cost Estimates

8.1.1 Introduction

8.1 This section summarises the methodology and results of the costing assessment for the T2AT schemes. The approach has been developed in line with the All Company Working Group (ACWG) guidance on cost consistency. To ensure a degree of

consistency across the different SROs, the ACWG has provided guidance and a spreadsheet template for capturing the Quantitative Costed Risk Assessment (QCRA) and calculating Optimism Bias (OB)[21]. Costs are presented for each of the two T2AT options in turn. Further detail may be found in Supporting Document A2a and A2b: Cost Report.

8.2 Net Present Value (NPV) and Average Incremental Cost (AIC) have been derived from the Capex and Opex estimates using the standard calculation template provided by the ACWG. NPV and AIC have been calculated for 100% utilisation and the current Estimated operational utilisation scenario for the assets (see Section 4.1).

8.1.2 Capital and Operating Cost estimates

8.3 Estimates for base capital cost, costed risk, optimism bias and operational cost are summarised in Table 8.1, which also provides a comparison to Gate 1. It should be noted that the Gate 1 values have been adjusted to a 2020/21 cost base to allow for comparison with Gate 2.

Table 8.1 Cost estimates for T2AT options and comparison to Gate 1 equivalents

Option Name	Units	LTR 50 Ml/d	LTR 100 Ml/d	BRI 50 Ml/d	BRI 100 Ml/d
Option Benefit	MLD	50	100	50	100
Capex (20/21)					
Base Capex	£m	278	334	272	324
Costed Risk	£m	47	63	70	91
Optimism Bias	£m	43	58	43	56
Total Gate 2 Capex	£m	368	455	385	471
Total Gate 1 Capex	£m	140	221	150	241
Change G1 to G2	%	162%	106%	157%	96%
OPEX (20/21)					
Gate 2 Fixed	£m/annum	0.5	0.9	0.6	1.0
Fixed: G1 to G2	%	37%	27%	15%	2%
Gate 2 Variable	£/ML	96	96	108	107
Variable: G1 to G2	%	0%	0%	2%	8%

8.4 Net Present Value (NPV) and Average Incremental Cost (AIC) has been estimated for each T2AT working solution using the ACWG standard methodology, based on HM Treasury Green book with a declining schedule of discount rates (HMT Green Book: Annex 6, Table 8) and an 80-year assessment period. Estimates for the NPV and AIC for each T2AT working solution are provided in Table 8.2.

Table 8.2 NPV and AIC estimates for T2AT working solutions and comparison to Gate 1 equivalents

Option Name	Units	LTR 50 Ml/d	LTR 100 Ml/d	BRI 50 Ml/d	BRI 100 Ml/d
Option Benefit (DYAA)	MLD	50	100	50	100
Total planning period benefit	Ml	340,000	680,000	340,000	680,000

[21] ACWG (2021), Appendix A-1 - Optimism Bias and QCRA Template - Rev C.xlsx

Option Name	Units	LTR 50 Ml/d	LTR 100 Ml/d	BRI 50 Ml/d	BRI 100 Ml/d
Total planning period indicative capital cost (CAPEX NPV)	£M	304	380	318	394
Estimated Utilisation *					
Total planning period indicative operating cost (OPEX NPV)	£M	23	43	25	47
Total planning period indicative total cost (NPV)	£M	327	423	343	441
Average Incremental Cost (AIC)	p/m³	82	54	87	57
Maximum Utilisation (100%) **					
Total planning period indicative operating cost (OPEX NPV)	£M	43	82	47	90
Total planning period indicative total cost (NPV)	£M	347	462	365	484
Average Incremental Cost (AIC)	p/m³	88	60	94	63
Gate 1 AIC (20/21)	p/m³	58	45	65	51

Note * 40% utilisation is assumed for these calculations to enable comparison between options: 1 in 500 year deployable output for 365 days / year, and 40% of the estimated maximum variable operating cost, based upon output of long-term water resources modelling (see Section 4.1 and Supporting Document A1a, section 4). There is no comparative AIC for Gate 1 as these utilisation calculations were not available at Gate 1.

Note ** 100% utilisation is assumed for these calculations to enable comparison between options: 1 in 500 year deployable output for 365 days / year, and estimated maximum variable operating cost.

Changes in costs since Gate 1

8.5 The capex cost estimates at Gate 2 are based upon a much more granular concept design and a 'bottom-up' cost estimate of many of the main elements, compared to the approach used at Gate 1, which was based around more generic cost curves to ensure accurate comparison between options by WRSE. This has resulted in some cost increases since Gate 1 which are presented more fully in Supporting Document A2a and A2b: Cost Report, and summarised in Table 8.3 below.

8.6 The major change to the capex costs is in the estimated cost of the land associated with the WTW site. The site selection work (see Supporting Document A5: options refinement report) used a high level options appraisal process to identify a preferred WTW site for the working solutions. This was always intended only as an indicative site for the purposes of appraisal and costing at Gate 2. The previous cost appraisal for Gate 1 used generic UK Government costs to estimate land acquisition and compensation values, which have now been updated with more accurate appraisal of land value based upon the indicative location and current landuse of the sites. This has resulted in a significant increase in capex value. Secondly, the options appraisal process favours brownfield over greenfield sites, which further raises land costs due to compensation costs, engineering complexity and the future development value for such sites. For the LTR solution particularly, the estimates are at the upper end of the likely cost, as the preferred site is an existing industrial complex in a highly congested area with few alternative sites. It should be noted that the current site is a working solution only and further work is planned during the next stage of the project to review the site selection work, ensure a more accurate understanding of

the trade-offs between different sites in terms of cost, engineering complexity, environmental impacts and planning constraints and hence confirm the selection of the most appropriate site prior to project deferral. To take account of the uncertainty in the land costs, a range of cost values was derived, with the lower end estimate used to derive base capex values and the additional cost to the upper end estimate used as part of the costed risk.

8.6 Changes to operating costs since Gate 1 are less pronounced than capex, but are driven by factors such as a ~15% increase in capacity for the treatment works and pipelines following additional DO modelling (see Section 4.2.1) and changes to power consumption, which has decreased as result of pipeline and pump optimisation.

Table 8.3 Summary of upward cost drivers since Gate 1

Factor	Impact on LTR option costs since Gate 1	Impact on BRI option costs since Gate 1
The costs associated with land acquisition and compensation has increased significantly. This is driven by confirmation of the proposed land required for the working solutions and a detailed appraisal of these sites, which has selected an operational brownfield site in preference to greenfield, which inflates land values.	Approx. 56% of capex uplift	Approx. 60% of capex uplift
The relocation of the WTW from greenfield to a brownfield site to decrease environmental and planning risks has resulted in additional engineering complexity. Further work is planned in the next stage to confirm the WTW preferred site and to better understand the trade-offs between cost, planning suitability and environmental impacts.	Approx. 28% capex uplift	Approx. 3% capex uplift
Increase in pipeline length, primarily to avoid environmental and planning constraints, cost of the pipeline crossings over rivers and other utilities (particularly HS2) has increased or number of crossings has increased.	Approx. 12% capex uplift	Approx. 36% capex uplift
An allowance has been added for pipeline land compensation costs and environmental mitigation measures, along with contaminated ground processing.	Approx. 2% of capex uplift	-

8.2 SRO Benefit Estimates

8.2.1 Natural Capital Appraisal

8.7 The Natural Capital Assessment identified that both options could cause the temporary and permanent loss of natural capital stocks during construction. Stocks that are likely to be permanently lost include pasture, woodland and active floodplain. However, best practice mitigation (including the use of trenchless techniques) and reinstatement/compensation of habitat means that most natural capital stocks post construction will have no to little change.

8.8 An alternative route for both of the pipelines was established, based upon optimising natural capital (NC). This alternative would have less permanent loss of pasture and active floodplain. The assessment of BNG calculates that

- For the LTR option, approximately 77 BNG habitat units could be lost due to the temporary removal of habitats during construction, reduced to 57 units for the alternative, optimised transfer route.

- For the BRI option, approximately 129 BNG habitat units could be lost due to the temporary removal of habitats during construction, reduced to 113 units for the alternative, optimised transfer route.

The optimised pipeline routes will be developed further during the next phase.

8.9 The overall predicted impact on Natural Capital Stocks for both the indicative and the 'Natural Capital Optimised' routes, and the quantitative assessment of the unmitigated predicted impacts of this on the Provision of Ecosystem Services are shown in Supporting Document B1: Environmental Appraisal Report (chapter 16).

8.2.2 Wider socio-economic benefits assessment

8.10 Wider benefits are those areas of environmental and social value that are associated with constructing and operating the scheme. Areas of disbenefit are also considered. Further details of the work completed may be found in Supporting Document B1: Environmental Appraisal Report (chapter 17) for both options. The main findings are summarised in Table 8.4 below.

Table 8.4 Summary of socio-economic benefits identified at Gate 2, for both options

Category	Benefits attributable to both options
Economic Impacts	New operational phase jobs are expected to generate approximately £6.9 million (over the 30 year appraisal period).
Health and wellbeing	Proposals to enhance green infrastructure links and local footpaths could lead to health and well-being benefits.
Benefits realisation approach	A draft partnership strategy has been developed as a basis for future engagement with stakeholders in order to help deliver some of the benefits and enhancements from changes to land use and provision of BNG.

8.3 Best Value Planning

8.11 The WRSE draft Regional Plan has been derived using the published methodology and metrics[22]. This Regional plan has been translated into the company centric Water Resource Management Plan 2024 (WRMP24) for the partner companies.

8.12 A 'Best Value' water resource plan is one that delivers wider benefits to society and the environment. It considers a range of factors alongside economic cost in the identification of the preferred water resource programme that will form the basis of the plan. The development of a best value plan is promoted by the EA, Ofwat and Natural Resources Wales in the Water Resources Planning Guideline.

8.13 WRSE is carrying out best value analysis to develop the Best Value Regional Plan. The Thames Water and Affinity Water WRMPs are cascaded from and fully aligned with the WRSE Regional Plan, and so the same best value metrics have been considered in both plans.

8.14 Best value metrics have been determined for the SRO scheme. The metrics considered in addition to cost and carbon emissions are Natural Capital (NC), Biodiversity Net Gain (BNG), SEA benefit, SEA disbenefit, resilience: reliability, evolvability and adaptability, and customer preference.

[22] https://www.wrse.org.uk/media/sy1bu4to/method-statement-best-value-planning.pdf

8.15 The methodology for the metrics utilised at a regional level, consistent with the draft WRMPs, is provided in Annex 1, Part 3 of the WRSE draft Regional Plan. A summary of the best value metrics utilised for T2AT is included within Thames Water's and Affinity Water's draft WRMPs, alongside other SROs and non-SROs for context.

8.16 The position of the T2AT SRO within the WRSE draft Regional Plan and draft WRMP24 is summarised as follows. Further information and justification of the reported pathway and associated sensitivity analysis may be found within Affinity Water's draft WRMP24 (Section 9):

- In the best value plan, the LTR option is selected in the preferred (reported) pathway, which corresponds to future situation 4 in the WRSE adaptive pathways. The scheme is selected in two phases – 50 Ml/d by 2040 and a further 50 Ml/d in 2045. The first phase is selected in 7 of the 9 future situations modelled and the second phase in 5 of the 9 modelled futures. The timing of the second phase does vary between 2042 (situation 1) and 2060 (situation 7).
- The implementation of the LTR option in the best value plan is supported by the development of the 100 Mm^3 South East Strategic Reservoir Option (SESRO) by 2040, providing additional resource into the River Thames catchment for sharing with Affinity Water.
- In this best value plan, the BRI option is only selected in future situation 1 (which is the adaptive branch with the highest growth and enhanced Environmental Destination) for supply by 2056. Therefore, the scheme is not required within the current WRMP24 planning period (2025 – 2050). It is for this reason that this scheme is considered a 'back-up', with no further work proposed after Gate 2.
- In the cost-efficient planning scenario, the selection of the T2AT is largely the same as the best value plan, but the need for the BRI option and for the second phase of LTR is slightly deferred (but by <5 years).

9. Stakeholder and customer engagement

9.1 Community Engagement

9.1.1 Summary of activity since Gate 1

9.1 The stakeholder engagement activity undertaken since Gate 1 has been three-fold:

- Activity to inform the development of the South East (SE) regional plan to ensure stakeholders understand how T2AT, and other solutions, fit within the strategic water resource planning framework.
- T2AT specific discussions focused on legal, regulatory and strategic issues. The engagement was primarily with regulators and strategic stakeholders and designed to be collaborative, with regular progress meetings. This approach facilitated agreement on scope and methodological approaches.
- We also began engagement with the then newly formed Chalk Stream First group looking at an alternative solution based on the idea of not abstracting from the aquifer in the headwaters allowing availability for surface water abstraction in the lower catchments of the Rivers Colne and Lee.

9.2 We have not undertaken any more detailed community engagement ahead of Gate 2, as it was considered more appropriate to defer this activity until the need for the scheme had been confirmed in the WRSE draft Regional Plan. Once the scheme is confirmed, then the communities potentially affected can be engaged in more detail and the scheme refined and optimised to reflect that feedback. This is expected to include Initial contact and negotiations with critical landowners affected by the scheme.

Activity to inform the South East regional plan

9.3 The engagement and consultation on the emerging regional plan took place between January and March 2022. The emerging plan gave early sight of emerging solutions and enabled initial feedback from stakeholders.

9.4 Thames Water and Affinity Water proactively raised awareness of the consultation on the emerging plan in Oxfordshire to ensure there was wide awareness and local communities had the opportunity to participate. Although this activity was very focused on SESRO it included information on the T2AT option as well to ensure the stakeholders and the community understood the connection of the two schemes.

9.5 In addition, for selected other regulatory stakeholders (Historic England and National Highways) and Local Planning Authorities directly affected by the T2AT options, we undertook a more detailed webinar and workshop. This session provided an opportunity for us to explain the T2AT scheme options in more detail and to outline the process that had been followed for options appraisal and how this integrated with the regional water resource planning process. We were able to incorporate any site specific feedback or commentary from these stakeholders into our option refinement process as we developed the preferred working solutions towards Gate 2.

9.6 WRSE received over 1,150 written responses to the consultation. Over half of the individual responses to the consultation on the emerging plan focused on specific water resources options identified for development, such as large new reservoirs, strategic water transfers, and water recycling schemes.

9.7 WRSE published a response document[23] in May 2022 which provided a summary of the consultation responses, highlighted the main themes and issues raised in the responses and provided WRSE's consideration of the points and resultant action. We have listened to the points raised, in the consultation, and in dialogue with stakeholders and ensured all these points are fully addressed in the further work to develop the long-term water resources plan and the ongoing work to examine potential options, of which the transfer is one option. Our response to the key concerns raised are summarised in Table 9.1 below.

Table 9.1 Summary of relevant feedback to the WRSE emerging regional plan and resultant actions

Issue	Our response
Water Quality	Additional information will be published for the draft regional plan will provide including how water quality impacts will be considered and addressed. For Gate 2, we have reviewed and update our drinking water quality risk assessments for the two leading T2AT options, to ensure that appropriate control measures are built into the scheme, as required.

[23] WRSE Emerging Regional Plan: Consultation Response Document, May 2022

Issue	Our response
Selection of route to protect designated sites and priority habitats	A key element of the Gate 2 work conducted by companies is route selection based of ecological and habitat assessments. WRSE and the water companies will publish detailed information on the option appraisal and environmental assessments alongside the draft regional plan and draft WRMP24s in Autumn 2022. The Gate 2 SRO submissions will also be published. The Gate 2 submission includes extensive work on the appraisal of alternative routes to reflect planning and environmental constraints and then on the refinement of the chosen concepts into a working solution for Gate 2. This working solution already takes account of designated sites and priority habitats and adjusts the designs to reflect this constraint and stakeholder feedback. Further details may be found in Supporting Document A5: Options Refinement Report.
Financial and environmental costs of a pipeline	Initial environmental assessments have been completed for each of the strategic resource options. The work was shared with stakeholders and local communities in an open and transparent way when complete, but still at a formative stage of scheme development. WRSE and the water companies will publish detailed information on the option appraisal and environmental assessments alongside the draft regional plan and draft WRMP24s in Autumn 2022. The Gate 2 SRO submissions will also be published.
Detailed information on carbon	This has been a key assessment for WRSE, the water companies and the Gate 2 development and will be published with the consultations. The water companies are also committed to reach net-zero carbon emissions for operational activities by 2030 and further work is underway to consider opportunities to reduce both the operational and the embodied carbon impact of future solutions. There are a range of opportunities that could be developed as part of the SESRO scheme to help minimise and mitigate carbon impacts during the life-time of the scheme. Further details may be found in Supporting Document A3: Carbon Strategy.
Risk of INNS, water chemistry and pathogens transferring.	The additional environmental assessment information which will be published for the draft regional plan will provide information that a number of respondents were seeking in the emerging regional plan, including how water quality and INNS risks and impacts will be considered and addressed. The INNS risk assessment for T2AT has been updated for the Gate 2 submission.

Technical Liaison Groups

9.8 Engagement has been embedded throughout the Gate 2 programme of work, it builds on the Gate 1 engagement with regulators and strategic stakeholders and feedback previously received. It comprised meetings with regulators, the establishment of topic specific Technical Liaison Groups (TLGs), 1-2-1 sessions with technical specialists, as well as activity to support WRSE and company engagement. This approach has ensured that the Gate 2 concept design and associated assessments has developed in an iterative manner, taking account of and trying to resolve emerging issues and constraints as the work has progressed.

- Quarterly update meetings have been held with RAPID to discuss the programme, outputs, risks and issues.
- A number of Technical Liaison Groups (TLG) have been established. The purpose of the TLGs is to enable collaborative working with regulators and stakeholders who have specialist knowledge or a defined stake in the topic. An overview is presented in Supporting Document D: Stakeholder and Customer Engagement Strategy
- We have also held 'one-to-one' meetings with specific groups on specific topics including
    - Chalk Streams First (CSF) – several workshops, email exchanges and sharing of data between technical members of the teams involved
    - Two key planning led workshops (December 2021 and July 2022) to which various stakeholders were invited including all the Local Authorities along the

possible routes, Historic England, and National Highways to share and critique the screening methodologies used to shortlist route options and explore any particular concerns.

9.1.2 Strategy after Gate 2

9.9 The community engagement strategy for T2AT has been developed to advise stakeholders of the different stages that will be followed to deliver the project and the opportunities for providing comments. However, this is set within the context that the exact combination and timing for the implementation of the T2AT options is uncertain and it is likely that the scheme will be deferred for a significant period of time. The engagement strategy will need to be adjusted to reflect this complexity as the project progresses.

9.10 There are multiple processes running in parallel around the SROs, such as the WRSE regional plan, partner company WRMPs and the future potential for DCO submissions for individual schemes. As a result, there is potential for confusion amongst affected communities. In response, future engagement held by the project partners will provide a clear explanation of the overall decision-making context for T2AT and the particular purpose of individual rounds of consultation. Amongst other things it is hoped that this will assist stakeholders to align their responses with matters in hand whilst being reassured that there will be fair opportunities to raise additional concerns in subsequent rounds of consultation and engagement.

9.11 It is proposed, that in addition to the proposed consultation associated with the Water Resources Management Plan (WRMP24) in late 2022, a number of further opportunities to enable technical and public stakeholders to engage in discussion on specific issues associated with T2AT could be undertaken for 2023 onwards. The timing of future engagement may be adjusted as the scheme promotion develops, depending on the outcome of the option studies and the deferrals planned for these SROs, and as a result of the consultation and engagement undertaken on WRMP24. However, for T2AT, in light of the proposed future programme, with Gate 3 deferred until 2029, we would propose to undertake initial engagement only ahead of Gate 3 Checkpoint 1 (June 2024). We plan to defer the remaining engagement and statutory consultation on the scheme, which would be required as part our the future DCO submission, until the scheme is re-started after 2028[24]. Therefore, our proposals for the next stage of the project will be limited to engagement with key landowners and presentation of options associated with the preliminary design ideas for the scheme including aspects such as pipeline routes and construction approaches, sites for the WTW and pumping stations, construction access and construction phase details.

9.12 Engagement by the project team with technical stakeholders and regulators will continue on a regular basis throughout this process, via the Technical Liaison Groups, as it has through Phases 1 and 2. This will help to ensure alignment of technical experts on elements like data collection and assessment methodologies.

[24] Engagement that would be undertaken subsequent to scheme deferral and remobilisation would be planned at a later date depending on the timing and issues still to resolve.

9.2 Customer Preference and Engagement

9.2.1 Introduction

9.13 For Gate 2, our collaborative customer research[25] has progressed on the themes we identified at Gate 1:

- Firstly, exploring through the regional engagement what customers view as 'best value', how they weight those metrics and prioritise – enabling us to assess how different schemes 'perform' in terms of the customers' preferences.
- Secondly, looking at how we can make schemes more acceptable to customers, we looked to dive deeper on views regarding public value – exploring with customers what they mean by the term, their preferences, whether their views alter dependent on their proximity to the scheme and how much they would be willing to pay for a range of possible 'added value' options for a scheme.
- Finally, we looked how customers perceive, understand and ultimately how we need to engage customers when we change their source of water. We explored this immersively, including through taste testing.

9.2.2 Findings

9.14 Over 300 household customers were engaged to explore their preferences regarding the 'best value' criteria developed by WRSE. In general, customers place more weight on the delivery of secure supply of water, followed by cost of environmental improvements, with resilience placed on the lower end of the scale.

9.15 The research project into public value was collaborative across 11 SROs. The key aims were to understand what preferences and added value our customers perceive is important, as part of infrastructure development. Of particular relevance to T2AT:

- customers told us that most feel that the principle of transferring water from areas of abundance to areas of scarcity 'makes sense' and assume that this system is already in place in the UK. However, there are some concerns that arise when customers learn about the potential for contamination during the transfer process.
- These concerns are also reinforced by the idea that water coming from other areas might be 'worse' than that which people are used to i.e., in quality or characteristics such as hardness.
- A minority of customers living in areas that are perceived as less water-stressed (e.g. rural areas outside London) have hesitations about sending 'their water' elsewhere. Despite this, Water Transfer is largely considered a sensible option.
- For the majority of customers, there is a particular lack of clarity around infrastructure requirements for transfers – it is unclear what type of infrastructure will be involved (e.g., canals, pipes, rivers) and how much new infrastructure will be required, which also makes it difficult to estimate the disruptive impact on local areas and natural environments.

[25] We have undertaken an efficient and collaborative programme of customer engagement across several water companies to support the SROs. Where practical we have utilised regionally led work. For other areas we have formed 'club' projects with other SRO teams – maximising the expertise across the companies.

9.16 The research study into customers' views on changing their water source was also collaborative across 11 SROs. 1,400 customers and 200 non-households were engaged during the quantitative phase.

- Customers say they are unlikely to engage with communications on source change, and taste tests indicate that most are not able to detect differences at the level that might be expected in a source change. However, there is still a need to communicate to explain the rationale for the change, alleviate taste concerns and provide clear guidance on the impact.
- The product sample tasting reassured customers that water transferred from other areas will not necessarily taste noticeably different.

9.17 One of the key outputs from this research was a communications framework which took all the learning from the research to produce a practical tool to use when we do decide to change a water source, and the language, framing and communications we should employ and the timings around those communications.

10. Board statement and assurance

10.1 This report meets the assessment criteria defined by RAPID, in accordance with the PR19 Final Determination. The options for the T2AT scheme are presented with robust evidence and a complete set of technical assessments to support all assertions made. The analysis is consistent with available policy and technical guidance, including that produced by the All Company Working Group (ACWG) and any deviations are justified. Uncertainties are explained, explored and quantified, where possible, enabling expected impacts to be discussed along with appropriate mitigation to manage such uncertainties.

10.1 Assurance approach

10.2 The assurance framework used for this submission has been developed jointly by TW and AFW. This approach provides an effective programme of assurance which considers areas that we know are of prime importance to our customers and regulators; or may have a significant financial value. Due to previous stakeholder commentary on this and related SROs, all areas of this Gate 2 submission were considered high risk and hence received three line assurance.

10.3 Atkins Limited were appointed as our external assurers. Our approach was augmented by experience that the companies gained through the Gate 1 assurance process and the sharing of best practice.

10.4 Atkins' Assurance Report confirms that, overall, at the completion of their assurance work, they consider:

- The Gate 2 submission is consistent and aligned to the regulatory requirements for Gate 2 as set out in Ofwat's final determination and subsequent additional feedback.
- For the information within their scope, the information contained within the Gate 2 submission has been derived using methodologies, assumptions, and input data suitable for Gate 2 and is therefore reliable

- The assurance scope is appropriate for the submission.
- Their opinions and feedback have been appropriately considered
- Progress on the solution to date is commensurate with the Final Determination timeline of being 'construction ready' for AMP8. However, it is likely that there will be a pause in the development of the scheme during Gate 3 to reflect the wider context of RAPID and WRMP expectations.
- For the information within their scope, that the work carried out to date is of sufficient scope, detail and quality which would be expected of a large infrastructure scheme of this nature at this stage.
- The expenditure that has been incurred in generating the Gate 2 submission is efficient and relevant to the development of the submission

10.2 Board Statement(s)

10.5 A copy of the Board Statement(s) is provided within the covering letter to this submission.

11. Efficiency of expenditure for Gate two and forecast

11.1 Gate 2 costs

11.1 The costs for the period between the Gate 1 and Gate 2 submissions are presented relative to Ofwat's Final Determination allowance. Due to the timing of the assurance of this report, the total costs are reported as the sum of the value of work completed (to end September 2022) plus estimated forecast costs for remaining work to Gate 2.

11.2 For accurate comparison with the Final Determination allowance, as requested by RAPID, actual costs are deflated back to a 2017/18 cost base[26] (see Table 11.1 below).

Table 11.1 Deflationary factors used for actual cost calculations

AMP7	Deflation Factors *
Year 1 (2020/21)	0.9469
Year 2 (2021/22)	0.9283
Year 3 (2022/23)	0.9102

* from actual costs back to 2017/18 cost base

11.3 The cost allowances to produce the Gate 2 submission were provided in Ofwat's Final Determination documentation[27]. Overall, as shown in Table 11.2, the forecast spend to Gate 2 represents an underspend of approximately £50k under the funded Development Allowance, allowing for the underspend at Gate 1. This efficient delivery includes the additional work that has had to be done on the additional solution that was identified in the WRSE emerging regional plan in January 2022 (i.e. the BRI solution). This work was required to achieve the required level of technical detail at Gate 2 and ensure consistency between the options. As noted in Section 3.3, we decided not to seek the designation of a new SRO at this stage from RAPID,

[26] using Thames Water's Internal Business Plan (IBP) deflationary factors, based upon the CPIH (November 2019 dataset) index

[27] PR19-final-determinations-Strategic-regional-water-resource-solutions-appendix.pdf (ofwat.gov.uk)

due to the expected limited financial implications of the additional work required for Gate 2 and also the uncertainty associated with the ultimate inclusion of both solutions in the WRSE draft Regional Plan.

11.4 We estimate that the cost of the additional work required for Gate 2, due to the extension of the agreed Gate 1 scope to include a second solution, to be approximately £380k (17/18 prices). A breakdown of these costs is provided in Table 11.5. Overall, if these additional costs are excluded, our costs to Gate 2 would be £1.44M, well below the development allowance, showing an efficiency of 23%.

11.5 The reasons for this efficient delivery of the Gate 2 submission are explained in subsequent sections. All required outputs for the Gate 2 submission have been delivered, along with the agreed early mobilisation of activity required to deliver Gate 3 in accordance with the proposed programme.

Table 11.2 Gate 1 forecast total cost for each partner company (£M, 2017/18 prices)

Company	Forecast Total Cost to RAPID Gate 2	Ofwat FD Allowance for Gate 2	Previous underspend on Gate 1	Underspend
Thames Water	£0.91	£0.82	£0.12	-£0.02
Affinity Water	£0.91	£0.82	£0.12	-£0.02
TOTAL	**£1.82**	**£1.64**	**£0.24**	**-£0.05**

11.6 In accordance with the latest gate 2 guidance from RAPID, more detailed cost breakdowns are provided for any category where the costs exceed £500k in Supporting Technical Document F-2: Efficiency of spend. For T2AT, this only applies to costs for Feasibility Assessment and Concept Design, largely reflecting the additional work required in this area to support the additional BRI solution.

11.7 The breakdown of costs to Gate 2 is shown in Table 11.4, in accordance with the reporting template provided by RAPID.

11.8 We can confirm that we have completed the majority of the Gate 2 tasks that were proposed at Gate 1. Only one of the specified tasks has not yet been completed (Table 11.3 below), due to the revised approach we adopted to Gate 2 to accommodate the multi-solution approach for T2AT.

Table 11.3 Summary of Gate 2 omissions from Gate 1 proposed scope

Category	Gate 1 proposed scope	Gate 2 rationale for exclusion
Land Assessment	Collation of Property Information	Additional BRI solution meant that the concept design of neither Gate 2 solution was sufficiently developed to benefit substantially from land referencing ahead of Gate 2. This is planned for LTR following Gate 2, for the current refence solution.

Table 11.4 Gate 2, Forecast Cost Breakdown (as per RAPID template)

Category	Activity	Expenditure (£, 2017-2018 prices)	% of Total Expenditure	Description of Activity
Programme & Project Management	Planning, management, governance and assurance of the project	162,254	8.9%	Programme Manager, Project controls and programming support, Assurance, Project Director and Executive governance
Feasibility Assessment and Concept Design	All engineering design and feasibility investigations	694,227	38.0%	Engineering design and all associated, client technical direction, cost and carbon estimating, water quality risk assessment
Option benefits development and appraisal	Analysis of potential benefits from the scheme	49,650	2.7%	Water resources modelling, DO assessment, long-term utilisation analysis, conjunctive use analysis, cost-benefit analysis and NCA
Environmental Assessment	Appraisal of environmental impacts and initial mitigation strategies, including engagement with environmental regulators	355,431	19.5%	EA and NE costs, water quality modelling, WFD and aquatic ecological assessments, desk-based assessments of high risk environmental issues, initial HRA, BNG assessment, licensing strategy
Data Collection, Sampling, and Pilot Trials	All field based sampling and data collection	362,167	19.8%	Aquatic ecological surveys, water quality survey (R.Thames and R.Lee), algal surveys and experimentation
Procurement Strategy	Consideration of options for procurement of scheme	85,246	4.7%	Strategic review of procurement routes, client governance, external advisory services and steering group on commercial matters
Planning Strategy	Consideration of options to consent the scheme	40,153	2.2%	Strategic planning review and DCO strategy, land access and acquisition advice
Stakeholder Engagement	All engagement activity and customer preference studies	34,096	1.9%	Customer research and preference studies, stakeholder lead for both partner companies, support to WRSE engagement processes
Legal	Legal advice, as required	41,709	2.3%	Legal advice on various issues and policies
Other				
Total		**£1,824,934**	**100%**	
Gate 2 Allowance	*Including G1 underspend*	**£1,870,000**	-	
Gate Underspend		**-£45,066**	**-2.41%**	

Table 11.5 Gate 2, Estimated Cost Breakdown of additional work on BRI option

Category	Work package reference	Expenditure (£, 2017-2018 prices)	% of Total Expenditure	Description of Activity
Programme & Project Management	WP10; WP19, CE01; WP22	£60,000	16%	Project management of new tasks, governance, additional technical and external assurance for additional documents / analysis completed
Feasibility Assessment and Concept Design	WP7, CE02	£230,000	61%	Engineering concept design for T2AT Beckton solution
Option benefits development and appraisal				
Environmental Assessment	WP12, CE04 WP14, CE01	£70,000	18%	Additional WFD assessment Additional environmental appraisal (and associated documentation) for T2AT Beckton solution
Data Collection, Sampling, and Pilot Trials				
Procurement Strategy				
Planning Strategy				
Stakeholder Engagement				
Legal	WP18	£20,000	5%	Estimated additional costs for additional legal review of Gate 2 documents and planning strategy
Other				
Total		**£380,000**	**100%**	

11.2 Efficiency of Gate 2 costs

11.9 The efficiency of the spend to Gate 2 has been assured through a series of control mechanisms on the procurement, delivery and reporting of the required technical services, which are summarised in in Table 11.6 below:

- The approach(es) taken to procurement
- Cross-SRO working and integration with WRSE regional modelling
- Control and governance of change

Table 11.6 Gate 2, Cost efficiency overview

Approach	Efficiency achieved	Contribution
The work that we have completed was aligned to RAPID's requirements.	Costs applied only to work packages and scope that is directly required to deliver the Gate 2 submission or to mobilise for and avoid programme risks for Gate 3 and beyond. This results in a very targeted scope of work.	Very high
Standard methodologies for key areas	Shared methodologies continued to be developed for Gate 2, across numerous SROs. Application of shared methodologies reduces technical work effort (standardised, templates, outputs etc) and prevents need to assure bespoke methodologies, driving consistency with other SROs for Gate 2 submission.	Medium
Integrated use of WRSE modelling capability	The WRSE Investment Model has been used to help explore the sensitivity of the need and timing of this specific SRO. Use of WRSE data and models helps reduce technical work effort, prevents the need for additional models to be developed and reduces the time required to assess options for Gate 2.	Medium-Low
Implementation of common procurement principles	Standardised rules for the procurement of services on behalf of multiple project partners has helped to provide best value for money. This has been delivered through the continued application of a prioritised hierarchy of standard procurement approaches, helping to drive competition and efficiency into external procurement by the best placed project partner. This also allows shared governance over technical services between the project partners, which drives accountable efficiency into the process.	Low
Adoption of competitive procurement and qualitative benchmarking	Many of the key external support services has been procured using competitive approaches, with the majority going via framework mini-bid processes. Overall, we have procured 57% of the value of the work packages for Gate 2 via either competitive tendering or mini-bidding on existing company frameworks. The remaining 43% was procured using direct award on company frameworks to ensure competitive rates. Where direct award was used, e.g. highly specialised technical work, qualitative benchmarking and challenge using professional judgement against similar previous work packages ensured efficiency.	Medium – High
Procurement of aligned work-packages across multiple SROs	Several work packages have been procured on behalf of multiple SROs, to drive efficiency into both procurement and delivery (economies of scale for contractors, fewer contracts to let and manage and fewer consultancy interfaces). These approaches apply to 48% of the value of Gate 2 work packages.	High
Application of rigorous PM controls	Robust cost control implemented by the Project Manager and overseen by the Programme Management Board (PMB) helps prevent 'scope creep' and cost escalation.	Medium

11.10 Further discussion and a breakdown of these efficiency principles may be found in Supporting Technical Document F-2: Efficiency of spend.

11.11 A simple qualitative comparison across the other Thames Water SROs shows that the spend for each of the technical categories is relatively similar; the Gate 2 spend is efficient and aligned with other similar SROs. However, outliers include:

- The proportion of the costs assigned to feasibility assessment and concept design may be slightly higher than for other Thames SROs. This is because we have had to undertake the concept design for two solutions, as described previously, as directed by the WRSE emerging regional plan in January 2022.

11.3 Gate 3 Forecast costs

11.12 The forecast costs for Gate 3 are based upon a thorough appraisal of the work breakdown structure for Phase 3 of the project. The project costs are based upon a combination of benchmarking to similar work undertaken during previous phases and expert judgement[28]. The forecast should therefore be treated as an estimate. It will be reviewed and refined on a monthly basis, throughout Gate 3, as work package scope and costs are agreed with suppliers. Governance by the PMB will ensure adherence to RAPID Final Determination allowances.

11.13 The forecast costs to Gate 3 Checkpoint 1 are £2.108M, inclusive of estimated risk and contingency. The breakdown of this cost may be found in Supporting Document F-2: Cost Efficiency Report. Costs for the remaining scope to achieve Gate 3 approval would be confirmed at Gate 3 Checkpoint 2.

11.14 No changes to the penalty scale, delivery incentives, assessment criteria or contributions are currently proposed for the Gate 3 Checkpoint 1.

12. Conclusions and recommendations

12.1 Conclusions

Feasibility and cost

12.1 Further options appraisal has identified two leading solutions for the Thames to Affinity Transfer – the LTR option linked to SESRO and Wraysbury Reservoir and the BRI option linked to either the Beckton effluent reuse option or Teddington DRA option of the London Effluent Reuse SRO. Both schemes were included in the WRSE emerging regional plan in January 2022, but subsequent modelling has confirmed that only the LTR option be included in the WRSE draft Regional Plan and in the draft WRMP24 (reported pathway) plan.

[28] Input has been sought from the supply chain on the estimated costs of the main technical work packages, but the costs are not, at this stage, based upon detailed supplier proposals or the outcome of a tender process.

12.2 Both options have very similar Net Present Value, when considered under the estimated operational utilisation profile. The 100 Ml/d LTR option has a slightly lower NPV of £423M and an AIC £0.54/m^3 compared to £441M and £0.57/m^3 for the BRI option.

12.3 The base capex values for both schemes has been updated for Gate 2, following more detailed engineering appraisal and assessment of land costs. The capex costs for the two 100 Ml/d options have significantly increased since Gate 1, largely driven by land costs. The indicative nature of the working solutions means that current costs are considered an 'upper-end' estimate of the expected delivery costs for both solutions. To manage this risk, a primary consideration for the next stage of the project will be associated with the WTW site selection. This will be reviewed and reconsidered at the next stage, to ensure the most appropriate site is identified taking account of the trade offs between cost, planning constraints and environmental impacts.

Water Resource Planning

12.4 Both schemes could deliver an average deployable output of 50 or 100 Ml/d. The WRSE draft Regional Plan selects the 100 Ml/d T2AT LTR option, which also delivers conjunctive use benefit to London equivalent to 50% of the average DO.

Environment

12.5 The schemes would protect AFW's customers against future drought scenarios and also be used as part of the baseload water supply, helping meet the shortfalls that will occur as existing abstractions from sensitive chalk stream catchments are reduced under Affinity Water's Environmental Destination scenarios.

12.6 The environmental assessments completed did not identify any significant environmental risks where mitigation could not be provided, and it is not considered that there any insurmountable environmental issues that should prevent either of the options from progressing, if required.

12.7 Both options are compliant under the Water Framework Directive. The Habitats Regulations Assessment did not identify any Likely Significant Effects either alone or in combination for either option.

12.8 Both options result in construction and operational phase carbon emissions, but the LTR option has whole-life emissions approximately 40% lower than the BRI option. Various opportunities for carbon emission mitigation have been identified.

Scheme delivery

12.9 Both of the schemes are estimated to have a 6 year planning and development timeline, with an estimated 5 years required for construction and commissioning, providing an earliest available delivery date of 2034.

12.10 For T2AT, there is potential to deliver lower cost to customers (and increased value-for-money) under a fully competitively tendered delivery model, such as DPC or SIPR. SIPR is discounted due to lack of required size and complexity.

12.11 There are no critical impediments to the application of DPC for either T2AT solution. Therefore, the defining factor between In-house and DPC delivery will be value for money. Further work is recommended to explore these different procurement routes and confirm which would provide best value for money.

12.12 The recommendation is to secure consent for the T2AT project through a DCO pursuant to the PA2008 process. T2AT only assumes NSIP status if its output exceeds 80Ml/d and is not wholly a drinking water transfer. If required, it would be the Partner Companies' intention to apply to the Secretary of State for a direction under section 35 of the PA2008 to designate a lower capacity T2AT scheme as an NSIP. However, as the T2AT option (LTR) that is selected in the draft WRMP24 has a capacity of >80 Ml/d, such direction may not be required. It is expected that any DCO application will need to be integrated with (or likely run pursuant to) the consenting process required for the new raw water resource for the transfer.

12.13 The programme for future RAPID gateways needs to be adjusted from that originally planned, to ensure efficient delivery of the schemes.

- For the T2AT LTR scheme, it is proposed that the scheme be deferred until AMP8, with Gate 3 Checkpoint 1 being proposed in June 2024 and then Gates 3 and 4 after 2028. The dates for Gates 3 and 4 are proposed to be confirmed, if required, when the scheme is restarted at a proposed Gate 3 Checkpoint 2.
- For the T2AT BRI scheme, it is proposed that the scheme is deferred at Gate 2, with no further work proposed at this stage, as this scheme does not form part of the reported pathway for the draft WRMP24 of either partner company.

Costs

12.14 Overall, the Gate 2 costs are £50k under the Development Allowance confirmed by RAPID. This includes the additional work that had to be completed to complete the required technical analysis for both of the T2AT solutions in parallel. The additional work amounts to approximately £0.38M, hence showing the efficient delivery of the Gate 2 submission.

12.15 Our current work breakdown and cost forecast confirms that we expect to spend £2.1M of the Gate 3 Development allowance by June 2024 (Gate 3 Checkpoint 1), prior to deferring this scheme until 2028.

12.2 Recommendations

12.16 It is recommended that:

- The T2AT LTR scheme continue to a Gate 3 Checkpoint 1 in mid-2024 and then be deferred until 2028, to enable efficient delivery of the subsequent DCO and scheme delivery, when required.
- The T2AT BRI scheme be indefinitely deferred, and no further work should be undertaken after Gate 2.