Strategic regional water resource solutions: Preliminary feasibility assessment

Gate one submission for Thames to Affinity Transfer

Date: 5th July 2021

Template version: draft 10, 9 February 2021

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Glossary	
Scheme Partners	Affinity Water and Thames Water
Abbreviations	
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
BPT	Break Pressure Tank
CCW	Consumer Council for Water
CPO	Compulsory Purchase Order
DAF	Dissolved Air Flotation
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
HRA	Habitat Regulations Assessment
ICA	Instrumentation, Control and Automation
IP	Infrastructure Provider
ITT	Invitation to Tender
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
NPV	Net Present Value
OA	Operational Agreement
OBC	Outline Business Case (for a DPC process)
Ofwat	Water Services Regulation Authority
PA2008	Planning Act, 2008
PINS	Planning Inspectorate
PMB	Programme Management Board
PS	Pumping Station
RGF	Rapid Gravity Filter
SEA	Strategic Environmental Assessment
SoR	Statement of Response
SoS	Secretary of State for Environment, Food and Rural Affairs
SRO	Strategic Resource Option
SSSI	Site of Special Scientific Interest
STT	Severn to Thames Transfer
TPO	Tree Protection Order
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

Overview

1.1 The Thames to Affinity Transfer (T2AT) is a viable solution for a transfer of raw water from current or proposed sources available to Thames Water's (TW) London WRZ to Affinity Water's (AFW) Central Region. The T2AT partners have worked collaboratively to review this proposal and can confirm that no 'showstoppers' have been identified. On this basis we recommend that the scheme proceed to Gate 2.

1.2 The solution proposed by both partners in their WRMP19 preferred plan was a raw water transfer from the River Thames. Flows would be augmentated by releases from a new storage reservoir in the Thames catchment.

1.3 WRMP19 identified the need to investigate and shortlist combinations of transfer routes with either reservoir storage, effluent reuse or trading resources. The WRMP19 options have been robustly reviewed and challenged, resulting in an unconstrained list of 33 possible alternatives. The transfer could be derived from various new sources of water, either from the Thames upstream of Teddington Lock or from existing treated effluent in the Thames tideway (sharing of resources from the London Reuse SROs).

1.4 Options screening has enabled 8 newly short-listed options to be configured, costed and submitted into the regional (WRSE) modelling process. They are shown as indicative routes on the map in Figure 1 below. WRSE will be evaluating all of the options with public consultation planned for January 2022, allowing us to shortlist further and then progress further technical assessments for Gate 2.

1.5 Any additional natural streamflows that may be delivered through future reductions in chalk groundwater abstraction by AFW may be used by these options as extra resource for London or else potentially to augment flows upstream of any new raw water abstraction.

Key Facts, "At a Glance"

Parameter	Response for SRO	Section
Deployable Output (DO)	The options could deliver a dry year annual average DO during a 1 in 500 year drought of between 45 and 90 Ml/d. Modelling of the optimal combined operation of TW and AFW's supply systems has been started. Initial results are promising and indicate the DO could increase further. This will be developed for Gate 2.	4
Earliest delivery date	Construction expected to be able to commence in 2028. Excluding source water constraints, the options could be commissioned by January 2034.	3
Cost	The larger capacity options have a maximum utilisation AIC of between £0.41/m^3 and £0.76/m^3. The capex costs are broadly comparable to the option proposed at WRMP19, although the option configuration has been refined.	4, 10

Parameter	Response for SRO	Section
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 WTW sites.	5
Water Quality Risks	No major factors that would undermine the feasibility of the scheme, although further monitoring is recommended.	5
Preferred option	Overall, the Existing Thames Reservoir option performs best overall, with lowest capex, least environmental impacts and smallest carbon footprint.	10
Planning Issues	The recommendation is to secure consent for the T2AT project through a DCO pursuant to the PA2008 process. Direction from the SoS may be required to ensure qualification as an NSIP. The current assumption is that the T2AT scheme and any associated new source water SRO would be consented as separate projects.	7
Procurement	The three leading procurement options would be using traditional procurement routes, via a late / very late DPC model or else a Joint Venture Collaboration between the partner companies through the creation of a Special Purpose Vehicle. Further work is planned.	6
Key Risks	The key risks identified for the scheme include programme risks associated with the integration of the WRSE, WRMP24 and subsequent DCO processes, environmental risks with scheme consenting and planning risks linked to the NPS for Water resources. Mitigation has been identified for all and further work to reduce uncertainty is planned for Gate 2.	9

Customer Preferences

1.6 Proposals to share water between regions are supported positively by customers, although transfers tend to be less favoured than demand options and supply options such as reservoirs, which customers feel bring added value to the community. The T2AT concept is therefore broadly aligned to our customers' preferences, but further work is required for Gate 2 to optimise the scheme to limit cost, impacts and disruption to customers. The leading option already targets these issues.

Conclusions

1.7 The options considered have widened out the possible source water alternatives for the T2AT, to include other raw water sources into the Thames Basin and possible sharing of effluent reuse schemes in London. All options have been submitted to the WRSE regional planning process, to ensure optimal water resource strategy choice for the South East. Our extenal assurance has confirmed that the Gate 1 studies have been both relevant to final scheme submission and efficiently delivered.

1.8 At this stage, it is hard to confirm a preference for the T2AT scheme in isolation, as the source water for the options varies greatly, but at this stage the Existing Thames Reservoir option appears the most cost effective and has the lowest

environmental impact. The WRSE regional plan is required to confirm the optimum T2AT solution, and to identify the preferred raw water source so that assessments such as in-combination effects can be examined. We propose that this scheme continues into Gate 2 as all of the shortlisted options remain feasible. Gate 2 studies will progress on that basis, until a clear preference emerges from the WRSE modelling. We propose to maintain the partnership between Thames Water and Affinity Water, maintaining the current solution partnership.

1.9 Our Boards have signed the Board Statement and recommend that development of the T2AT options should continue to Gate 2.

2. Solution description

Outline of the solution

2.1 The Thames to Affinity Transfer (T2AT) is a raw water transfer from Thames Water's (TW) London WRZ to Affinity Water's (AFW) Central Region (WRZ 3 or 4). In the WRMP19 the T2AT was conceptualised as a two-phase raw water transfer from the River Thames, linked to a share of the new resource created by the SESRO scheme. Phase 1 was required by 2038 and phase 2 by 2054.

Options and Configurations

2.2 The transfer is conceptualised to use a share of various new sources of water, either the South East Strategic Reservoir Option (SESRO), the Severn to Thames Transfer (STT) one of the London Reuse SROs.

2.3 To ensure that the best value combination of options can be selected by the WRSE regional plan and hence incorporated into TW's and AFW's WRMPs, the options were reviewed and challenged for Gate 1. The screening process reduced 33 unconstrained options to a shortlist of eight, with a 50 and a 100Ml/d capacity alternative for each option. Section 4 provides more detail and a summary is shown below. An indicative plan is shown in Figure 1.

Concept 1: Options supported by new resource in River Thames

Option name	Source	Abstraction	Conveyance	Treatment
Sunnymeads 1	STT or SESRO	A1. Sunnymeads	Raw water transfer to WTW	T1. Harefield
Maidenhead	STT or SESRO	A2. Cookham	Raw water transfer to WTW	T1. Harefield
Sunnymeads 2a	STT or SESRO	A1. Sunnymeads	Raw transfer to WTW Treated water to Harefield	T2. Iver
Walton 2b	STT or SESRO	A3. Walton	Raw transfer to WTW Treated water to Harefield	T2. Iver
Existing Thames Reservoir (ETR)*	SESRO	A4. Existing Thames Reservoir	Raw transfer to Iver, existing tunnel Treated water to Harefield	T2. Iver

* linked to SESRO only to avoid unmitigated reduction in Thames Water's storage volume in London

Concept 2: Options supported by London Reuse options in west London

Option name	Source	Abstraction	Conveyance	Treatment
Teddington Direct River Abstraction (DRA)	Teddington DRA	A5. Teddington	Raw water transfer to WTW	T1. Harefield
Mogden Reuse Indirect*	Mogden indirect reuse	A3. Walton	Raw transfer to WTW Treated water to Harefield	T2. Iver

* option has same physical footprint as Walton 2b, but source water different

Concept 3: Options supported by London Reuse options in east London

Option name	Source	Abstraction	Conveyance	Treatment
Beckton Reuse Indirect	Beckton indirect reuse*	A6. River Lee	Raw transfer to WTW	T3. North Mymms

* Another potential source is water abstracted as part of the London Reuse SRO (Teddington DRA option), which abstracts water upstream of new treated effluent discharge, and uses a combination of existing and extended infrastructure to discharge at the same location as the proposed Beckton Reuse option.

Overall costs

2.4 The cost of the different options is documented in Section 10 of this report. In summary terms, the financial Net Present Value of the 100 Ml/d options varies between £288M and £402M. The lowest economic cost is for the 100Ml/d Existing Thames Reservoir (ETR) option which has an AIC of £0.41/m3. The capex costs have been benchmarked against independent cost intelligence, as part of our assurance activities. The findings are included in Section 4. Section 14 includes details of the costs to deliver subsequent RAPID gateways.

Resource benefits

2.5 The water resource benefits of the different options have been estimated using the model developed by WRSE. The options could all deliver a dry year annual average DO, during a 1 in 500 year drought, of between 45 and 90 Ml/d. There is expected to be a material conjunctive use benefit from the T2AT (see Section 4) that could substantially increase the overall DO between the partner companies.

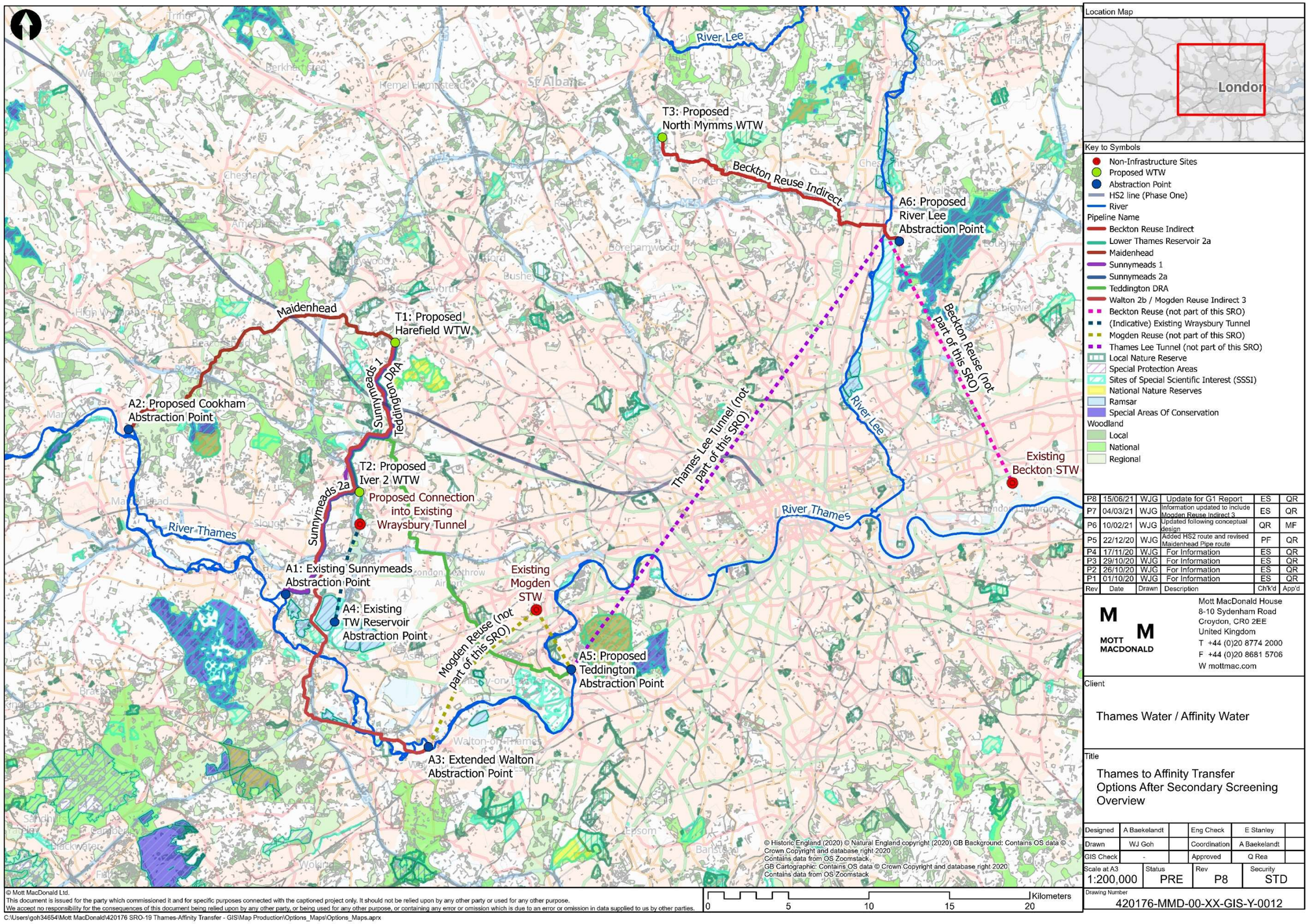
Social, environmental and carbon assessment

2.6 As detailed in Section 5, positive benefits will result from operation of the T2AT scheme contributing to a resilient water supply. However, construction of the scheme will likely result in some negative construction phase effects, but these should be manageable through suitable mitigation. The construction impacts would be similar between options, with the ETR option performing best overall and Walton 2b performing worst.

2.7 All options are likely to generate a permanent loss of high value Natural Capital stocks, based due to the removal or clearance of habitats during construction. The optimisation of pipeline routes and permanent sites will take place ahead of Gate 2 to avoid, minimise and mitigate such impacts.

2.8 As discussed in Section 5, no informative in-combination environmental assessment can be completed at this stage, as this requires that the likely source water is identified first, through the WRSE regional planning process. This information will be made available from the Regional Plan in time for Gate 2.

Figure 1 *Options overview map*



Rev	Date	Drawn	Description	Ch'k'd	App'd
P8	15/06/21	WJG	Update for G1 Report	ES	QR
P7	04/03/21	WJG	Information updated to include Mogden Reuse Indirect 3	ES	QR
P6	10/02/21	WJG	Updated following conceptual design	QR	MF
P5	22/12/20	WJG	Added HS2 route and revised Maidenhead Pipe route	PF	QR
P4	17/11/20	WJG	For Information	ES	QR
P3	29/10/20	WJG	For Information	ES	QR
P2	26/10/20	WJG	For Information	ES	QR
P1	01/10/20	WJG	For Information	ES	QR

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Thames Water / Affinity Water

Title

Thames to Affinity Transfer
Options After Secondary Screening
Overview

Designed	A Baekelandt		Eng Check	E Stanley	
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GIS Check	-		Approved	Q Rea	

Scale at A3	Status	Rev	Security
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2.9 Carbon footprint analysis is included in Section 5 . The ETR and Beckton reuse options have the lowest overall carbon footprints.

Drinking water quality

2.10 For Gate 1, the ACWG Water Quality Risk Framework Report[1] has been used for the water quality risk assessments (WQRA). Risks were traced from catchment scale through to consumers, in collaboration with DWI. In addition, any further option-specific limiting hazards were identified using existing DWSP and EA water quality monitoring data, and then confirmed by water quality representatives from across the partner companies.

2.11 As expected for a reach of the Thames with numerous existing PWS abstractions, this initial WQRA did not highlight any major factors that would undermine feasibility, but has highlighted actions that are required to allow for a more comprehensive understanding of the water quality risks before Gate 2. The collection of supplementary data that reflects the current level of hazards is the primary requirement.

Wider benefits

2.12 Analysis of the resilience benefits of each option has been assessed using the WRSE resilience framework, as discussed in Section 10. The ETR option provides the most resilient of the options.

2.13 All of the transfer options provide opportunity for biodiversity enhancement through habitat creation and also to develop wider socio-economic benefits (e.g. providing programmes on water at local educational facilities).

Scheme interdependencies

2.14 The T2AT options are all dependent upon source water from another SRO. This is highly flexile, with source water potentially available from the South East Strategic Reservoir Option (SESRO), Severn Thames Transfer (STT) or either west or east London reuse options. The west London T2AT options are also able to make use of water that is added to either the River Lee or Colne through wastewater treatment works or the reduction in Chalk groundwater abstractions from the upper catchments. The east London T2AT option may be more constrained in this respect, as there are resilience issues associated with moving water from west to east through the existing London system.

2.15 Initial investigations for Gate 1 have shown that it is unlikely to be feasible to use the *unsupported* STT as the raw water source for the T2AT. As described in Section 4, Affinity Water's system currently lacks raw water storage, and the water resource modelling has shown that the main requirement for new water is in dry years during the period of summer demand. The unsupported transfer is

[1] ACWG WQ Risk Framework Report – Final (Strategic WQ Risk Framework FINAL Report) | 19/01/21 , Rev 06

not reliable during this period due to the Hands Off Flow constraints, so the scheme would require storage in order to be used for Affinity. The total storage required for the 100Ml/d option is in the order of 10% of Thames Water's existing reservoirs. Thames' planned outages for the purposes of reservoir maintenance involve similar storage loss and require significant planning to enable the outage to take place, with increased risk to security of supply. To allow for a similar additional loss of storage would create an unacceptable risk to Thames Water's security of supply in London, as well as placing significant restrictions on routine planned maintenance. The *supported* STT, London effluent reuse and SESRO schemes remain usable sources of water for the transfer.

2.16 The options are constrained to limit the transfer to 100 Ml/d from any one of the potential raw water sources. However, they are not all mutually exclusive and multiple 50 Ml/d options could be selected. The options are defined to enable freedom of choice for the WRSE regional model to define a regionally optimal solution. It may also be feasible to consider transfer options greater than 100Ml/d, but it is more prudent to consider this once regional modelling assessments are available.

National and regional planning context

2.17 The National Framework (EA, March 2020, "Meeting our Future Water Needs: a National Framework for Water Resources"), sets out the challenge for water resources in England for the next generation, showing that if no action is taken by 2050 there is a regional need for public water supply the South East of England of 1,765 Ml/d. This framework identifies the need for regional transfers to help meet this challenge. The T2AT provides a wide choice of options for transfer of raw water to manage pressures on public water supply in the Affinity Water Central region.

2.18 The regional water resources plans are tasked with identifying the best value solutions to meet the national challenge. Each T2AT scheme is linked to an SRO, where co-creation of the source option with others would be promoted. Through identifying a wider number of potential T2AT options we have maximised the potential to identify a regional best value solution to the widest number of customers across the partner companies' supply areas.

3. Outline project plan

Programme overview

3.1 This section provides the project-level plan which sets out the key outcomes that need to be achieved prior to Gate 2. A detailed breakdown of the tasks to be completed to achieve these outcomes may be found in Section 15.

3.2 Up to Gate 1, the scheme development has proceeded to plan with all key milestones met to date.

3.3 On the basis that the water resources plan requires the scheme, and the critical dependencies and assumptions are resolved (see Table 2), then it is on track to proceed through the gated process to allow construction to start during Asset Management Plan (AMP) 8, 2025 to 2030. . The overarching programme is illustrated in Figure 2 below. The key phasing of subsequent activities and decisions beyond Gate 1 are outlined in Table 1 below.

Table 1 Programme Phasing Overview (through to commissioning)

Phase	Description	Summary of activities and decisions
2	To RAPID Gate 2 in October 2022	Continued work on options refinement, scheme feasibility and concept design, with associated regulator and technical stakeholder engagement. Requiring the timely confirmation of the preferred option, timing and need for the scheme within both the WRSE regional plan and the Draft WRMP24 for both partners. This phase will also require the progression of the draft Statement of Case and value for money assessment for a DPC and the development of the overarching strategy and timeline for DCO application.
3	To RAPID Gate 3 in summer 2023	Development of the chosen option. Expected to include conclusion of the public consultation and subsequent approval of WRMP24, notification of the DCO to the Planning Inspectorate (PINS), further outline design and initial EIA scoping studies and initial informal pre-application consultation for the DCO. It is planned that this phase will coincide with Ofwat's DPC control points B&C (approval of Statement of Case and Procurement timetable). The critical decision point for SRO progression was identified in both partner companies' WRMP19 documents was in 2023, during Phase 3.
4	To RAPID Gate 4 in summer 2024	Continued refinement and optimisation of the chosen option, including design development and refinement to reflect known impacts and stakeholder concerns, EIA scoping and commencement of EIA studies and additional informal pre-application consultation for the planned DCO. It is possible that direction for the publication of the final WRMP24 will be received during Phase 3, which would enable the acceleration of the formal consultation and DCO process. It is planned that this phase will coincide with Ofwat's DPC control point D (Ofwat's approval of the DPC ITT).
5	DCO application	Following publication of the partner companies' WRMP24 documents, will include the formal consultation on and submission of a DCO application and the associated formal examination and decision-making process, followed by the Secretary of State's decision. During this period, the Outline Business Case (OBC) would be developed, enabling Ofwat's Control Point E to be approved and the procurement process to be started in parallel.
6	Final procurement	Ofwat's approval of the DPC Final Business Case (Control F) and subsequent award of a Competitively Appointed Provider (CAP) enabling scheme delivery to commence.
7	Construction & Commissioning	The draft construction programme identifies that, overall, a programme of approximately 5 years is required between consenting and the subsequent commissioning of the 100 Ml/d T2AT options. It is currently assumed that the scheme could not be finally commissioned until the associated source water scheme was fully consented and operational.

Pre-construction phases

3.4 On the basis of this current programme, given all of the uncertainties outlined previously, a 6 year period for planning and development is expected after Gate 2, with construction expected to be able to commence in 2028. These dates

assume the 'worst-case' programme with publication of the final WRMP in 2025. On the basis of an estimated 5 year construction programme, an earliest available date for the scheme is therefore defined as January 2034. It may be noted that the earliest available date for the largest SESRO option is the end of 2037 but that slightly earlier dates may be possible for smaller options and the other potential source water SROs.

3.5 The lead time for one of the London reuse schemes is estimated to be approximately 7-9 years (earliest operational start 2029-2031 depending on option / capacity), as reported by the London Reuse SRO project. This is earlier than the 15 years required for the larger SESRO reservoirs. This may enable the T2AT to use a share of the resources from the London reuse or STT options, hence be delivered slightly earlier than if combined with SESRO. The choice of source should be clarified by the WRSE regional plan, expected January 2022.

Dependencies and Assumptions

3.6 The delivery plan will be dependent upon a number of critical dependencies and assumptions, which will be monitored and managed through the programme risk management process. These are summarised in Table 2 below.

Progress review and lookahead to future RAPID Gates

3.7 The programme is on track to deliver the future RAPID gateways as originally planned, with Gate 2 in October 2022, Gate 3 in summer 2023 and Gate 4 in summer 2024. The exact timing of the publication of the partner companies final WRMP24 may influence the conclusions that can be drawn at Gates 3 and 4 regarding the need for the scheme and hence timing may need to be reviewed. This will be discussed with RAPID as part of the process to Gate 2.

Issues and missing information

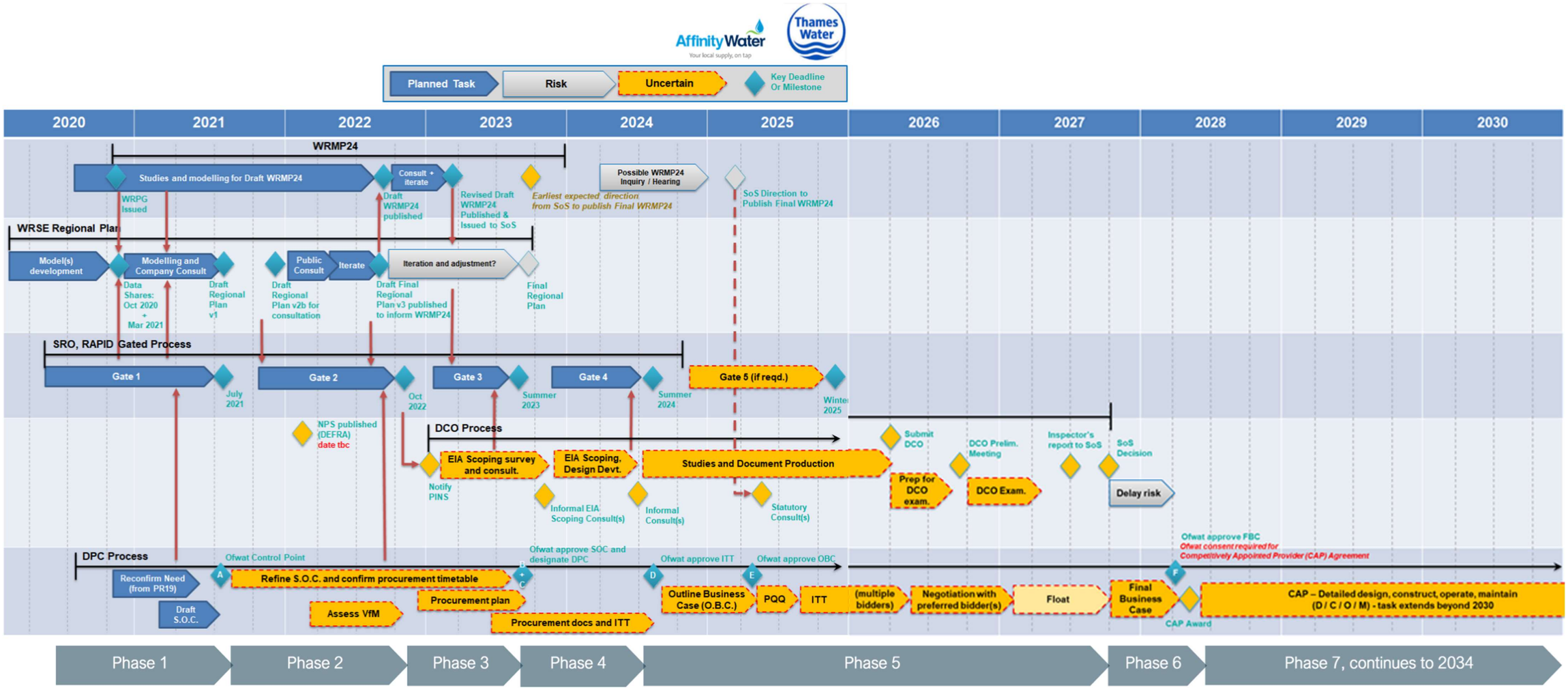
3.8 There is no other critical missing data to report at Gate 1. The confirmation of the preferred option and the need for the scheme is to be provided by the WRSE regional modelling process during Gate 2.

3.9 The detailed programme for Gate 2 includes a range of new and ongoing surveys to provide baseline data and engineering and environmental assessments that will be completed ahead of Gate 2, in order to try to resolve ongoing uncertainties with the scheme design, impacts or stakeholder concerns.

Recommendation

3.10 The programme analysis work undertaken to support the Gate 1 submission confirms that the scheme is feasible and can be delivered by the current required date of 2038 as set out in WRMP19. The earliest start delivery date for the scheme is 2034. It is, therefore, recommended that the scheme continue to Gate 2, for the further assessment of the alternative options and scheme configurations.

Figure 2 SRO Overview Programme to approval of DCO and appointment of CAP[2]



[2] Note: "Risk" refers to an additional activity that might need to occur; "Uncertain" refers to an activity that is expected to be required, but timing and duration are currently uncertain

Table 2 Key programme dependencies and proposed mitigation / action(s)

Critical assumption / dependency	Proposed actions and mitigations
The publication of the National Policy Statement (NPS) on Water Resources Infrastructure by Defra. The timing and content of this is currently uncertain. The NPS is expected ahead of Gate 2 and to confirm that the need for a scheme would be determined largely by the approved company WRMP.	Subject to an ongoing 'watching brief' by the scheme partners and their legal advisors
The timing of any direction by the Secretary of State to the scheme partners, to publish a final WRMP24, is currently uncertain. It is expected that this could be as early as Autumn 2023, occurring at the end of Phase 3. However, there is a risk that a formal public Inquiry or Hearing process could delay the direction until Spring 2025. This is the worst-case scenario for our future programme.	Ongoing dialogue between the partner companies, the EA and Defra throughout the WRMP24 process, during Phases 2 and 3.
Based upon previous assumptions[3], it is assumed that the formal consultation on any DCO application would not commence until the partner companies had received direction to publish their final WRMP24. This results in an assumed DCO consultation commencing in March 2025 at the earliest, with a subsequent DCO application 12 months later; hence, an expected decision by the Secretary of State in the second half of 2027. This would mean that the scope of work associated with scheme consent applications that can be delivered in time for RAPID Gate 4 is reduced from that outlined in RAPID's published expectations.	We have taken legal advice on this matter and will continue to collect further information and refine our understanding of this issue during subsequent project stages. This assumption will continue to be challenged to assess whether the DCO application timing may be accelerated and clearly is dependent upon the timing of the final publication of WRMP24 noted previously.
It is expected that the T2AT will be dependent upon another source of raw water (to supply the transfer). The current options rely upon a new source of raw water into the fluvial Thames or one of the London effluent reuse schemes. It is currently assumed that all of these options will also need to follow a formalised DCO consenting route and the DCO application for the transfer scheme will need to be pursuant (and probably subsequent) to that for the associated source water scheme. This means the exact timing of the DCO application is dependent not only upon the publication of the Final WRMP24 but also on the timing of the DCO for the source water. It may also be noted that if the SRO requires a s35 Direction from the Secretary of State, to confirm the scheme as DCO due to the capacity thresholds in the NPS for NSIPs, then this would need to be obtained prior to EIA Scoping being submitted which may add further dependency into the DCO process.	The current programme assumes that the DCOs will be largely concurrent, and this will be confirmed during Phase 2 once the scheme timings and interdependencies are confirmed by the WRSE regional modelling process.
It is currently assumed that Ofwat's approval point F, approval of the Final Business Case and final contract documents would need to be pursuant to the consenting (DCO) approval for the same scheme. In order to de-risk the future delivery programme, it will be necessary to start the formal procurement of a CAP (PQQ, ITT and negotiation) before the DCO is approved, but not appoint the CAP until the DCO is duly made. It is noted that this may bring significant additional commercial risk to bidders and to the partner companies if the procurement process was delayed or (in the worst-case) aborted, due to the DCO not being approved. However, this risk is considered acceptable at this stage to ensure future scheme delivery.	Will continue to collect further information on this matter as we develop the procurement strategy to Gate 2 (see Section 6). It is planned to discuss this issue with Ofwat, via RAPID, during Phase 2 to confirm their position on this dependency.
One possible option is that the scheme will be procured through a DPC process, following Ofwat's standard control points and process. A late or very late DPC is one of the leading options recommended in Section 6 of this report. However, as noted in Section 6, there are variant models (and alternatives) to be considered, but the current programme assumes that a late DPC model will be applied, subsequent to the securing of the scheme's DCO by the scheme partners.	This will continue to be reviewed, as the commercial model is developed in Phase 2 and the subsequent programme dependencies challenged.

[3] Thames Water, 2020, Final WRMP19, Section 11.259

4. Technical information

Options configuration and operation

4.1 The unconstrained options for T2AT were developed from previous (WRMP19) work. This review and challenge process has resulted in a total of 33 unconstrained options, including a direct raw water pipeline from SESRO.

4.2 The screening methodology used was aligned with the updated AFW WRMP24 options appraisal process. A common, robust process has been used to screen all options for supply to AFW. The two-stage screening process resulted in the 33 options being reduced to eight (see Figure 1), with a 50 and a 100Ml/d alternative for each.

4.3 The scope of each option is summarised in Table 3 below . All options are included within the WRSE regional modelling, to ensure that the optimal combination of new water resource and associated treatment and conveyance option(s) may be selected. All of the options proposed are technically feasible and deliverable within the required timescales.

4.4 The shortlisted options are conceptualised to ensure that any additional natural streamflows, that may be delivered through future reductions in chalk groundwater abstraction by AFW, may be used, either as extra resource for TW's London WRZ or else potentially to augment flows upstream of new abstractions used for the options.

Table 3 Option Descriptions and operational overview

Option name	Description
Sunnymeads 1	Abstraction of raw water at an existing AFW intake plus conveyance to a new WTW at Harefield.
Maidenhead	Abstraction of raw water at a new intake, plus conveyance to a new WTW at Harefield.
Sunnymeads 2a	Abstraction of raw water at an existing AFW intake and conveyance to a new WTW near Iver. The potable water is then conveyed to Harefield.
Walton 2b	Abstraction of raw water at an existing AFW intake and conveyance to the proposed WTW near Iver. The potable water is then conveyed to Harefield
Existing Thames Reservoir (ETR)	Water from TW's existing Thames Reservoirs is abstracted via a proposed connection into an existing raw water tunnel. This raw water is then diverted to a proposed new WTW. The potable water is subsequently conveyed to Harefield.
Teddington Direct River Abstraction	Abstraction of raw water at a new intake at Teddington, upstream of Teddington weir and upstream of the proposed Teddington DRA outfall (part of London Reuse SRO); conveyance to a new WTW at Harefield.
Mogden Reuse Indirect 3	This option comprises the same infrastructure as Walton 2b, but utilises water from the proposed London Reuse SRO Mogden Reuse option. The T2AT Mogden Reuse Indirect 3 option includes an extension of the London Reuse SRO outfall to upstream of an AFW intake on the Thames.
Beckton Reuse Indirect	Indirect transfer of reuse water from one of the east London STWs to a new WTW near North Mymms. The proposed abstraction point would be located on the River Lee, downstream of the outfall from the proposed Beckton Reuse option, within the London Reuse SRO.

Network Connectivity

4.5 It should be noted that the scheme design covered by this SRO incorporates the upgrades required to transmit the treated water to a specified delivery 'hub' within Affinity Water.

4.6 Any additional requirements for network enhancements beyond the delivery 'hubs' will be planned as part of AFW's 'Connect 2050' project. This builds on the 'Supply 2040' concept developed for WRMP19, allowing transfer of water across the existing supply area and accommodating different combinations of SROs and chalk groundwater abstraction reductions. This will be reported in the first half of Gate 2, once the future demand configurations have been defined through WRSE and consultation with the EA. For Gate 1, the AFW MISER model was used to simulate the basic internal network enhancements that might be required to manage the SRO import.

Operational overview

4.7 As noted in Section 6, the primary need for T2AT is during dry year summer conditions. However, the scheme may also be needed during average operating conditions as a result of future sustainability reductions at existing groundwater sources. Therefore,scheme design enables day-to-day operation at low utilisation (at c25% capacity) but then relatively rapid increase to peak operating capacity. Section 6 outlines further discussion on this issue, to be explored ahead of Gate 2.

4.8 Maintenance liabilities would be similar across all options, and in accordance with AFW asset standards for raw water pipelines, treated water mains and WTW.

Option costs

4.9 The costs of the different options are documented in Section 10 of this report. Design life of the assets has been based on Affinity Water standard life, adjusted for consistency with those outlined in WRSE guidance[4]. These range from 5 years for items such as membrane filters to 100 years for items such as large diameter transfer pipelines.

Cost Benchmarking

4.10 The costs for a selection of the options have been benchmarked against independent cost intelligence. The capex costs for the options were found to be within 10% of the average benchmark costs, hence deemed acceptable and reasonable for this stage of the project. Opex costs for the two WTW were also benchmarked and appear low, but acceptable for the level of design development required for the Gate 1 submission.

[4] WRSE Options Appraisal – Guidance on option identification, screening and development' (Mott MacDonald, 2020

Water resource benefits

4.11 As noted in Section 2, the options could deliver a dry year annual average DO, during a 1 in 500 year drought, of between 45 and 90 Ml/d, allowing for losses during the treatment process.

4.12 One of the key advantages of this option is that it can enhance the benefits provided by the source water through water cycle management and resource sharing between TW and AFW. This means that the DO of source water options (e.g. SESRO) is effectively increased when AFW's system and sharing of schemes is considered, in comparison to considerations of the Thames system alone. There are three ways in which the DO is enhanced, as summarised in Table 4 below.

Table 4 Summary of conjunctive use DO benefits from T2AT

	Description
1	*Effluent Returns:* A significant proportion of the water supplied to AFW via the transfer scheme will be returned to either the River Colne or River Lee upstream of Thames Water's intakes, as a routine part of the wastewater system operation. This proportion of the water that AFW takes therefore automatically becomes available to Thames again.
2	*Flow benefits of Chalk groundwater abstraction reductions.* As AFW reduce abstraction from Chalk groundwater in the headwaters of the Lee and Colne, a proportion of that water will naturally make its way through to TW's intakes on the Lee and Thames, providing them with a DO benefit, although this relationship of loss to gain is not 1:1. On a theoretical basis the benefits could apply to any of the options that are being considered for the T2AT scheme, although operationally this may be less certain for those options involving East London reuse, as there is no opportunity for direct sharing of storage between TW and AFW and resilience issues associated with increasing the eastward transfer of water through existing infrastructure.
3	*'Conjunctive Use' benefits.* The modelling has shown that AFW tends to experience the critical point of a drought later than TW, often in the year afterwards when Thames has been able to partially recover its storage position. Added to this, the nature of the existing supply systems means that the transfer is likely to only have to operate fully during significant late spring-summer demand events. These two factors mean that the storage required to provide a given DO for AFW is potentially much less than the storage required to operate the scheme at the stated capacity full time.

Note: The first two items are incorporated into the WRSE economic modelling as proportional benefits, based on net changes in AFW demand levels and as a percentage of the abstraction reductions indicated in each environmental destination scenario.

4.13 The flow benefits from sustainability reductions are of particular interest to stakeholders, as this covers the concept outlined by 'Chalk Streams First', where the flow increases are used by the downstream abstractions to mitigate against the loss of DO from the cessation of Chalk groundwater abstraction in the upper catchments. In order to support the analysis of the benefits a project has been undertaken as part of the Gate 1 activities examining conceptual hydrogeology and empirical evidence, which has been used to create an algorithm that can feed into the RSS water resources model and evaluate the DO benefit from abstraction reductions. During Gate 2 there are two workstream activities that will be carried out to finalise this element of the benefits of T2AT:

- Work is underway to expand the evidence basis for the coefficients used in the algorithm to include empirical data from all of the AFW sustainability reductions that have been carried out to date, and results from modelling abstraction reductions in the Vale of St Albans (VSA) and (more recent) Herts Chalk groundwater models. This will report and be shared with stakeholders in the early part of the Gate 2 programme.
- Initial test modelling using the algorithm to evaluate DO benefits in the RSS model has been completed for Gate 1, which has confirmed that the approach works and is useable. This will therefore be applied once the environmental ambition scenarios have been identified with WRSE, and the enhanced empirical evidence referred to above has been used to confirm the range and sensitivities of the coefficients contained with the algorithm. This process will also be completed early within the Gate 2 process to allow appropriate stakeholder engagement.

4.14 At Gate 1, the evaluation of the third factor (conjunctive use potential) indicates that if AFW needed 50Ml/d of DO from SESRO (net of the effluent discharge benefits described in Table 4 (1) above), then this may actually only require between 25 and 45 Ml/d of the yield of the reservoir. These are initial modelling values only. Gate 2 work will concentrate on understanding the operational realities associated with future configurations of the AFW resource system (e.g. extent and location of the sustainability reductions).

4.15 It is also likely that the capacity of the transfer will need to be higher than the stated DO in order to realise these benefits. At this stage, it may be noted that the operational utilisation of the T2AT is uncertain, whether as a resource to meet peak demands or as a more 'business as usual' resource to help manage future reductions in existing abstractions. The nature of the utilisation will govern the required capacity of the pipeline (and the associated pipeline size and costs). Our initial modelling suggests that, if used solely as a short-term drought scheme, based on the AFW demand profile and allowing for the benefits of temporary use and non-essential use bans under such conditions, the capacity of the transfer would need to be in the order of 15 – 20% higher than the average DO required (for example, the 50Ml/d DO scheme may require in the order of 60Ml/d capacity pipeline) in order to manage the burden placed by summer peak demands on the scheme. Such magnitude of increase in capacity is likely to be a marginal impact on cost, and within the scope of the optimism bias allowance at this stage. It is planned to explore all of these areas further for Gate 2, and, if required, update the scheme costs for the WRSE modelling.

Data provided to WRSE

4.16 The cost, carbon, lead-time, deployable output and dependency data for all shortlisted options have been submitted into the WRSE options database.

4.17 In order to allow environmental assessments to be carried out, spatial data for each component was provided (e.g. indicative WTW sites and pipe routes). The

options have been assessed by WRSE to determine environmental metrics. These metrics have been reviewed and discussed with the T2AT SRO team and aligned to the findings and data within this Gate 1 report, to ensure consistency.

4.18 Overall, the data provided to WRSE allows each of the shortlisted options to be considered against all other options, to enable the selection of the WRSE Best Value Plan.

5. Environmental and drinking water quality considerations

Overview of Environmental Assessment

5.1 Environmental assessment has been undertaken in accordance with the methodology in the All company Working Group (ACWG) and WRMP environmental assessment guidance.

5.2 An initial drinking water quality risk assessment has also been completed in accordance with the ACWG guidance and a summary statement provided of the potential risks to drinking water quality and supply issues.

Strategic Environmental Assessment

5.3 The SEA assessment was undertaken to inform both the Gate 1 report and the WRSE environmental metrics, to ensure consistency across the two processes. Each of the options is predicted, generally, to result in similar minor positive, neutral or minor negative effects across all the SEA objectives in construction and operation, with the following notable exceptions (Table 5).

5.4 Overall, against the SEA assessment criteria, the ETR and Beckton Reuse options performed better, whilst Sunnymeads 1 and Walton 2b options performed worst. However, it should be stressed that pipeline routes and permanent site locations are indicative at present and this assessment will be reviewed once routes and locations are confirmed to ensure that the conclusions do not change.

Table 5 SEA exceptions, specific to certain options

Objective	Phase	Assessment of majority of options	Exceptions	Rationale
Biodiversity	Construction	Moderate residual negative effect	**Major Negative:** Sunnymeads 1, Sunnymeads 2a, Walton 2b and ETR	Potential impacts on designated conservation sites
Soil	Construction + Operation	Neutral	**Minor Negative:** Sunnymeads 1, Maidenhead, Tedd. DRA and Beckton Reuse	Enhanced agricultural land value for WTW sites
Climatic factors	Operation	Moderate residual negative effect	**Major Negative:** Sunnymeads 1, Teddington DRA	Higher carbon emissions than for other options

5.5 The SEA (nor the associated HRA) does not include an in-combination assessment, as the types of in-combination impacts that will require consideration would be between different SROs (e.g. sharing resources or creating cumulative impacts in the same catchment) or between the SRO and local development plans (which may cause cumulative construction impacts or unforseen operational issues). Any assessment would thereore be meaningless at this stage due to the wide range of possibilities and hence unknown timing and combinations of schemes. An in-combination assessment will therefore be completed for the regional WRSE plan. We will review the findings in our revised environmental assessments for Gate 2.

Habitats Regulations Assessment

5.6 An HRA has been carried out based on the screening exercise undertaken by Water Resources South East (WRSE) and the subsequent Appropriate Assessment (AA), if required, was undertaken by the T2AT SRO. The initial screening was undertaken without consideration of mitigation factors.

5.7 The HRA screening has identified potential 'likely significant effects', and 'uncertain effects' for each of the options. The subsequent AA undertaken for Maidenhead, Teddington DRA and ETR options did not identify any transmission pathways by which a Likely Significant Effect could reasonably occur. Therefore no adverse effects on the integrity of the Habitats Sites are considered likely. No key risks to Habitats Sites were identified during construction or operation of these options. The AA undertaken for Sunnymeads 1, Sunnymeads 2a, Walton 2b and Beckton Reuse options did identify transmission pathways, but concluded that no adverse effects on the integrity of those Habitats Sites are likely if the suggested mitigation measures are observed.

Water Framework Directive Assessment

5.8 The WFD screening completed by WRSE indicated that a number of options (Sunnymeads 1, Sunnymeads 2a, ETR, Beckton Reuse) are anticipated to have very low risks of being non-compliant with WFD objectives, and do not require further assessment. For the other options, where waterbodies and option impacts were 'screened in', further (Level 2) assessment was undertaken.

5.9 Level 2 WFD assessments were completed for the Maidenhead, Teddington DRA and Walton 2b options. The findings indicate that there are potentially precautionary WFD compliance risks associated primarily with the operation of any additional/new abstractions. The potential hydrological effects could conflict with achieving WFD status objectives. For new or modified intakes, it is recognised that appropriate fish and eel screening would be required to prevent entrainment. At Gate 1, this has been included as likely mitigation, but moderate/amber risks have been maintained until option designs and assessments are further progressed.

Invasive Non-Native Species (INNS) Risk Assessment

5.10 The INNS risk assessment conclusions were the same for all options, with a medium risk of invasions from freshwater INNS and a low risk of contravening INNS legislation.

5.11 The output of the INNS risk assessment suggests that there is no risk of INNS spread associated with any of the proposed T2AT raw water transfer options. However, it should be noted that this is partly because the assessment tool takes account of mitigation and the fact that all pipelines terminate at a WTW, rather than discharging raw water to a reservoir or watercourse. This assessment assumes no risk from the WTW and does not include consideration of WTW overflow, for example. These risks will be assessed further at Gate 2.

Biodiversity Net Gain and Natural Capital Assessment

5.12 High-level Biodiversity Net Gain (BNG) and Natural Capital (NC) assessments identified the following:

- Natural Capital: All options are likely to generate a permanent loss of high value NC stocks, based upon current indicative routing and locations.
- Biodiversity Net Gain: All options are likely to result in a loss of BNG habitat units due to the removal or clearance of habitats during construction and the time taken for compensatory habitat to reach maturity.

5.13 There are expected to be impacts on existing ecosystem services due to both the pipelines and the permanent (WTW) sites. Post-construction remediation of the pipeline routes should avoid permanent impacts except for woodland areas. However, the construction of the WTW is expected to cause the loss of several ecosystem services namely carbon storage and food production.

5.14 From a BNG/NC perspective, the best option overall would be Maidenhead, while the worst one would be Teddington DRA. Optimisation of pipeline routes and permanent sites will take place ahead of Gate 2 to avoid, minimise and mitigate such impacts. Opportunities for habitat reinstatement and / or creation will be explored once condition of existing habitats is better understood.

Assessment of opportunities for net zero carbon contributions

5.15 The majority of the embodied and operational carbon impacts for all options are driven by the construction and pumping associated with the transfer pipelines. Details of the carbon footprint analysis are shown in Section 10.

5.16 As expected, the highest carbon footprints are associated with the longer pipelines, such as are required for the Walton and Teddington DRA, because these options will entail both more material and higher pumping head to overcome friction losses. The ETR and the Beckton Reuse options have the lowest embodied and operational carbon footprints.

Comparison between options and mitigation overview

5.17 The environmental impact from the construction of each option would be similar across all options, with the ETR option performing best overall and Walton 2b performing worst overall.

5.18 The assessments undertaken have identified a number of mitigations that would be required, should the options be taken forward, including pipeline routes and the location of sites to be refined in order to avoid protected, sensitive environmental sites or sensitive community facilities and directional drilling, in order to avoid or reduce likely effects on watercourses and sensitive community facilities.

5.19 Where possible, opportunities for reinstating land to achieve amenity and biodiversity improvement and potential positive community effects, for example by improving access to recreational and open space, will be explored.

Initial drinking water quality considerations and risk assessments

5.20 The water quality risk assessment (WQRA) process has been applied in accordance with the methodology developed by the ACWG Water Quality Risk Framework Report[5]. This initial RA is based upon existing water quality monitoring data, which is being enhanced on an ongoing basis by the SRO procured monitoring programme. The SRO programme will take a number of seasons to complete, but will be finished in time for the Gate 2 WQRA.

5.21 The WQRA process followed for Gate 1 included a collaborative workshop, with water quality representatives from both partner companies, which highlighted several key considerations. These included the need for customer engagement to define acceptability, additional raw water quality data and further analysis around key chemical determinants for certain options.

5.22 As may be noted from Section 10, the ETR option provides additional water supply resilience. The shared use of the existing Thames Reservoirs provides additional bankside storage that AFW do not currently have access to, hence driving additional buffer capacity in the event of a pollution incident.

5.23 The Gate 1 WQRAs confirmed the concept design for the treatment process of each option at this stage. However, supplementary data may reveal updated risks from limiting hazards and this will aid in the development of updated treatment designs. A key workshop outcome was that enhanced cryptosporidium treatment should be considered in the Gate 2 treatment design. Therefore, a key outcome from the initial assessments is that additional data is needed on all options. An ongoing water quality monitoring programme in the Thames basin has been implemented, in agreement with the EA, DWI and NE.

[5] ACWG WQ Risk Framework Report – Final (Strategic WQ Risk Framework FINAL Report) | 19/01/21 |

The data requirements highlighted in these WQRAs have been communicated for inclusion in the monitoring programme.

5.24 An early draft of the Drinking Water Quality analysis was provided to DWI for comment before formal submission of the Gate 1 report. Going forward, proactive engagement will be undertaken with the DWI as the treatment design and WQRA progresses.

6. Initial outline of procurement and operation strategy

Procurement strategies considered

6.1 A range of potential procurement options have been considered for the scheme, including all varieties of the Direct Procurement for Customers (DPC) model. Due to the current early stage of scheme development, the strategy does not provide a definitive recommendation for a single procurement option, but does summarise and justify a preferred 'direction-of-travel' to take forward to Gate 2 for further development.

6.2 A broad range of possible procurement models for delivery and operation of the scheme were considered. For each, we have mapped the risk allocation between parties, and compared this with the key commercial risks identified.

6.3 To assess the suitability of the different procurement models, we have used the criteria set out by Ofwat for the assessment of DPC suitability and adapted this for the other models considered. To provide some insight into the value-for-money of different models, we have used a high-level commercial risk and pricing assessment. The results are shown in Table 6. At this early stage, the leading options are a late / very late DPC model or a collaboration JV.

Scheme Ownership

6.4 In summary, with the exception of IP models, 'ultimate accountability' resides with TW or AFW under all models considered. 'Day-to-day control' could reside with different parties under different options within most models, but further clarity on the preferred operational regime is needed to determine the specific implications of this for the T2AT scheme.

Developing the procurement strategy

6.5 Key next steps to progress the procurement strategy towards Gate 2 include:

a. Further development of the operational regime and implications for the preferred procurement strategy, including how often the transfer is likely to be used above minimum flow and interdependency with other SRO schemes.

b. More comprehensive, detailed procurement appraisal of the key technical, delivery and operational risks of the scheme, their mitigations, and whether they are best able to be managed by TW, AFW or the supply chain.

c. Further investigation of the value-for-money analysis of different procurement models, particularly focusing on supply chain operational capability and including scenario-testing (e.g. different drought conditions, delays to other SROs or significant delays during construction).
d. Market engagement with design, construction, equipment, operations, and finance providers will commence after Gate 2 once scheme 'go-ahead' is more certain. However, light-touch, targeted early engagement around specific commercial aspects may be useful before Gate 2.

Table 6 Assessment of Procurement Models

Procurement Models	Assessment of Procurement Models for T2AT	Rating
Typical current models	T2AT is an estimated capital investment significantly greater than £100m, but would be deliverable through traditional procurement routes. It is foreseeable that the function of the pipelines may introduce some challenge in developing the inter-company regulatory, operational, and commercial arrangements due to the interface between the two water companies and the shared use of assets, however, these arrangements are likely to be achievable.	
Early DPC	Through the workshops there was an identified need for significant early involvement from water companies in the early stages of developing this project to enable planning consent. This would be particularly important for overcoming early stakeholder objections, land access/rights, environmental impacts, potential for public enquiry, early design feasibility, and managing public perceptions. Transferring planning risk to a CAP is likely to result in a significant risk premium, reducing value-for-money. It is unclear whether any better capability that the supply chain has over water companies at managing delivery and operational risks for a pipeline will be sufficient to offset the additional planning risk premium.	
Late/Very Late DPC	This scheme may favour a late DPC approach as this would mitigate many of the early planning challenges around such a project. Construction of new pipelines is recognised as a frequent event and well understood process, with a mature supply chain.	
Split DPC	Similar to the early DPC model, the split DPC model would require planning risk to be transferred to the CAP, which is likely to result in a significant risk premium, reducing value-for-money.	
Collaboration JV	Collaboration between water companies through the creation of a Special Purpose Vehicle could 'compartmentalise' scheme risk investment risk and offer some financial protection. It will also enable capability of both water companies to be cooperatively applied, and the flexibility to involve the supply chain where appropriate, through the project life-cycle to overcome the early planning risks through to construction.	
IP Model	This would require a licenced service provider which, through the size of the scheme, would need regulatory endorsement. At this stage, there is no existing legal framework for the SRO schemes to be individually licenced, therefore this model is not considered feasible.	

6.6 For Gate 1, we have assumed the 'whole scheme' (i.e. abstraction, conveyance and treatment) is within the scope of the CAP. This will be reviwed for Gate 2, in response to latest guidance from DWI associated with the operation and maintenance aspects of water treatment assets by a CAP. At present, our

understanding is that a legal solution is required to enable DWI powers and duties to apply to that entity. There would be options to remove the WTW from the CAP's scope, if required.

Anticipated operational utilisation

6.7 Initial modelling suggests the scheme would mainly operate under dry year summer demand conditions to support deficits in AFW WRZ4. The chosen 'hub' locations mean that the scheme could also be utilised to provide onward transmission to WRZs in neighbouring catchments (Colne and Lee) that will be more impacted by dry year annual average deficits driven by future sustainability reductions and climate change impacts. During dry year summer conditions, modelling suggests that operation of the transfer may be needed for relatively short periods of time, expected to be less than 100 days, due to the scale and timing of such demand conditions for AFW.

6.8 Affinity Water currently operates a number of resilience connections with Thames Water in order to manage times of peak demand and emergency responses (to outage events for example). Should the scheme include bankside storage (specifically, the existing Thames Reservoir option), the scheme could be used for blending between the existing direct river abstraction and reservoir storage which may enable more continuous operation.

6.9 Given the current anticipated operational utilisation, the scheme could be considered 'low utilisation' under normal operating conditions. This means that the additional operational issues will need to be considered during subsequent design phases, including:

- Potential water quality impacts related to intermittent utilisation (taste / odour / aged of water)
- Sweetening flows to meet statutory obligations in order to be able to 'ramp up' the scheme in short timeframes
- Elements of the scheme could be candidates for modular design (e.g. new treatment works) to be utilised up to capacity over long term forecasts
- Consideration of future conjunctive use modelling across multiple companies to optimise utilisation and operational approach.

Anticipated operational strategy

6.10 Given the possible procurement routes for T2AT, with likelihood of a DPC or collaborative partnership, operational 'interfaces' between different operating parties involved would need to be managed commercially and technically to control the quantity and quality of the water delivered. If there were multiple different parties operating the source water system, the conveyance and treatment and then the distribution system to AFW's customers, potential risk will exist. Given the complex mutual interdependencies within such an integrated system, the overriding operational philosophy for each will be developed ahead of Gate 2, once the leading / preferred options are clarified.

7. Planning considerations

Overview

7.1 The recommendation at Gate 1 is to secure consent through a DCO pursuant to the PA2008 process. Should the scale of the project fall below the threshold for an NSIP, this will require the securing of a direction from the Secretary of State under section 35 of the PA2008 to bring the development into the process.

7.2 The relationship between the T2AT and any new soucre of water, is a key strategic planning consideration. The current assumption is that both elements will be consented as separate projects and thus subject to two separate planning applications. This approach will be reviewed for Gate 2 once the timing and need for the SROs are confirmed by the WRSE regional modelling.

7.3 The justification and need case for the T2AT project will be influenced by any new additional raw water source being developed. As a consequence, the need case for T2AT is likely to rely upon the additional raw water source project being progressed first. This may not extend to awaiting a final consenting decision on the source water scheme, but should be sufficient to demonstrate that it is actively being progressed as an NSIP.

7.4 A further consideration relates to the status of both T2AT and associated raw water source as EIA 'projects'. This consideration relates to whether they are so interdependent that they are, effectively, part of the same project and should be assessed as a whole. If this conclusion were to be reached, the implications could be that they could be promoted as a single NSIP application. Legal advice on this matter will be sought during subsequent project stages as a preparatory step for successful future scheme promotion.

Table 7Key planning risks

Risk	Mitigation
Demonstrating the 'need' case for the project	If not qualifying as an NSIP, seek section 35 Direction from the Secretary of State.
Unable to secure desired consents within the DCO	Identify the list of secondary consents required and included in a DCO at an early stage (Gate 2 consideration). Begin to communicate these to stakeholders (esp. regulators) at an early stage.
Inadequate EIA	Identify project requirements, description and flexibility as early as possible to enable effective EIA scope.
Inadequate pre-application consultation	Ensure compliance with the PA2008 and regulations. Production of a high quality Consultation Report
Post-consent approvals / conditions	Embed flexibility in the scope of the EIA and DCO. ECI can add significant value in framing the scope of the DCO.
Appeals and Judicial review	Ensure all information is well evidenced, justified and reasoned, being built on a robust need case that has been had stakeholder engagement.

Risk	Mitigation
Land acquisition	Produce a robust compulsory acquisition strategy. Ensure purchase of all property can be justified as essential for the project (and in accordance with policy); Ensure effective consultation and engagements.

Key steps to be addressed prior to Gate 2

7.5 The key planning tasks to be completed ahead of RAPID Gate 2 include documenting the methodology for options appraisal, consulting on this with affected LPAs, producing a Planning consent strategy (which includes defining the project for DCO and EIA purposes) and developing strategies for critical aspects such as the Section 35 Direction that may be required from the SoS and the statutory DCO consultation.

Programme and relationship with RAPID, WRSE and WRMP24

7.6 The current consent programme for T2AT estimates a 6 year programme for development and planning deliverables. It is appropriate for the wider consultation and engagement strategy (including formal statutory consultation under the PA2008 process) to occur following the publication of the draft WRMP24 (quarter 4 2022), which aligns with post Gate 2 of the RAPID Gated process.

7.7 If there are other SROs in a similar position to T2AT, needing to also seek Section 35 Directions due to the NSIP thresholds, then it may be appropriate for the Companies involved to engage collectively with Defra to determine whether a further review of the water transfer NSIP thresholds might be appropriate. Once the position is clearer, the timing and duration of any Section 35 applications will be reflected in updated SRO programmes at Gate 2.

8. Stakeholder engagement

Customer engagement completed ahead of Gate 1

8.1 We participated in a research programme coordinated by WRSE, involving nine water companies, to examine customers' understanding of water resources and the need for regional solutions. This coordinated approach ensured feedback was comparable across regions and solutions and was cost efficient. The research provided evidence on customers' understanding of the need for regional water resource solutions and the level of support for sharing water resources. The key findings from this research were:

- Proposals to share water between regions are seen in a positive light by customers. It was highlighted that customers needed to consider SROs in the context of both alternative options and the regional planning context.
- Customers have firmly established views on the priority of transfer options: less favoured than both demand options and supply options such as reservoirs, which customers feel bring added value to the community.

Customers are less willing to see water transferred out of their region if the recipients are more wasteful.

- Recycling schemes draw mixed views from customers. In general, the more informed customers become over time, the more they recognise the benefits of water recycling. But customers can still have concerns over impacts (e.g. water quality) and need appropriate assurances.
- Largely, transfers via river or canal are preferred to pipeline options because they are perceived by customers to have wider benefits and fewer negative impacts. However, customers do have various concerns about transfers, including cost, construction disruption, environmental impacts, energy use and lack of benefits to local communities.

Regional Collaborative Stakeholder Engagement

8.2 The T2AT is a key option for the WRSE regional plan to consider. For Gate 1 we have focused the majority of our wider stakeholder engagement via WRSE to ensure stakeholders are fully informed of the wider context of T2AT, can input at the most informative point and we were able to minimise stakeholder fatigue.

8.3 WRSE has an on-going engagement and consultation programme to support the development of the South East regional plan and South East Company's WRMP24s. In 2020 the focus of the programme was on the building blocks of the plan (e.g. planning policies and technical methods) and in 2021 the engagement has broadened to focus on feasible solutions and the approach to determine the best value plan. Consultation on the draft plan is scheduled early in 2022.

8.4 Up to Gate 1, engagement has focused on Tier 1 statutory consultees and Regulators, ensuring close alignment on issues of data collection and assessment and focusing on understanding and legal / regulatory compliance which could prevent or substantially change the design of the scheme. Table 8 provides a high-level summary of the engagement to date.

Table 8 SRO specific Stakeholder Engagement to Gate 1

Stakeholder	Scope of interest	Activity to date
Environment Agency	Water quality and environmental monitoring and assessment including the requirements of and compliance with the WFD. Delivery of wider environmental ambition and objectives.	Regular monthly updates with NAU (including EA and NE representatives) to share progress on technical studies.
Natural England	Legal and regulatory requirements with respect to the natural environment plus landscape and environmental benefits and opportunities for enhancement	NE representative attends monthly NAU meetings
Drinking Water Inspectorate	Drinking water quality and treatment solutions. Concerns regarding source water – particularly recycled sources.	Regular meetings with DWI team on technical studies and options regarding water quality monitoring, drinking water risk assessment and options development.
Historic England	To ensure the historic environment is protected but to reconcile that with the economic and social needs and aspirations of the people who live and use the area.	HE representative attends TW/ Affinity quarterly forums and engaged at high level - further detailed engagement will be required once route is confirmed.

Stakeholder	Scope of interest	Activity to date
RAPID	Responsibility for overseeing the work to examine the SROs and for administering the Gated process	Active engagement to update and introduce general options analysis and more detailed discussions on approach to customer and stakeholder engagement.
CCG / CCW	Protecting customer interests, ensuring plans and schemes are developed with customer engagement and input.	WRSE Regional CCG group meeting regularly to input into WRSE customer engagement (including SRO engagement)
Local Authorities	Local authorities will be key during planning process regarding location and disruption of any works.	Identification of key LAs based on early options scope*. Invited to the joint TW/ Affinity quarterly forum and the April WRSE options consultation.
Wider stakeholder	Joint Water Resource quarterly forums have been held for stakeholders across both companies. These highlight the WRSE process and inform about opportunities to respond to the consultations.	
* including Parish of Iver, Bucks Unitary Authority, Hillingdon Council, Runnymead Borough Council, Welwyn Hatfield Borough Council and Harrow Council		

Customer and Stakeholder engagement proposed to Gate 2

8.5 At this point, the evidence base we have from our Customer preference work can primarily inform: (a) customer understanding of the need for large scale regional water resource solutions; and (b) the level of support – in principle – for sharing water resources and the SRO proposals as they stand. Further research for Gate 2 will seek to address the following issues and concerns raised by customers:

How we communicate the **efficient use of resources** for customers. Companies will need to demonstrate and communicate current and future levels of leakage and water use within their own and recipient companies' areas.	**Service levels** - customers in donor companies want reassurance that the long-term viability of sharing water does not come at the expense of deteriorated service. We need to look at how we communicate the wider strategic movement of water.
Water quality. Assurances are needed about safety and reliability of transferred water (particularly from a recycled source) and whether their supply will change.	**Scheme design, construction, and operation**. Customers want more information on the transfer design including costs, operational strategy, build as well as environmental impact and opportunities.

Targeted Stakeholder Engagement

8.6 For Gate 2, targeted engagement will include the following activities:

- Continued engagement with wider stakeholder population regarding the development of the Regional Plans, the selection and prioritisation of solutions and the reconciliation of WRMPs across the region. This provides an integrated approach between the WRSE consultation, subsequent WRMPs and leads into scheme specific consultation on the SRO that may follow.
- Continued technical engagement with the EA, NE and DWI and with CCW and CCGs, to share the planned customer engagement work.
- As we optimise the options early in the Gate 2 process (see Section 15), we plan to engage with the affected LPAs, focusing on the options selection

process, appraisal of alternative and any resultant concerns regarding site specific choices / routes and issues regarding future scheme consenting.

9. Key risks and mitigation measures

Risk Register

9.1 The risk register for the programme consists of two specific elements:

a. The overarching **Programme Risk Register**, as reported to RAPID through the quarterly reporting process. This provides a register of programme level risks to the overall delivery of the scheme or to the achievement of the required strategic outcomes.

b. The initial **Qualitative (non-monetised) Risk Register**[6], which provides a breakdown of possible construction risks that may have a material impact on capex costs. A fully costed risk register will be developed ahead of Gate 2, once the options list has been reduced to a better defined preferred solution.

9.2 Initial discussions have been held with the Environment Agency NAU with regard to how environmental risks are best identified and managed after Gate 1 in a collaborative manner with the environmental regulators. The aspiration of the SRO is to ensure that all pertinent environmental risks are discussed and agreed with environmental regulators and captured within the programme risk register, thereby enabling regular proactive communication of the progress of technical work to address and avoid such risks to be shared with the regulators. We plan to establish a regular forum for the communication and discussion of progress against such risks, to ensure a close and productive working relationship between the SRO and environmental regulators.

Key risks and associated mitigation

9.3 The key risks may be derived from the existing risk registers and are summarised (Table 9 below) to provide an overview of the mitigation strategy for each element. The categorisation follows that used in the programme risk register, as shared previously with RAPID during the quarterly reporting process.

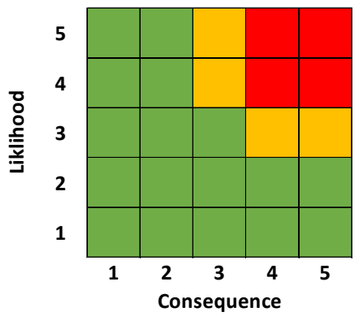
[6] At this early stage of the project, with multiple, high level options still under consideration, it has not been possible to produce an accurate costed risk register. Cost uncertainty has been addressed via the Optimism Bias methodology, as approved by the All Company Working Group.

Table 9 *Key risk themes and proposed mitigation*

Risk Theme	Details	Pre-Mitigation			Proposed Mitigation	Post-Mitigation		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
Programme	• Delays to WRSE regional plan programme or lack of integration between regional plans, which results in delays to subsequent WRMP24 and / or SRO promotion as the latter is expected to be reliant on the preceding regional and company strategic plans to define the need for the scheme. • Delays to the publication of the Final WRMP24 for either partner company, due to the need for a formalised public hearing or enquiry process, resulting in delay to the subsequent formal DCO process required for scheme promotion. • Failure to secure a direction from the Secretary of State to confirm that the scheme is an NSIP, resulting in the need to seek consent for the scheme under the TCPA, causing delay due to the complexity of the application and the involvement of multiple local planning authorities.	4 4 3	4 4 5	High High Medium	The regional and company planning risks will be mitigated through continued close liaison with the regional coordination group (RCG), regional modelling teams at WRSE and with the WRMP teams within both partner companies, to ensure that the SRO options are represented appropriately within both regional and company specific water resource management plans and presented for comment within the resulting public consultations during 2022. The NSIP direction risk will be mitigated through early definition of the planning strategy for the SRO (ahead of Gate 2) and, if required, seeking legal advice on this issue.	3 3 2	4 4 5	Medium Medium Low
Stakeholder	At this stage in the development of the project, with so many options being considered, the key stakeholder risks are considered to lie with potential scheme delays due to opposition to the choice of scheme at a regional level and through more local community challenge or issues with local routing constraints.	4	5	High	These risks will be managed primarily through the close alignment with the WRSE modelling and consultation, as noted above. However, to address the potential risk of more local concerns with the chosen scheme, we have also outlined in Section 15 an approach for Gate 2 that will develop, articulate and consult upon the options appraisal process followed and specifically engage with local planning authorities to secure their agreement to the analysis undertaken and results found.	3	5	Medium
Environmental	We have identified a number of key environmental areas that could cause a risk to the successful delivery of the T2AT scheme. At this stage, noting that further assessment will be required as the chosen scheme is selected and refined during subsequent project stages, these do not include site specific environmental impacts, as our assessment completed to date suggest (see Section 5) that all such issues should be mitigatable through standard design and construction practice. However, the following issues remain: • Delays in obtaining (or failure to secure) abstraction consents from the EA, noting that there may be a risk that the existing Lower Thames Operating Agreement (LTOA) requires refinement and / or the inclusion of the T2AT abstraction within that protocol. • There is growing pressure on existing groundwater abstraction due to the potential impact on streamflows in the Chilterns (upper Colne and Lee); this may change the need case for the T2AT through reductions to Affinity Water's baseline supplies, but the timing and nature remains unclear.	5 5	5 5	High High	We plan to mitigate the first risk through targeted hydrological investigations, in close liaison with the EA, ahead of Gate 2, to establish in principle whether the existing abstraction control arrangements remain valid and appropriate or whether the LTOA requires amendments. We plan to mitigate the second risk through ongoing analysis of the impacts of reductions to future groundwater abstraction in the Rivers Colne and Lee and the impacts this might have on available supplies for Affinity Water, environmental benefit in those watercourses and possible enhancements to Thames Water's deployable output in London. This work will be ongoing as part of the WRSE regional plan and the partner companies' WRMPs, with specific additional modelling to support the need for the T2AT and associated raw water sources undertaken by the SRO project	3 3	4 5	Medium Medium
Planning	As discussed in Section 7, there are a number of risks associated with the consenting of the T2AT scheme, particularly regarding whether it is deemed an NSIP and how the connectivity with the consenting approach for the new source of raw water for the transfer should be best managed. The first has already been discussed under programme risks and the second cannot be easily mitigated until the WRSE regional modelling provides initial results to identify the preferred combinations of options at a regional				We plan to mitigate the first risk through the clear definition of the options appraisal methodology and close liaison with the WRSE regional modelling, as noted previously. This will help ensure we can clearly articulate the process we have followed to select options and explain to stakeholders how the regional modelling helps select the best value plan for the South East. We will maintain close liaison with WRSE, to ensure early visibility of preferred regional programmes, to reduce option choice and, as explained further in Section 15, we have developed a work programme for Gate 2 that is agile and enables us to			

Risk Theme	Details	Pre-Mitigation			Proposed Mitigation	Post-Mitigation		
		Likelihood	Consequence	Risk		Likelihood	Consequence	Risk
	scale. Additionally, we have identified two key risks with the current planning strategy: • There are currently a high number of alternative options, which are integrated with a wide range of other SROs. This may add complexity to consulting effectively upon the options appraisal process and defining the need for the scheme. • There is currently a lack of a National WR Policy Statement, which may undermine statement of need for the SRO referring back to WRMP24. There is a risk the NPS is not published.	3 2	4 5	Medium Medium	focus on whichever transfer option choice is preferred at a regional level. There is not a great deal that can be done to mitigate the second risk, noting that both partner companies have previously made representation on the draft NPS, except to remain in close liaison with Defra through our various professional advisors. We currently assume that a Final NPS will be published ahead of Gate 2.	2 2	4 5	Low Medium
Financial	Additionally, we have identified one further key financial risk. The Gate 2 forecast cost is currently very close to the Final Determination allowance, meaning there is risk of overrun.	3	5	Medium	As outlined in Section 14, our mitigation for this is to procure and manage a number of work packages across both SESRO and T2AT concurrently, for efficiency and sharing of costs, particularly for advice on commercial models, procurement strategy and planning advice. At this stage, both SROs are inherently linked, hence this combined approach is most efficient. It may be most efficient to procure these work packages under SESRO only, with advisory benefits passing to T2AT but without incurring financial contributions. We will discuss and agree this strategy with RAPID, to ensure no inadvertent bias in actual costs that might skew financial comparison between SROs.	2	5	Low
Operational	As noted in Section 6, there are potentially some very complex operational interfaces with the T2AT that need to be developed and resolved. These may be complex to define and manage and may have a material impact upon the choice of procurement route for the scheme.	4	4	High	Development of an operational strategy, as outlined in Section 6, and develop better definition of the utilisation and operation of the scheme on both a day-to-day basis and also during drought periods using the available water resources models. This will help definition of operational philosophy and hence constraints and requirements for 'handover' points.	3	4	Medium

* Assessment of risk in accordance with a standard 5 x 5 matrix of likelihood and consequence, as illustrated below:



10. Option cost/benefits comparison

Solution delivery date

10.1 As noted in Section 3, an earliest available date for the scheme is defined as January 2034. It is estimated that the scheme delivery period will be similar across all options.

Summary of economic costs

10.2 Capex, Opex and Optimism bias have been derived following the guidance given in the ACWG cost consistency method[7]. The capital cost estimates for the options have been derived using AFW's standard Long-Run Marginal Cost spreadsheet. This enables the costs of standard engineering items to be estimated, based upon AFW's assured business planning cost estimation database. This cost estimating process is consistent with the approach taken for WRMP19. Optimism Bias was calculated as detailed in the ACWG Cost Consistency Methodology. Opex costs were generated for each element. Opex included labour, power, chemicals and an allowance for operational maintenance.

10.3 Construction capex and opex costs have been used to generate the NPV values for the elements using the Treasury Green book with a declining schedule of discount rates) and an 80-year period. The estimated NPV and AIC for each of the 100 Ml/d options is shown in Table 10 below. It should be noted that these costs do enable comparison between options, but do not take account of the holistic costs of the scheme, as they exclude the required raw water source hence should not be used for decision making in isolation.

Table 10 NPV and AIC for each of the 100 Ml/d capacity options

Option name	Units	Sunnymeads 1	Sunnymeads 2a	Maidenhead	Walton 2b
Option benefit – additional resources or demand saved	Ml/d	100	100	100	100
Total planning period option benefit (NPV)	Ml	697,870	697,870	697,870	697,870
Total planning period indicative capital cost of option (Capex NPV)	£000	238,961	231,870	235,355	301,587
Total planning period indicative operating cost of option (Opex NPV)	£000	85,000	91,706	83,434	100,976
Total planning period indicative option cost (NPV)	£000	323,961	323,576	318,789	402,563
Average Incremental Cost (AIC) (max. utilisation)	p/m³	46	46	46	58

[7] ACWG (2020), Cost Consistency Methodology, 412624 | CC-400 | C

Average Incremental Cost (AIC) (25% utilisation)	p/m³	39	39	39	49
Option name	**Units**	**Existing Thames Res.**	**Teddington DRA**	**Mogden Reuse**	**Beckton Reuse**
Option benefit – additional resources or demand saved	Ml/d	100	100	100	100
Total planning period option benefit (NPV)	Ml	697,870	697,870	697,870	697,870
Total planning period indicative capital cost of option (Capex NPV)	£000	201,070	287,967	301,587	237,763
Total planning period indicative operating cost of option (Opex NPV)	£000	87,718	91,337	100,976	79,892
Total planning period indicative option cost (NPV)	£000	288,788	379,304	402,563	317,655
Average Incremental Cost (AIC) (max. utilisation)	p/m³	41	54	58	46
Average Incremental Cost (AIC) (25% utilisation)	p/m³	34	46	49	39

Note: maximum utilisation is assumed for these calculations: 1 in 500 year deployable output for 365 days / year, to enable comparison between options. 25% utilisation is assumed for alternative AIC. Required utilisation to be confirmed through WRSE modelling.

10.4 The lowest overall NPV and AIC is for the ETR option. Whether this scheme is optimal for the south-east region will be determined by the WRSE Best Value Planning framework.

10.5 Costs for future RAPID gateways are discussed in Section 14.

Carbon Costs

10.6 The breakdown of the carbon footprint for the different options is summarised in Table 11 below.

Table 11 Summary of carbon footprint for each option

	Operational Carbon Emissions at full capacity)* ('000 tCO2e/yr)		**Embodied Carbon Emissions ('000tCO2e)**	
Option	**50 Ml/d**	**100 Ml/d**	**50 Ml/d**	**100 Ml/d**
Sunnymeads 1	5.8	10.7	24	40
Maidenhead	5.7	10.4	22	38
Sunnymeads 2a	5.7	10.6	26	43
Walton 2b	6.9	12.1	38	64
Existing Thames Reservoir (ETR)	5.3	10.1	20	33
Teddington DRA	6.5	11.8	31	52
Mogden Reuse Indirect	6.9	12.1	38	64
Beckton Reuse Indirect	5.3	9.8	23	39

*assuming full utilisation and 'normal' Grid, based upon Total UK Grid average (Carbon Accounting Workbook v14) - 0.000277 tCO2e / kWh, including transmissions and distribution losses.

10.7 The lowest overall carbon footprint is for the Beckton reuse and ETR options, as these have shortest pipeline routes and least pumping. However, those options sourced from reuse are likely to have a higher total operational carbon footprint (when source water is included) due to the high energy demands of treatment.

Water Resource benefits

10.8 The water resource benefits of the different options have been previously documented in Section 4. The evaluation completed indicates that if AFW needed 50Ml/d of Deployable Output (DO) from TW's London WRZ, then this may actually only require between approximately 25 and 45 Ml/d of lost DO from the donor zone. This opportunity for optimised conjunctive use is a unique benefit of the T2AT options.

Environmental benefits

10.9 The options could all contribute to environmental net gain. This could take the form of habitat compensation, creation and/or species relocation schemes. The options also provide opportunities for amenity and biodiversity improvement through habitat creation, extensions or changes to public rights of way networks and improvements to existing habitats as part of reinstatement. Specific opportunities have not been developed for each option ahead of Gate 1, but will be considered for Gate 2.

Resilience Analysis

10.10 Analysis of the resilience benefits of each option has been assessed using the WRSE resilience framework[8], providing useful insight into the differences between the options.

10.11 Overall, the resilience between the options is very similar, as might be expected for this type of standard water supply asset, with good levels of resilience. The ETR option provides the most resilient of the options, with lower risk of failure and better ability to recover in the event of failure. The ETR provides additional reliability and operational flexibility provided by the shared use of existing reservoir storage, which reduces liklihood of service failure and increases the ability of the option to recover from a failure event.

11. Impacts on current plan

11.1 The T2AT scheme is included within AFW's and TW's final WRMP19. Four alternative futures were modelled as adaptive pathways, 'expected, challenging, aspirational and optimistic challenges' futures, where various combinations of

[8] WRSE, August 2020, "resilience-framework-response-to-feedback-03-august-2020_final.pdf (wrse.org.uk)"

supply demand balances were modelled. SESRO in combination with the T2AT is selected in the first three scenarios, but not in the very low forecast aspirational plan, although the timing of the need did vary significantly between them. In WRMP19, the earliest date for the T2AT, linked to new raw water resources in the Thames provided by SESRO, was under the simulated 'challenging future':

- First stage (50Ml/d) required by 2038
- Second stage (50Ml/d) required by 2054

11.2 The work undertaken for Gate 1 has not changed this plan, but has adjusted the context and options to deliver it:

- alternative source/transfer combinations have been identified. One of these options (ETR) provides a more cost-effective and resilient option than WRMP19.
- Other alternative back-up source options have been identified (STT or London Reuse). A transfer with one of these sources provides a potentially earlier start date due to a shorter construction duration than SESRO.

11.3 As discussed in Section 4 , modelling analysis has identified differing supply vulnerabilities of the AFW and TW systems, which reduces the DO disbenefit to TW compared with the DO benefit to AFW (i.e. a 1 in 500-year drought for London may be an event that does not impact AFW as severely, and vice versa). This arises from the conjunctive benefit of the wider system operation, which takes account of storage availability. This will be explored further into Gate 2, once the preferred option is identified by the WRSE regional modelling and the scheme is refined and optimised.

11.4 The risks to the Plan have been reassessed since WRMP19 as part of the Gate 1 process and incorporated into the current options set. The main areas of risk reassessment and management include:

- option concept design and costs have been reassessed, to increase accuracy,
- additional transfer options have been derived, which are based upon alternative sources of water to ensure robustness around shared use of SESRO and to enable flexibility if an earlier scheme is required, and
- the shared use of one of the existing Thames Reservoirs in the Thames London zone mitigates water quality issues of direct abstraction from the River Thames and also provides the resilience benefit of storage.

11.5 Analysis of the initial work supporting the development of WRSE regional plan have not changed the conclusions reached at WRMP19, which remains a robust basis of need for the scheme. However, a number of additional alternative options have been identified and proposed. These conclusions will be kept under review as the WRSE regional plan and partner companies' WRMP24 documents are finalised ahead of Gate 2.

12. Board statement and assurance

12.1 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.

Assurance approach

12.2 The assurance framework used for this submission has been developed jointly by Thames Water and Affinity Water. 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, alongside the likelihood or reporting issues. Areas of higher risk receive three line of assurance while other areas, where the risk is lower, may be targeted with first and second line (peer and management review) only.

12.3 Jacobs were appointed as our external assurers and the assurance approach was augmented by experience that the companies gained through the PR19 assurance process and the sharing of best practice (e.g. the use of an Independent information declaration form developed by Thames Water).

Items to highlight

12.4 Jacobs' Assurance Report confirms that, at the completion of their assurance work, they consider:

a. The Gate 1 submission is consistent and aligned to the regulatory requirements for Gate 1 as set out in Ofwat's final determination and subsequent additional feedback.
b. For the information within their scope, the information contained within the Gate 1 submission has been derived using methodologies, assumptions, and input data suitable for Gate 1 and is therefore reliable.
c. The assurance scope is appropriate for the submission.
d. Their opinions and feedback have been appropriately considered.
e. Progress on the solution to date is commensurate with the Final Determination timeline of being 'construction ready' for AMP8.
f. 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.
g. The expenditure that has been incurred in generating the Gate 1 submission is efficient and relevant to the development of the submission.

12.5 We constantly look to improve our assurance approach and will conduct a "lessons learnt" exercise before we finalise our assurance approach for Gate 2.

Board Statement(s)

12.6 A copy of the Board Statement(s) has been provided with the covering letter that supports this submission.

13. Solution or partner changes

13.1 There are no changes to solution partner for T2AT at RAPID Gate 1.

13.2 The are no solution substitutions for T2AT at RAPID Gate 1 and the option(s) considered at WRMP19 remain valid. Additional options have been added to the short-list of feasible solutions since WRMP19 (as noted in Sections 2 and 4) and are undergoing assessment within the WRSE regional modelling.

14. Efficient spend of gate allowance

Breakdown of Gate 1 costs

14.1 The costs up to the Gate 1 submission are presented relative to Ofwat's Final Determination allowance. Due to the timing of the authoring and assurance of this report, the total costs are reported as the sum of actual costs for work actually completed (to end April 2021) plus estimated forecast costs for remaining work to Gate 1 (5th July 2021). The assessment of the spend is included in the assurance activity for Gate 1 (see Section 12).

14.2 For accurate comparison with the Final Determination allowance, as requested by RAPID, actual costs are deflated back to a 2017/18 cost base using Thames Water's Internal Business Plan (IBP) deflationary factors, based upon the CPIH (November 2019 dataset) (see Table 12).

Table 12 Deflationary factors used for actual cost calculations

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

*from actual costs back to 2017/18 cost base

14.3 The cost allowances to produce the Gate 1 submission were provided in Ofwat's Final Determination documentation[9]. Overall, as shown in Table 13, the forecast spend to Gate 1 represents a saving of £0.23M against the final determination allowance. The reasons for this efficient delivery of the Gate 1 submission are explained in subsequent sections. All required outputs for the Gate 1 submission have been delivered.

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

Table 13 Gate 1 forecast total cost for each partner company

Company	Forecast Total Cost to RAPID Gate 1 (£M, 2021 prices)	Forecast Total Cost to RAPID Gate 1 (£M, 2017/18 prices)	Ofwat FD Allowance for Gate 1 (£M, 2017/18 prices)	Saving (£M)
Thames Water	£0.46	£0.43	£0.55	£0.12
Affinity Water	£0.46	£0.43	£0.55	£0.12
TOTAL	**£0.92**	**£0.86**	**£1.09**	**£0.23**

14.4 The breakdown of the total forecast cost is shown in Table 14. The total forecast costs may be further broken down, to show the proportion of spend across the main technical workstreams.

Table 14 Cost breakdown, by technical area

	Total Cost (17/18 prices)		% spend
Program Mgt. and Governance	£	105,386	12.3%
Assurance	£	30,096	3.5%
Commercial and legal support	£	25,656	3.0%
Stakeholder engagement	£	11,653	1.4%
Engineering analysis and design	£	273,561	32.0%
Environmental studies	£	302,140	35.3%
Drinking Water quality studies	£	41,012	4.8%
Planning and land studies	£	6,037	0.7%
Water Resource modelling	£	7,824	0.9%
Regulator costs (EA and NE)	£	52,106	6.1%
Sub-total	**£**	**855,472**	**100%**

14.5 We have undertaken initial qualitative benchmarking of the proportion of total cost assigned to each workstream across other SROs undertaken by the partner companies. This analysis provides an initial understanding of outliers and identifies that, for most workstreams, the percentage splits are well aligned to other SROs. The following areas show a difference from the average of more than 10%:

a. **Engineering analysis and design.** The scheme has undertaken an extensive options appraisal. As documented in Section 4, in order to ensure that the options for the transfer represented the full range of feasible variants, we undertook extensive options appraisal from first principles and then developed a concept design for 8 short-listed options. This required a greater level of effort and detail than would have been the case for more SROs with better developed and well defined options.

Efficiency of Gate 1 costs

14.6 Overall, as noted in the previous sections, the programme has delivered the Gate 1 submission for an efficiency saving of £0.23M (approximately 22%). This efficiency has been provided through 7 key principles, which are discussed in Table 15 below.

Table 15 Cost efficiency overview

Area	Application	Efficiency achieved	Contribution
A	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 1 submission or to avoid programme risks for Gate 2. This results in a very targeted scope of work.	Medium
B	Standard methodologies for key areas (e.g. environmental assessment)	Shared methodology and application reduces technical work effort (standard templates, outputs etc); no need to assure bespoke methodologies across all SROs, driving consistency with other SROs for Gate 1 submission.	Low - Medium
C	Use of technical assessments undertaken for WRSE	Standard methodology applied by WRSE to all constrained options (environmental and resilience) helps drive consistency; use of WRSE data and assessment outputs helps reduce technical work effort and time required to assess options for Gate 1.	High
D	Implementation of common procurement principles	Standardised rules for the procurement of services on behalf of multiple solution partners to provide best value for money; Prioritised hierarchy of standard procurement approaches to drive competition and efficiency into external procurement; Allows governance over the procurement of technical services and drives accountable efficiency into the process.	Low
E	Adoption of competitive procurement and qualitative benchmarking	98% of the value of the key external support services has been procured using competitive approaches, with the majority going via framework mini-bid processes. Where direct award was used, qualitative benchmarking using professional judgement against similar previous work packages ensures efficiency.	Medium - High
F	Procurement of aligned work-packages across multiple SROs	Several work packages procured on behalf of multiple SROs, to drive efficiency into both procurement and delivery (fewer contracts to let and manage and fewer consultancy interfaces). Examples include environmental and water quality surveys, procured across multiple SROs and Programme Management, Planning and land strategy and external assurance procured centrally for SESRO and T2AT.	High
G	Application of rigorous project management controls	All external work packages were delivered at or below the agreed contract value, including approved changes; robust control helps prevent 'scope creep' and cost escalation.	Low

Gate 2 proposed costs

14.7 Overall, the SRO forecast cost to Gate 2 is £1.6M (in 2017/18 prices), showing delivery of the Gate 2 requirements within the FD allowance of £1.635M. These cost estimates are derived through a detailed work breakdown structure of the work required up to Gate 2 (see Section 15), and the assignment of costs to each work package using professional judgement and an assessment of similar activities undertaken on other previous projects. These costs assume that detailed technical analysis will be undertaken on shortlist of the leading options, as confirmed by the WRSE regional modelling. Further explanation of this rationale is provided in Section 15. Forecast costs for futute Gates will be

provided at Gate 2. However, at Gate 1, there is nothing to indicate that the spend for later gates will be significantly different to the FD allowance.

14.8 As noted in Section 9, the forecast for Gate 2 is very close to the FD allowance. This is largely because the work effort and cost associated with the type of technical pre-application studies required for Gate 2 is not directly proportional to the capex value of the scheme. To manage this, we plan to procure and manage work across both SESRO and T2AT concurrently, for efficiency and sharing of costs, particularly for advice on commercial models, procurement strategy and planning advice. At this stage, as noted in Sections 3 and 7, both SROs are inherently linked, hence this combined approach is most efficient.

15. Proposed gate two activities and outcomes

Breakdown of Gate 2 activities and outcomes

15.1 Our Gate 2 activities are identified to meet the requirements of the RAPID gated process, recognising that they will be done in parallel to the WRSE planning process and the partner companies Water Resource Management Plans.

15.2 The preferred choice between the T2AT options cannot be solved with simple site-based options appraisal but relies upon the regional water resources modelling to identify the optimum combination(s) of source and transfer. Once the regional plan provides this guidance, we can then optimise that preferred concept with more site- specific studies.

15.3 To continue to develop all 8 shortlisted options would be inefficient and cause abortive costs. Consequently, we have derived a Gate 2 work breakdown that balances these conflicting pressures between multiple, geographically disparate options, very different environmental and engineering challenges between the options and a constrained, finite budget for technical analysis.

15.4 Initially, in order to develop the preferred option to a suitable level of detail for Gate 2, we will focus on the evolution of the option that emerges from the initial WRSE regional modelling. In the absence of the WRSE plan, we will continue to follow the preference from WRMP19 and develop the leading option linked to the River Thames, namely the Existing Thames Reservoir option. If one of the alternative concepts or sources is selected by the WRSE modelling (e.g. a conveyance linked to STT or London reuse) then we will adjust our detailed investigations accordingly.

15.5 In order to ensure that we easily adjust our preferred solution to reflect the outcomes of WRSE best value planning, we will document and consult with local planning authorities regarding our options appraisal methodology, to ensure firm foundations for any future scheme promotion irrespective of final option choice. It is expected that we will retain multiple options at Gate 2 as all shortlisted options are likely to remain on the constrained options set for the partner company's WRMP consultation process, but will only develop the level of detail for those selected by WRSE or the company WRMPs.

15.6 The key workstreams and activities proposed for Gate 2 are shown in Table 16 below and are aligned to the outcomes required by Ofwat's Final Determination[10]. The environmental monitoring plan, developed in support of this list of activities, and a detailed Gantt chart showing the sequencing and dependency between these tasks have been developed in parallel.

Table 16 Gate 2 Workstreams, activities and outcomes

Workstream	Key activities
Environmental Assessment	River water quality modelling; Initial aquatic and terrestrial environmental desk-based studies; Update and develop the assessments completed for Gate 1; Develop initial permitting and licensing strategy
Environmental Monitoring	Aquatic ecological survey (Rivers Thames); Water quality surveys; Targeted habitat survey for pipeline routes and sites, where required
Technical and Engineering Assessment	Options refinement and development. Develop the engineering concept design for preferred option(s); Update scheme costing to reflect any changes; Engage Early Contractor Involvement, if possible
Water Resources Modelling and Analysis	Further modelling (optimise operation and deployable output); Continued interface into the WRSE regional modelling process; Analysis of groundwater abstraction reduction scenarios
Commercial Assessment	Further development of the operational regime for the scheme; More comprehensive risk appraisal; Assessment of the procurement models.
Legal Support	Ongoing legal advice, as required
Planning Assessment	Engagement with LPAs re. options appraisal; Assessment of scope, timescale and powers for DCO; Confirm and produce overarching planning strategy for scheme promotion, including SoS direction on NSIP status.
Land Assessment	Collation of Property Information; Define the optimum approach for land acquisition; ID utilities constraints (power requisition and off-site routes)
Stakeholder Engagement, Third party stakeholder costs	Update to WRSE customer preference studies; Ongoing regular, technical engagement with environmental regulators, affected LPAs and CCs and others e.g. Historic England, HS2, Highways Agency and others); Interface into WRSE and WRMP24 engagement and Public Consultation processes
Programme Management, Governance, Reporting and Assurance	Programme management and governance; External assurance; Authoring, checking and reviewing of Gate 2 submission; Regulation review of proposals

Gate 2 penalty assessment criteria

15.7 No changes to the penalty assessment structure are proposed for Gate 2.

Assessment of solution delay impacts

15.8 The project is currently on-track to deliver the scheme by the required dates. At this stage we do not anticipate any solution delay impacts for the delivery of Gate 2. However, as discussed in Section 3, there are a number of critical assumptions and dependencies which might impact upon the successful commissioning of the scheme by 2038. These programme issues and risks will be explored further up to Gate 2 and more detailed mitigation defined for each.

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

16. Conclusions and recommendations

Conclusions

16.1 A much wider range of alternative solutions has been identified for Gate 1, utilising the sharing of resources from a range of different SROs. A shortlist of 8 options has been provided into the WRSE regional modelling process, to enable the optimal combination of new resources and transfers to be selected.

16.2 The options all deliver a deployable output of 45 – 90 Ml/d to Affinity Water, with an additional conjunctive use benefit expected to be seen in TW's London WRZ.

16.3 All of the options 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.

16.4 The Existing Thames Reservoir option has the lowest Net Present Value (£289M). The AIC is £0.41/m3 for the 100 Ml/d option.

16.5 The scheme will protect AFW's customers against future drought scenarios. However, the construction of the scheme will likely result in some negative environmental effects. None of the impacts undermines the feasibility of the shortlisted options. The impact of the construction of each option is similar, but with Existing Thames Reservoir performing best overall and Walton 2b performing worst.

16.6 The Existing Thames Reservoir and the Beckton Reuse options have the lowest embodied and operational carbon footprints.

16.7 The three leading procurement options would be using traditional procurement routes, via a late / very late DPC model or else a Joint Venture Collaboration between the partner companies.

16.8 The recommendation is to secure consent for the T2AT project through a DCO pursuant to the PA2008 process. It is expected that any DCO application will need to be integrated with the consenting process required for the new raw water resource for the transfer.

16.9 The programme is on track to deliver the future RAPID gateways as originally planned, with Gate 2 in October 2022, Gate 3 in summer 2023 and Gate 4 in summer 2024.

Recommendation

16.10 The programme analysis work undertaken to support the Gate 1 submission, along with the future programme and planning timeline, confirm that the scheme is feasible and can be delivered by the current required date of 2038 as set out in WRMP19. It is, therefore, recommended that the scheme continue to Gate 2, for the further assessment of the leading alternative option(s), pending confirmation of the preferred source / conveyance configuration by WRSE.