Strategic Solution Gate One Submission:
Preliminary Feasibility Assessment

Anglian to Affinity Transfer

5 July 2021

Contents

Acronyms

Acronym	Definition
A2AT	Anglian to Affinity Transfer
ACWG	All Company Working Group
AIC	Average Incremental Cost
AFW	Affinity Water
AWS	Anglian Water Services
BNG	Biodiversity Net Gain
BSA	Bulk Supply Agreement
CAP	Competitively Appointed Provider
CCG	Customer Challenge Group
CCW	Consumer Council for Water
CESMM4	Civil Engineering Standard Method of Measurement v.4
CWS	County Wildlife Sites
DBFMO	Design, Build, Finance, Operate and Maintain
DCO	Development Consent Order
DO	Deployable Output
DPC	Direct Procurement for Customers
DWI	Drinking Water Inspectorate
EA	Environment Agency
EBSD	Economics of Balancing Supply and Demand
ECI	Early Contractor Involvement
EIA	Environmental Impact Assessment
HRA	Habitats Regulations Assessment
ICA	Instrumentation, Control and Automation
INNS	Invasive Non-Native Species
JV	Joint Venture
LAs	Local Authorities
LRMC	Long-run Marginal Cost
M&E	Mechanical and Electrical
MCM	Million Cubic Metres
MO-RDM	Multi-Objective Robust Decision Making

Acronym	Definition
NAU	National Appraisal Unit
NC	Natural Capital
NIC	National Infrastructure Commission
NPV	Net Present Value
OB	Optimism Bias
PEI	Preliminary Environmental Information
PMG	Project Management Group
PPA	Power Purchase Agreement
PV	Present Value
QRA	Quantified Risk Assessment
RSS	Regional System Simulator
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SLR	South Lincolnshire Reservoir
SoCC	Statement of Community Consultation
SPA	Special Protection Area
SRO	Strategic Resource Option
SSSI	Site of Specific Scientific Interest
ToLS	Test of Likely Significance
UKTAG	United Kingdom Technical Advisory Group
VFM	Value for Money
WAFU	Water Available For Use
WFD	Water Framework Directive
WQRA	Water Quality Risk Assessment
WRE	Water Resources East
WRMP	Water Resources Management Plan
WRSE	Water Resources South East
WRW	Water Resources West
WRZ	Water Resources Zone
WTW	Water Treatment Works

1. Executive summary

Anglian to Affinity Transfer

Solution summary

- The Anglian to Affinity Transfer, or A2AT, is a strategic regional water resource solution for the transfer of water from the Anglian Water region to supply Affinity Water customers.
- The scheme relies on the development of a new source supply of water in the Anglian Water region, and options include a new South Lincolnshire Reservoir (SLR), a new Fens Reservoir or a new intake from the River Trent via Rutland Water.
- An options development and screening process has been carried out, which has resulted in four shortlisted options that we intend to carry through to gate two. These four different transfer options have been assessed for the different Anglian Water source options and Affinity Water network connection locations.
- The A2AT is being sized to provide a deployable output benefit to Affinity Water of between 50Ml/d and 100Ml/d.
- Whole life costs and Average Incremental Cost (AIC) are presented for "whole solutions" including the SLR and Fens Reservoir sources. This evaluation is complex due to the conjunctive use benefits that occur when the source water options are shared between Anglian and Affinity Water, so the AIC analysis is only intended to allow comparison between options in this submission, rather than as a comparison against other Strategic Resource Options (SROs).

Outline delivery plan

- The A2AT programme remains on track to be 'construction-ready' in AMP8, although the required 'into-supply' date is dependent upon the outcome of the regional modelling.
- The workstreams planned for gate two (and beyond) will ensure that there is a robust planning and market engagement process in place to help inform the preferred procurement model.
- The scheme is expected to be promoted as a Nationally Significant Infrastructure Project, requiring a Development Consent Order (DCO).

Water quality considerations

- Initial water quality risk assessments have not highlighted any significant issues.
- The output has been used to inform the proposed treatment requirements with a focus on the need to consider customer perception (taste, odour, hardness) due to a change in water type.

Key environmental outcomes

- Initial environmental assessments have not identified any significant issues with the options using the SLR or Fens Reservoir as the source, although some risks have been highlighted with the River Trent transfer option.
- The abstraction licence arrangement will be discussed with the Environment Agency to ensure no likely significant effects on designated sites; and a programme of monitoring will be in place to gather additional information to inform the ongoing assessments.
- Initial assessments suggest wider benefits could be realised including opportunities for environmental enhancement, improved climate-resilience and realisation of low-carbon targets.

Stakeholder engagement

- An extensive programme of customer engagement has been completed, and the overall consensus is that customers agree with the need for regional water resource collaboration.
- Transfer options are generally considered least favourable by customers, with the expectation that 'self-reliance' will be targeted first.
- Ongoing stakeholder engagement will include a first phase of community engagement in spring 2022, once the preferred option has been identified.

Scheme viability

- A2AT is a viable solution and the recommendation is that work should continue with this scheme to ensure it is construction ready by AMP8.

Key risks & assumptions

- The Water Resources East regional system simulator model will be used to select the preferred option. Potential delays could impact the programme to gate two.
- The timescales to align the scheme delivery with the planning (Development Consent Order - DCO) and procurement (Direct Procurement for Customers - DPC) requirements are not fully aligned and work is ongoing to mitigate the risks.

2. Solution description

This section sets out a summary of key information and an initial overview of the Anglian to Affinity Transfer (A2AT) Strategic Resource Option (SRO).

2.1 Solution outline

One of the potential solutions identified by Affinity Water in WRMP19 to address its forecast supply deficits was the option of transferring additional water from the Anglian Water region. Anglian Water's current supply and transfer infrastructure does not have spare capacity, so a new source and conveyance would have to be developed.

In WRMP19, the new source of water for the transfer was identified as the development of a new winter storage reservoir in South Lincolnshire (the South Lincolnshire Reservoir, or SLR). This was associated with an inter water company transfer referred to as the Anglian to Affinity Transfer, or A2AT.

The SLR scheme is a distinct SRO being developed by Anglian Water and Affinity Water.

The A2AT scheme is focused on the transfer of water from the Anglian Water region to supply Affinity Water customers. In addition to the SLR, other options are being considered as the source of water, including the proposed Fens Reservoir and the River Trent.

The A2AT is being sized to provide a deployable output (DO) benefit to Affinity Water of between 50Ml/d and 100Ml/d.

2.2 Options and configurations

The A2AT solution initially identified up to eight potential solutions, but once duplicates and less suitable versions of the same scheme had been screened out this was reduced to four shortlisted options. These four options could be used to supply water to either the Affinity Water Lee Water Resource Zone (WRZ3) or the Stort Water Resource Zone (WRZ5), and consist of:

- SLR to WRZ3.
- SLR to WRZ5.
- Fens Reservoir to WRZ5.
- River Trent to Rutland Water to WRZ3.

Two of the options are dependent on the implementation of the SLR SRO scheme as the source of water for transfer. The SLR SRO scheme includes abstraction from the reservoir to a new water treatment works (WTW) and then a transfer to an existing Anglian Water service reservoir north of Peterborough. These elements have been designed and costed as part of the SLR SRO, and do not form part of the A2AT scope.

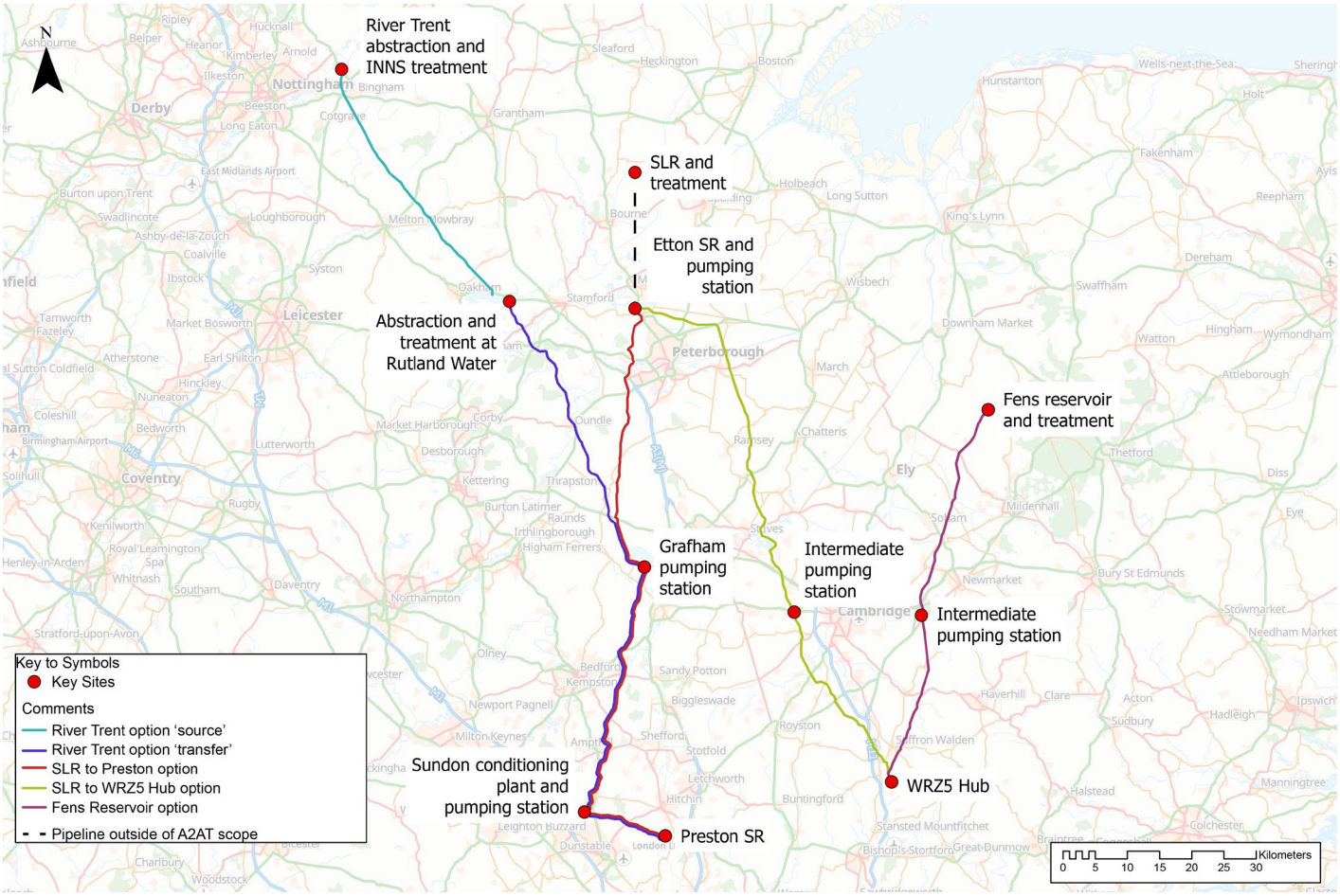
The Fens Reservoir is an alternate strategic scheme that is being developed by Anglian Water and is being considered as a potential source of water for the A2AT. The Fens Reservoir scheme will include a new WTW and has not been included as part of the A2AT scope.

The fourth option relies on abstraction of water from the River Trent to supplement the yield of the Anglian Water reservoir at Rutland Water. This additional yield could be used to transfer through to Affinity Water. This option would include additional treatment of the raw water from the River Trent, in addition to abstraction from Rutland Water and a new WTW.

Two potential reception points for introducing treated water into the Affinity Water supply network have been identified into either the WRZ3 or WRZ5. Both will require prior conditioning to ensure the water quality is acceptable and reinforcement to the downstream water supply network to accept the additional import for distribution to customers.

Full details for each of the concept design options are presented in Section 4.1. The configurations are summarised below and in Figure 1.

Figure 1: Map of A2AT selected options



The required capacity of the transfer scheme will be determined through regional water resource modelling, which is being carried out by Water Resources East (WRE) as well as more detailed deployable output assessment. However, in order to allow the gate one investigations to proceed, concept designs have been developed for each option. For the River Trent and SLR options, alternative designs for a capacity of 50Ml/d and 100Ml/d delivered to Affinity Water have been developed. For the Fens Reservoir option, designs have been developed for a capacity of 50Ml/d and 70Ml/d.

2.3 Overall costs

Option costs have been developed for each of the transfer options in accordance with the All Company Working Group (ACWG) cost consistency guidance[1]. Due to the current level of development at gate one, there is still significant uncertainty embedded into the proposed costs. However, this risk element has been incorporated within the proposed Optimism Bias (OB) and risk approaches. The estimate of the overall cost for each design is considered sufficient for gate one.

The total Net Present Value (Capex plus Opex) of the "whole solution" options, including Affinity Water's contribution to Capex and Opex of shared assets, range from £623million to £1,176million. Further detail on the costing approach can be found in Section 4.2 and Section 4.3.

2.4 Resource benefits

The deployable output (DO) estimates have been calculated using an adapted version of the regional system simulator model. The estimates confirm that the SLR and Trent A2AT options would be able to satisfy up to 100Ml/d of Affinity Water demand and also contribute to an increase in DO to Anglian Water, which can be significant in the case of the SLR given the additional storage it could provide and the availability of water in the River Witham. The Fens Reservoir could also deliver 70Ml/d to Affinity and add to Anglian Water DO. Further detail on the water resource benefit is presented in Section 4.5.

2.5 Environmental outcomes

Initial environmental assessments have been completed for the transfer options, including a Habitats Regulations Assessment (HRA), Water Framework Directive (WFD) and Strategic Environmental Assessment (SEA). Additional assessments for Invasive Non-Native Species (INNS), Biodiversity Net Gain (BNG), Natural Capital (NC), social outcomes and carbon have also been undertaken. The results are summarised in Section 5, and while no significant issues have been identified with the options using the SLR or Fens Reservoir as the source, some risks have been highlighted with the River Trent option.

1 Mott MacDonald (2020), Cost Consistency Methodology, Technical Note and Methodology

The abstraction licence arrangement will be discussed with the Environment Agency to ensure no likely significant effects on any designated sites. Further work will be required to collate information available to inform the assessments as the design continues to ensure that any WFD compliance risks are considered and addressed. Initial assessments indicate that there will be significant wider benefits realised by a number of the options, including opportunities for environmental enhancement, positive social outcomes, improved climate-resilience and realisation of low-carbon targets.

A programme of additional monitoring and environmental assessment is in progress to further develop the environmental assessments for the gate two submission.

While the A2AT options have been developed with the aim of avoiding impacts on people, for all options, there is the potential that even with mitigation, there may be temporary disruption for communities. When reviewing the assessment outputs, the preferred option overall would be SLR to WRZ3 while the least preferred would be the River Trent option.

2.6 Drinking water considerations

A Water Quality Risk Assessment (WQRA) was carried out for the A2AT solution in accordance with the guidance developed for the ACWG[2]. The outcome from the WQRA has been used to design the treatment requirements for the elements of the A2AT scheme.

No significant water quality concerns have been identified at this stage. Further water quality data is required, and a water quality monitoring programme has been proposed to provide additional data to allow the WQRAs to be developed to a greater level of detail and confidence for gate two.

2.7 Resilience benefits

The A2AT solution has been designed to ensure the scheme is resilient to an extreme drought, which is defined as a 1-in-500-year return period, and to account for potential climate change impacts in the 2050s, in accordance with the latest Environment Agency Water Resource Planning Guidance. For this stage of assessment, only one medium-range climate change scenario has been adopted corresponding to the high-emissions pathway. The reported deployable output benefits for each of the concept design options will contribute to the overall Anglian Water and Affinity Water supply resilience.

There are potential opportunities to increase the public water supply resilience benefits for the A2AT transfer, options that will be further reviewed for gate two. In particular, the River Trent option to provide a transfer to Rutland Water could provide resilience benefits to Anglian Water, which could be further enhanced with bankside storage at the new abstraction point. Creating cross connections between the new and existing mains between the Anglian Water and Affinity Water supply systems would also increase the resilience of both systems and allow for maintenance of shared assets.

2.8 Links to other options, schemes and elements

The A2AT SRO is considering a range of supply options to transfer water from Anglian Water to Affinity Water, including the SLR as a potential source. If the SLR is selected as the source of water for the transfer, A2AT considers transfers from the connection point to the Anglian Water network assumed in this assessment until the connection with the Affinity Water network but also includes for treatment of the water from the SLR. In addition to SLR, A2AT also considers alternative sources for the transfer, including the proposed Fens Reservoir and the use of existing capacity at Rutland Water supported by an intake on the River Trent.

The transfer schemes also require supporting downstream infrastructure to be constructed to distribute the flow to where it is required in the Affinity Water supply area. As part of this need to assess system operability in gate two, Affinity Water is initiating a project to produce a strategy that will underpin its WRMP and SRO submissions through the optimisation and modelling of its local strategic network (the 'Connect 2050' project). This strategic project will allow the company to understand the detail of the behaviour, constraints and opportunities of its strategic supply network and develop strategies to accommodate changes in bulk transfer arrangements brought about by the different SROs currently being investigated.

As well as the direct abstraction option, the SLR relies on a transfer of water from the River Trent. There are multiple competing demands for the River Trent, including the Minworth Effluent Reuse SRO and the Grand Union Canal SRO, which are both joint schemes between Severn Trent Water and Affinity Water. WRE and Water Resources West (WRW) have co-ordinated to create a River Trent Working Group to monitor developments across these schemes and alternative sources of water. These will continue to be assessed as the scheme develops.

2.9 Regional planning

There are complex interdependencies between Water Resources East (WRE), Water Resources South East (WRSE) and Water Resources West (WRW) regional groups and regional plans, and uncertainty exists at this stage around which configuration of SROs offers best value for customers and the environment.

The regional reconciliation process will confirm if the A2AT is required to meet the deficit in the Affinity Water area and the preferred combination of sources and routes based on the four options being progressed at gate one. To this end, the complex interaction between WRE and WRSE is being handled through conjunctive use system simulation to assess the DO implications of transferring water from the Anglian Water region to the Affinity Water supply area. Using the WRSE system simulator, a demand timeseries for the A2AT at 50 Ml/d and 100 Ml/d deficit has been generated to determine the impact that satisfying this additional demand has on the WRE regional plan. At the same time, in WRSE, a set of scenarios where the Affinity Water demand is reduced by 50 Ml/d and 100 Ml/d will be run to see how much impact that has. This iterative process will allow the performance metrics of the two regional plans to be compared to determine if the A2AT represents better value than the WRSE alternatives.

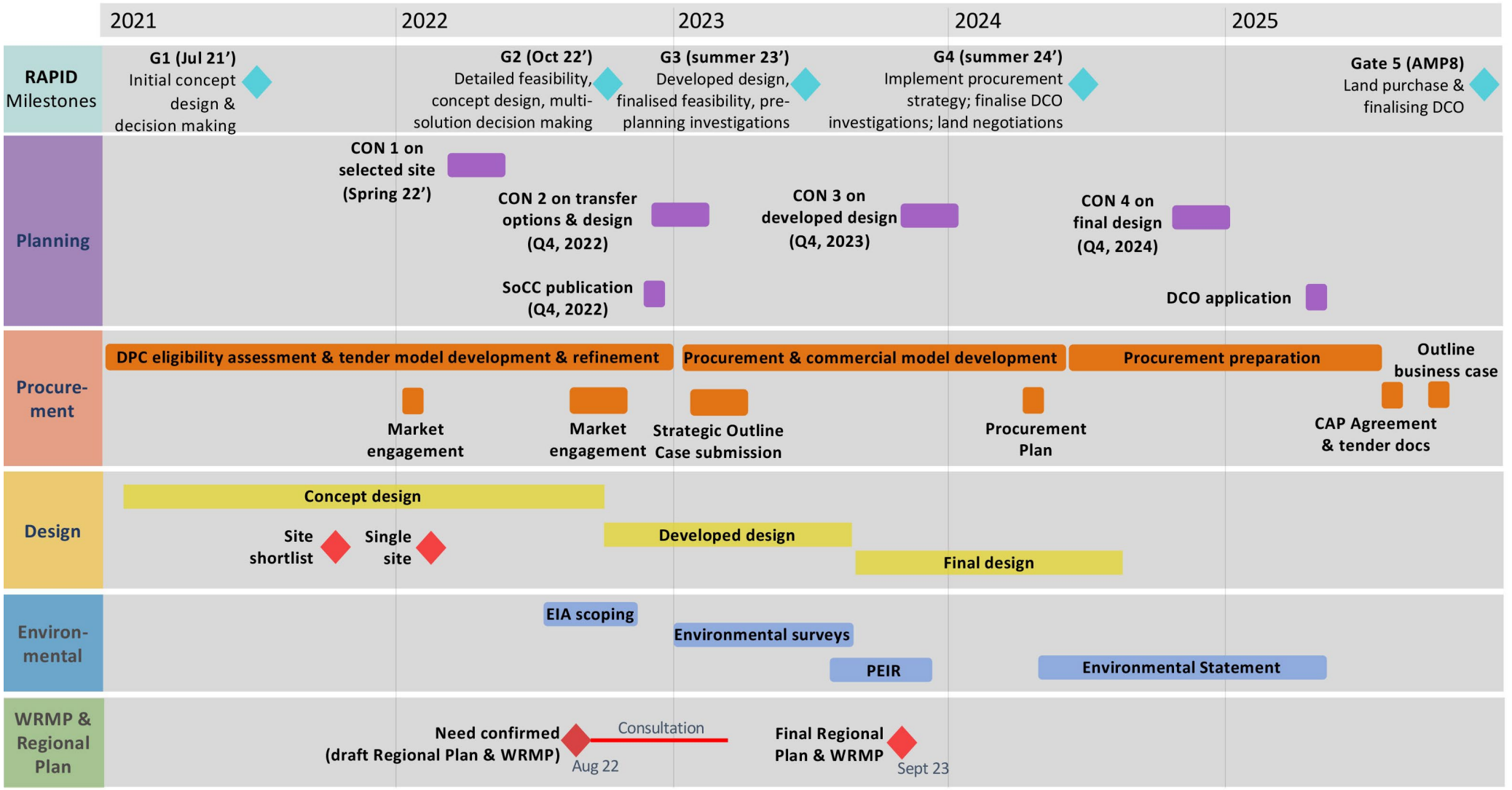
2 ACWG WQ Risk Framework Report – Final (Strategic WQ Risk Framework FINAL Report) | 19/01/21 | Jacobs

3. Outline project plan

This section sets out a clear project-level plan for the successful delivery of the A2AT scheme. Significant work has been undertaken to understand the requirements and interdependencies of the RAPID gates, the WRMP and regional planning process, and the planning and procurement strategies. A robust screening exercise has been carried out to evaluate all source options, concluding on the four preferred options as detailed in this report, and the initial concept designs produced for each of the options. Procurement experts have analysed options and confirmed initial feasibility of Direct Procurement for Customers (DPC) if delivered alongside the SLR or Fens Reservoir, and a planning advisor has produced an initial strategy for the planning process. This work has informed the project plan and will be further refined during the next stage of the RAPID process. Learning from the delivery of Anglian Water's strategic grid will also inform the overall strategy and delivery plan in the next stage.

The programme is currently on track and the plan presented provides a coherent approach to delivering the necessary outputs for each gate, with integration across the fundamental workstreams of planning, procurement, design and enabling, and construction.

Figure 2: Project-level plan corresponding to RAPID gateways



CAP = competitvely appointed provider; **CON** = public consultation; **DCO** = development consent order; **DPC** = direct procurement for customers; **EIA** = environmental impact assessment; **PEIR** = preliminary environmental information report; **SoCC** = statement of community consultation; **WRMP** = water resources management plan

3.1 Key activities and decisions

Figure 2 provides a summary of the key activities required to align the planning, procurement, design and enabling activities with both the RAPID gateways and the WRMP and regional planning programme.

- **Planning –** four public consultations (Con 1 – Con 4) are planned, with the first in spring 2022 to communicate the need for the preferred transfer option while gaining constructive feedback to inform the developed design and transfer routing. This comes before the need is confirmed in August 2022 but is necessary to ensure sufficient detail is developed prior to gate two. The anticipated DCO application is planned for spring 2025 but will be a focus throughout the programme to ensure the process is robust and well documented.

- **Procurement –** tender model development and refinement are the next key activities for procurement, with two phases of market engagement planned prior to gate two. The Strategic Outline Case will be submitted early 2023 once the concept design is agreed and the need understood, and the Competitively Appointed Provider agreement is planned for summer 2025.

- **Design –** once the preferred source option is confirmed following the output from the WRE regional simulator at the end of 2021, the design will be further developed before the route options defined. Further information is presented in Section 15, but the key milestone is to confirm the preferred source option early 2022 and the preferred route in summer 2022. This detail will be presented as part of the gate two submission.

- **Environmental –** a programme of ecology, flow and water quality monitoring is in progress to inform the gate two concept design. The Environmental Impact Assessment (EIA) scoping is planned to commence in autumn 2022, with environmental surveys following in 2023 to inform the final design process.

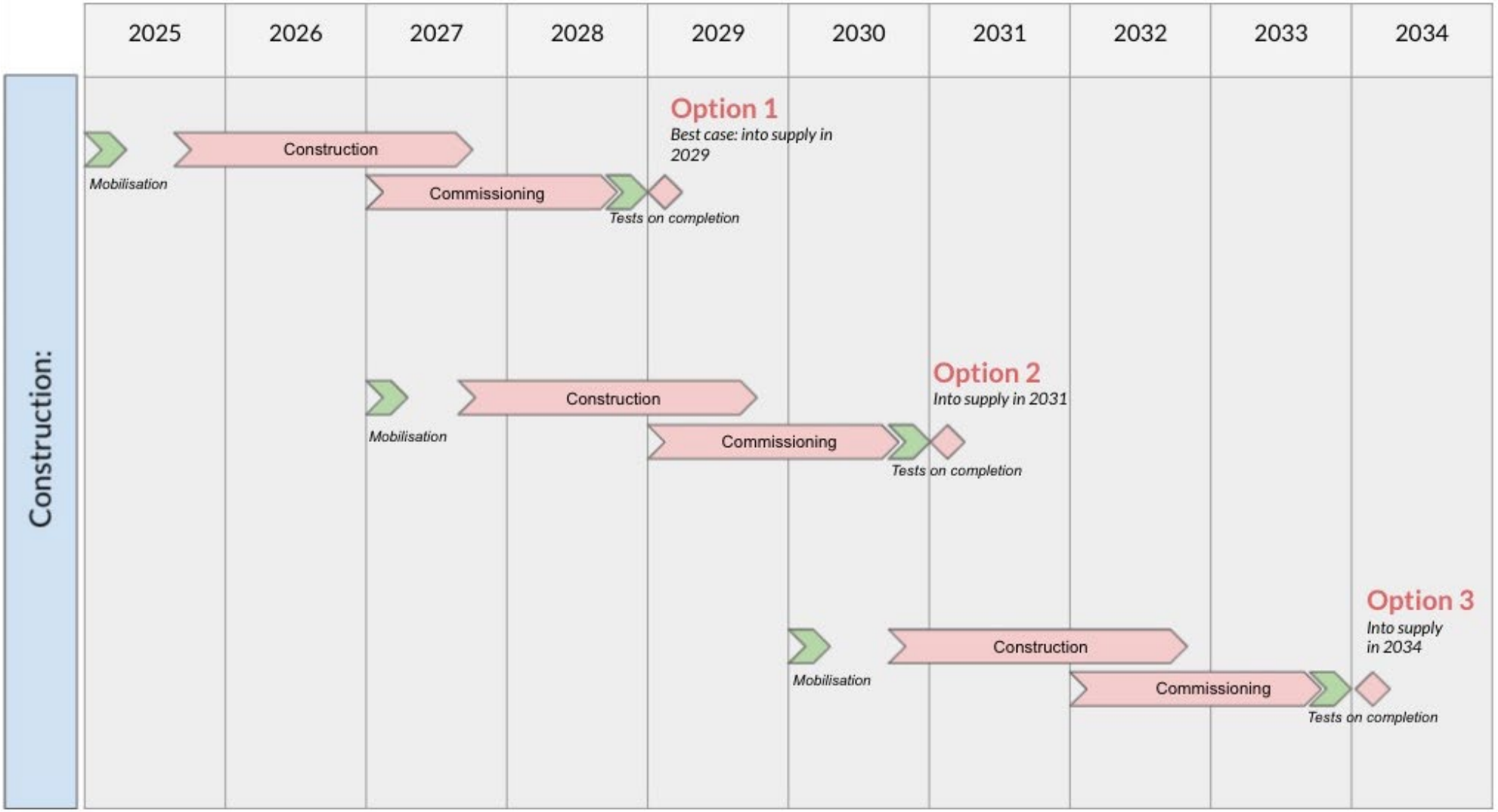
3.2 Construction programme

In line with RAPID aspirations, the programme provided in Figure 2 will enable a 'start on site' date in AMP8. Figure 3 presents a potential start date of 2025 and with an estimated site programme of just over four years, suggests that the earliest possible deployable output date is 2029, depending on the source. The draft regional plan and WRMP in August 2022 will confirm the need and dictate this programme. Other options are shown to represent what is possible.

3.3 Assumptions and dependencies

The programme assumes that the A2AT will be selected in the WRE regional plan and that the need is confirmed to necessitate starting on site in AMP8, thus remaining in the RAPID standard gated process. The programme is dependent on when the source of water will be available. If the SLR or Fens Reservoir are selected as the source, then the earliest deployable output for the transfer will align with the respective construction programmes, both of which currently suggest the earliest deployable output date of 2035.

Figure 3: Project-level plan showing indicative construction timescales



4. Technical information

This section sets out the technical information and preliminary feasibility assessment for the options considered for the A2AT up to gate one.

4.1 Initial configuration of options

The four A2AT options that have been developed for the preliminary feasibility assessment were identified from a longer unconstrained options list through a screening process that is aligned with the approach used by Affinity Water for WRMP24. These shortlisted options are described below.

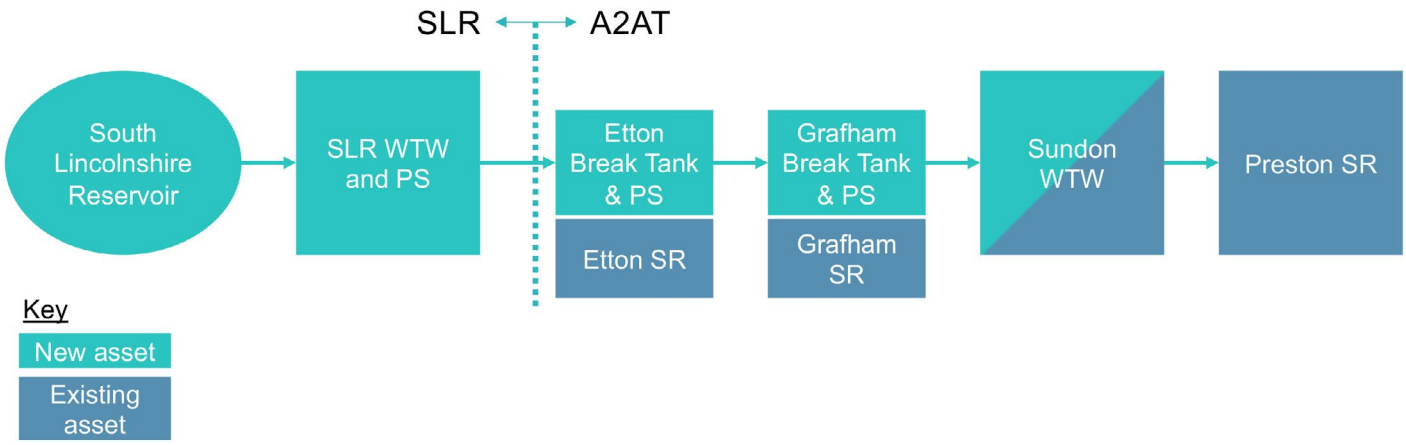
4.1.1 SLR to WRZ3

The SLR to WRZ3 option, which is shown schematically in Figure 4, interfaces with the SLR scheme at the Anglian Water service reservoir to the north of Peterborough. The SLR scheme aims to deliver up to 150Ml/d of chloraminated treated water to this site, a proportion of which would be for use by Anglian Water. It should be noted that the deployable output (DO) of the SLR could be higher than this, but at the moment the intention is that any 'upside' benefit would be taken by Anglian Water to manage WRE regional needs.

The A2AT scheme includes a break tank and pumping station at the site of the service reservoir to transfer water via a new pipeline to a new break tank at Grafham. There is an opportunity to divert water at this point into the Anglian Water network, and for this reason the transfer capacity has been sized at 50Ml/d greater than is required for onward transmission to Sundon. A new break tank would be provided at Grafham to allow the diversion, although this cross-connection is not within the scope of the A2AT scheme at present.

From the break tank at Grafham, a new pumping station would transfer water via a new pipeline to the existing Sundon site, where a new conditioning plant and break tank would be required. A further pumping station and pipeline would then transfer the conditioned water into the existing Affinity Water service reservoir at Preston in resource zone WRZ3. There is a current scheme to upgrade the service reservoir at Preston and no further allowance has been included in this option.

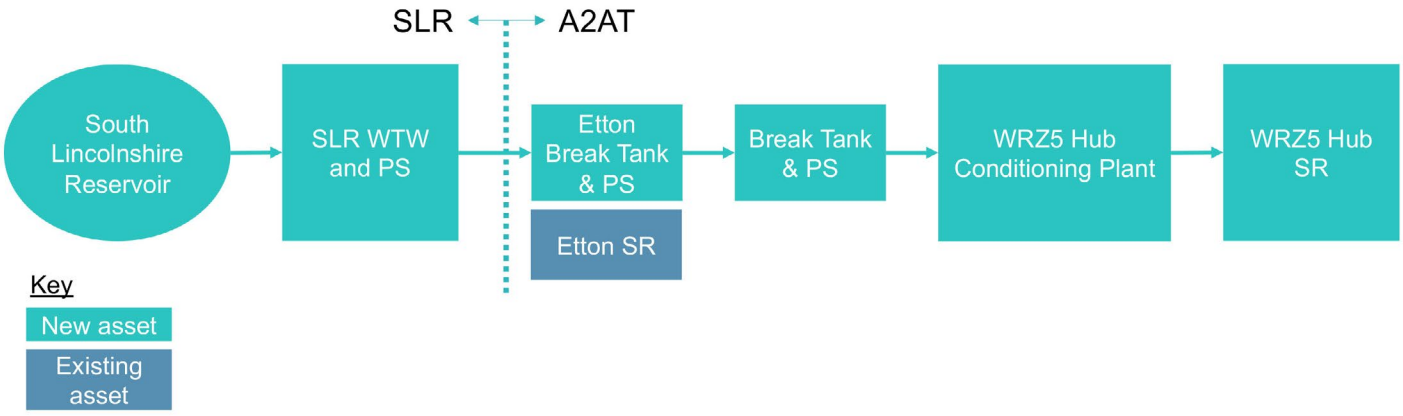
Figure 4: Schematic diagram of the SLR to Preston option



4.1.2 SLR to WRZ5

The SLR to WRZ5 option, which is shown schematically in Figure 5, also interfaces with the SLR scheme at the Anglian Water service reservoir to the north of Peterborough. However, in this case the new break tank and pumping station are designed to transfer the flow via a new pipeline to another new break tank and pumping station. From here, the water would be pumped via a new pipeline to a new conditioning plant and service reservoir in the Affinity Water resource zone WRZ5. This option does not currently include any diversion of water to the Anglian Water network between Peterborough and the WRZ5 Hub. However, there is an opportunity to amend this option to supply either Anglian Water or Cambridge Water from the intermediate break tank provided that the capacity of the upstream infrastructure is increased accordingly.

Figure 5: Schematic diagram of the SLR to WRZ5 option



4.1.3 Fens Reservoir to WRZ5

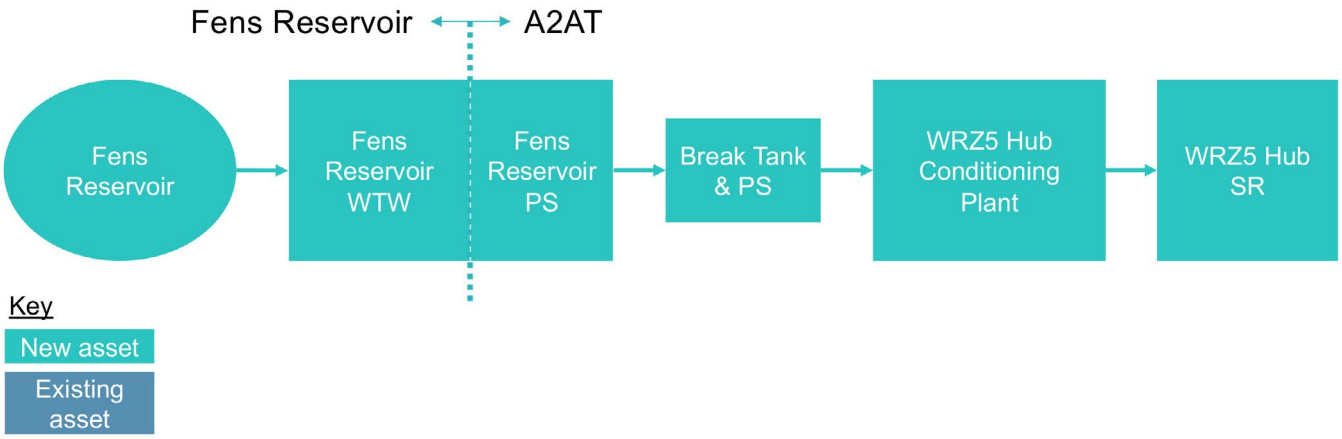
The Fens Reservoir is a new water storage reservoir currently being developed as a separate strategic option by Anglian Water and Cambridge Water, with the intention that a proportion of the supply feeds Cambridge. Depending on the output of the regional model, there is also the opportunity for this reservoir to supply the Affinity Region via the A2AT.

The Fens Reservoir to WRZ5 option, which is shown schematically in Figure 6, includes a new service reservoir and pumping station next to the proposed new raw water storage Fens Reservoir and WTW. The reservoir, associated draw-off arrangements and WTW form part of the separate strategic scheme and is outside the scope of the A2AT.

From the new Fens Reservoir WTW, chloraminated water would be transferred via a new pipeline to a new break tank and pumping station. As with the SLR to WRZ5 Hub option, water would be transferred from this intermediate pumping station to a new conditioning plant and service reservoir in the Affinity Water resource zone WRZ5. The allocated proportion of the water destined for Anglian Water would be diverted at the water treatment works. There is also the potential for a proportion of supply to be diverted to Cambridge Water if the need is confirmed in the regional simulator.

This option does not currently include any diversion of water to the Anglian Water network between the Fens Reservoir WTW and the WRZ5 Hub. However, there is an opportunity to amend this option to supply Anglian Water or Cambridge Water from the intermediate break tank provided that the capacity of the upstream infrastructure is increased accordingly.

Figure 6: Schematic diagram of the Fens Reservoir option



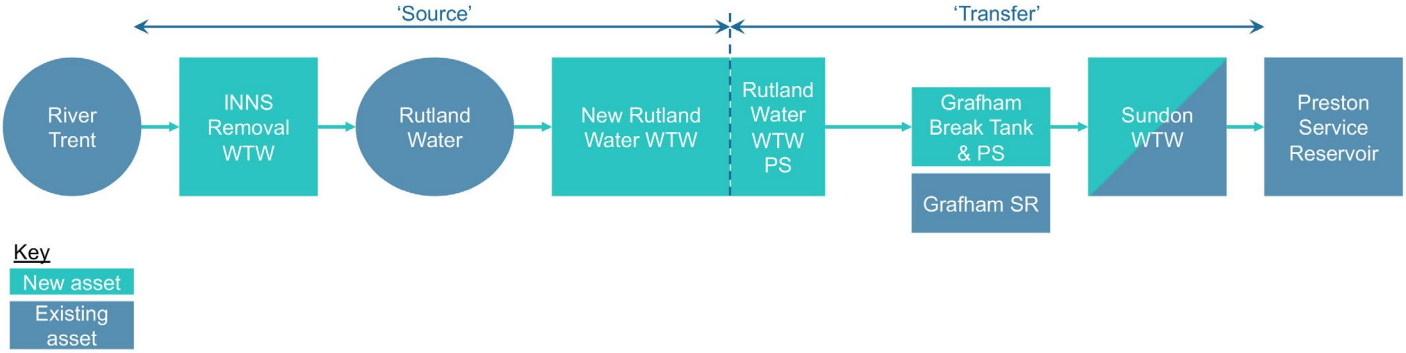
4.1.4 River Trent to Rutland Water to WRZ3

The River Trent to Rutland Water to WRZ3 option is shown schematically in Figure 7. For this option, raw water would be abstracted from the River Trent, in the vicinity of East Bridgford, where it would be partially treated at the abstraction point to mitigate the risk of transferring invasive non-native species (INNS) between catchments. The partially treated water would be transferred via pipeline to Rutland Water. The treatment, pumping station and new pipeline capacity has been sized to be three times the size of the A2AT delivery capacity on the premise that water would be abstracted for storage over a period of only four months per year based on the availability of water in the River Trent for abstraction (this assumption will be reviewed as the scheme develops). The modelling has assumed that the transfer from the River Trent will be used to refill Rutland Water whenever it is below the target refill curve and current intakes from the River Nene and River Welland are not enough to fill it up, and transferring to Affinity Water when the reservoir is above drought curves.

A new draw-off arrangement would be required at Rutland Water feeding a new water treatment works, service reservoir and pumping station to transfer chloraminated water via a new pipeline as far as Grafham. A new break tank would be provided at Grafham, providing an opportunity for water to be diverted to the Anglian Water supply system, although this cross-connection is not within the scope of the A2AT scheme at present.

From the break tank at Grafham, a new pumping station would transfer water via a new pipeline to the existing Sundon site, where a new conditioning plant and break tank would be required. A further pumping station and pipeline would then transfer the conditioned water to the existing Affinity Water service reservoir at Preston in resource zone WRZ3. As with the SLR option, there has been no additional allowance for an upgrade to the service reservoir as there is already a scheme in place.

Figure 7: Schematic diagram of the River Trent option



4.2 Initial costing and estimating report

To ensure consistency in costing, the ACWG guidance[3] has been followed and relevant templates have been used. Recent WRMP guidelines and HM Treasury Green book guidance[4] have both been followed for the valuation of greenhouse gasses. The overall estimate of carbon emissions has taken on best practice, using PAS2080 accredited carbon data and tools. The assessments have also taken into account ACWG guidance on consistency of data sources and scope boundaries.

4.2.1 Approach to costing and data used

The approach to costing has been driven by the best available data for the concept designs based on their level of development. Where possible, existing costing systems have been used, which have gone through significant assurance and are considered the most representative costs available. Where this has not been possible, due to the size or type of assets being delivered not being covered by existing cost data, unit rates have been used that represent industry norms and have been validated through benchmarking industry data. Costing reflects the early stages of design development for each of the concept designs. Costs have been developed based on the design scope for each concept as they stand at gate one, with the intention that further, more refined costing will be provided following further scheme definition.

3 *Mott MacDonald (2020), Cost Consistency Methodology, Technical Note and Methodology*
4 *Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)*

4.2.2 Communicating and accounting for uncertainty, risk and Optimism Bias (OB)

Considering the early stage of scheme development at gate one, it is important that the major areas of uncertainty are identified, estimated and communicated clearly and transparently for stakeholders to understand. In particular, the communication of principal risk can enable a clear focus on activities that will allow the largest reduction in uncertainty during future phases of scheme development and progression through the later gates. In this way, the principal methods for this communication include the following:

- **Risk register.** A project risk register has been developed and is summarised in Section 9. The risk register has been used to inform the OB assessment to ensure that sufficient allowance has been made for uncertainty in project costs. The risk register will be developed with risks quantified and used to monitor and manage ongoing cost risk as the scheme develops.

- **Optimism Bias (OB):** OB is the tendency to be over optimistic about large infrastructure projects, resulting in the underestimation of project costs, as well as other project parameters such as duration. To account for this, a percentage uplift can be applied to the calculated scheme costs. In this case, the ACWG OB template[5] has been used to estimate the OB at the current stage in design and reflect project cost uncertainty appropriately. The ACWG guidance requires 22 confidence statements to be assessed and scored. The template also requires a split in inputs between 'Standard Civil Engineering' and 'Non-Standard Engineering' depending on the perceived complexity of the infrastructure. The pipeline and WTW elements have been classified as 'Standard' with an OB allowance of 31.2%.

The OB for each of the elements was calculated separately and combined to form an overall OB allowance for each concept design. In the initial stages of project development, there is typically more uncertainty surrounding the project and confidence in the costs is lower. As such, the impact of OB reduces with project development. As the development of the schemes progress and the associated uncertainty decreases, the inputs to the ACWG OB template will be reviewed, and the applied uplift will be reduced accordingly. It is likely that some of the current scoring will be updated based on project-specific circumstances. The OB has been reviewed against the project risk register to avoid double counting of risk.

4.2.3 Capital costs

Capital costs (Capex) have been calculated for the transfer options using the Affinity Water standard LRMC unit costing approach, which incorporate the company's cost curves derived from historic data. For bespoke items not covered by these cost curves, engineering estimates have been made based on experience of implementing similar projects.

The Capex values for the A2AT options range from £447m to £532m for the 100 Ml/d option, to between £317m and £391m for the 50 Ml/d option. Optimism bias has been applied to the Capex estimates in accordance with the ACWG guidance on cost consistency.

It should be noted that these costs are not directly comparable with each other, as some of the options include additional costs associated with raw water sources (SLR or Fens Reservoir), whereas the River Trent transfer includes the source costs. The Average Incremental Cost (AIC) analysis provided in Section 4.3 provides an initial comparison between "whole solutions" by taking into account the costs associated with the SLR and Fens Reservoirs.

There are components within the A2AT options that have been previously costed in the Affinity Water WRMP19. These components were used to benchmark the costs and the comparison shows that the A2AT estimates are higher for the two conveyance components but lower for the two conditioning works components than the estimates in the WRMP19 programme. The conveyance component can be attributed to the selection of a larger diameter pipeline for A2AT resulting in a lower whole-life cost. Development of the design for the conditioning plant has realised significant efficiencies by using the existing service reservoir in the design.

4.2.4 Operational costs

The operational costs (Opex) for the transfer options have been calculated based on the power consumption and maintenance costs of any mechanical scoped elements, such as pumping stations and intakes. For the River Trent 'source' option they also allow for chemical consumption at the INNS and potable WTWs. For the transfer options, the Opex includes chemical consumption at the conditioning plant.

4.2.5 Capital replacement costs

An allowance has been made for capital replacement costs based on the recommendations by the ACWG on asset life for water resources planning and are summarised in Table 1. Asset capital replacement costs were calculated after an estimated capital construction period of 10 years. This will need further refinement once a specific capital delivery profile is developed.

5 *Mott MacDonald (2020), Cost Consistency Methodology, Technical Note and Methodology*

Table 1: Asset life

Asset type	Asset life (years)
ICA (Instrumentation, Control and Automation)	**10**
Plant and machinery	**15**
Power Supply	**25**
M&E (Mechanical and Electrical) works on pumping stations and treatment works	**20**
Reinforced concrete tanks / service reservoirs	**80**
Pipelines	**100**
Landscaping/environmental works	**30**

4.2.6 Embodied and operational carbon emissions

In addition to the assessment of cost, carbon assessments have been developed for each of the transfer options. Due to the current level of development for gate one, there is still significant uncertainty embedded into the proposed values, and the aim will be to reduce this uncertainty as much as possible as the scheme develops further. An assessment of the opportunities to reduce carbon to meet net-zero commitments are presented in Section 5.8.

The carbon assessment was undertaken in accordance with the ACWG methodology. Embedded carbon emissions have been estimated using existing carbon data from Anglian Water's carbon calculator. The carbon calculations have followed best practice from the CESMM4 Carbon & Price Book[6]. Operational carbon emissions, excluding emissions related to power consumption, have been estimated using the LRMC tool, based on the estimated volumes of chemicals and sludge disposal. Carbon factors were taken from the annual UKWIR carbon accounting workbook (v14)[7]. Emissions relating to power consumption have been calculated separately to enable the WRE regional model to apply incremental changes in carbon cost of power generation over time.

The embodied and operational carbon associated with each of the options is presented in Table 2 and 3.

Table 2: Carbon footprint of 50 Ml/d options

Option	Embodied carbon (tCO2e)	Operational carbon (tCO2e/ year)
River Trent 'source'	87,526	3,745
River Trent 'transfer'	73,879	6,654
SLR to Preston	71,580	6,849
SLR to WRZ5 Hub	71,626	5,688
Fens Reservoir	44,758	4,675

Table 3: Carbon footprint of 70Ml/d and 100Ml/d options

Option	Embodied carbon (tCO2e)	Operational carbon (tCO2e/ year)
River Trent 'source'	146,353	7,286
River Trent 'transfer'	173,501	13,349
SLR to Preston	167,902	15,862
SLR to WRZ5 Hub	156,633	13,177
Fens Reservoir (70Ml/d)	55,169	6,769

The embedded carbon footprint is the lowest for the Fens Reservoir option and the greatest for the River Trent option. Operational carbon footprint, which will be more significant than embedded carbon over time, is also lowest for the Fens Reservoir option, with a greater footprint for the River Trent option.

6 CESMM4: Carbon & Price Book 2013; Mott MacDonald & BRE; ICE Publishing
7 Workbook for Operating Operation GHG Emissions – Version 14; UKWIR (08/12/20)

4.3 Whole life costs and NPV

The present value (PV) has been calculated using the standard Treasury Green book discount rate which starts at 3.5% and drops to 3% and 2.5% after 30 and 60 years respectively. Capital and operational carbon emissions have also been monetised using the Treasury Green book traded and non-traded price of carbon. PV costs have all been calculated over 100 years and assume a 10-year construction period before operating costs and carbon start.

The estimation of AIC for the options is complex, as the River Trent option includes source water whereas the SLR and Fens Reservoir costs are included in a separate SRO. To provide a meaningful comparison, it is therefore necessary to include a proportional allowance of those SRO costs and add them to the cost of the transfer. This proportional allocation is complex, as the effective DO of the reservoir schemes increases when the conjunctive use between Affinity Water and Anglian Water is considered. To generate a meaningful 'Whole Solution' cost, the following assumptions have been made:

- The WAFU benefit for all options is equal to the DO provided to Affinity by the schemes (i.e. 50 Ml/d, 70 Ml/d or 100 Ml/d).
- For the SLR and Fens Reservoir options, a proportion of the Capex and Opex for those SLRs has been assigned to AFW. The proportion is equal to the share of DO that is provided to AFW. This is considered an upper bound to the proportion that Affinity Water would pay as it does not take into account the conjunctive use increase in benefit that arises from the reservoir schemes serving more than one water company. The lower bound that Affinity Water would pay would be based on the reduction in DO to Anglian Water, compared to a scheme which served their needs only. It is estimated that this would result in an overall reduction of NPV to Affinity Water of less than 3%.
- For the A2AT assets that are not shared, all of the Capex and Opex has been assigned to AFW.

Table 4 and Table 5 provide the NPV and AIC for Affinity Water based on the above proportional allocation of the source schemes, as described above

As there have been no commercial negotiations between the partner water companies at this stage, the AIC has been calculated based on the above approach. The actual mechanism for sharing costs will be more complex than this simplified assumption.

Table 4: 'Whole solution' estimate of NPV and AIC for Affinity Water only for 100Ml/d and 70Ml/d options (full utilisation)

Option name	Units	River Trent option (source + transfer)	SLR to Preston option	SLR to WRZ5 hub option	Fens Reservoir to WRZ5 hub option
Option benefit to Affinity Water – additional resources or demand saved (based on full implementation)	Ml/d	100	100	100	70
Total planning period option benefit (NPV)	Ml	697,870	697,870	697,870	488,509
Total planning period indicative capital cost of option (Capex NPV)	£000	951,713	941,842	860,629	757,181
Total planning period indicative operating cost of option (Opex NPV)	£000	223,855	287,663	261,990	207,238
Total planning period indicative option cost (NPV)	£000	1,175,568	1,229,505	1,122,620	964,419
Average Incremental Cost (AIC) to Affinity Water	p/m3	168	176	161	197

Table 5: 'Whole solution' estimate of NPV and AIC for Affinity Water only 50Ml/d options (full utilisation)

Option name	Units	River Trent option (source + transfer)	SLR to Preston option	SLR to WRZ5 hub option	Fens Reservoir to WRZ5 hub option
Option benefit to Affinity Water – additional resources or demand saved (based on full implementation)	Ml/d	50	50	50	50
Total planning period option benefit (NPV)	Ml	348,935	348,935	348,935	348,935
Total planning period indicative capital cost of option (Capex NPV)	£000	667,486	529,914	496,903	580,587
Total planning period indicative operating cost of option (Opex NPV)	£000	111,017	137,919	125,605	147,042
Total planning period indicative option cost (NPV)	£000	778,503	667,832	622,508	727,629
Average Incremental Cost (AIC) to Affinity Water	p/m3	223	191	178	209

4.4 Data provided to the regional groups

WRE has built a regional system simulator (RSS) to support best-value decision making. To support this assessment in advance of completion of the regional modelling, a sub-regional model focusing on the Anglian Water Ruthamford system has been developed. Apart from PWS needs, the RSS incorporates the demand for agriculture and the industry, as well as the environmental requirements defined by the Environmental Flow Indicator. A multi-criteria optimisation will define the preferred regional portfolio of supply and demand options to fulfil the needs of all sectors and will include the A2AT options.

In order to ensure consistency between the WRE RSS and the DO assessment conducted for the SLR, FR and A2AT schemes, the updated hydrology assessments completed as part of this work for the Witham, Trent, Black Sluice, Welland, Nene and Ouse catchments have been shared, as well as the proposed abstraction licence arrangement for potential new intakes. In the WRE RSS, the conveyance capacity of the A2AT is not fixed, allowing the optimisation to select the optimum size considering the wider regional needs and options. However, the configurations to be tested have been defined based on the concept designs presented in this gate one submission.

4.5 Initial water resource benefit assessment

The four transfer options have been added to the WRE RSS sub-regional model for the Ruthamford system. The use of the WRE RSS has enabled testing of a wider set of climate conditions given its quick runtime. Potential extreme droughts (e.g. 1 in 500 years) have been derived using a weather generator conditioned by climate drivers that represent key aspects of the climate system. Stochastic rainfall and potential evapotranspiration series have also been perturbed to represent conditions in the 2050s using the latest UKCP18 spatially coherent projections. For this stage of assessment, only one medium-range climate change scenario has been adopted corresponding to the high-emissions pathway.

The transfer to Affinity Water has been incorporated as a time series of deficit calculated within the Affinity Water's portion of the WRSE regional system simulator for two levels of maximum demand (50 Ml/d and 100Ml/d). The Scottish method for establishing DO has been implemented, where the system is simulated for the whole set of climate change perturbed stochastics for different values of demand and number of years with a failure (when rota cuts are required) recorded. The DO is then estimated as the maximum demand that can be satisfied without failing more than 1 in every 500 years. An adjustment was made to the values estimated in this way to reflect the more extreme hydrology in the River Trent in the historical period before and after the stochastic one in anticipation of revised climate datasets that will be incorporated in subsequent appraisals for gate two.

The DO estimates for the transfer options are shown in Table 6. The estimates confirm that the SLR and River Trent options would be able to satisfy up to 100Ml/d of Affinity Water demand and also contribute to an increase in DO to Anglian Water, which would be significant in the case of the SLR given the additional storage it could provide and the availability of water in the Witham. The Fens Reservoir could also deliver 70Ml/d to Affinity and add to Anglian Water DO.

Table 6: Deployable output for the transfer options

Source	Estimated DO (Ml/d)
SLR fed from Witham / Trent – piped	**229**
SLR fed from Witham / Trent / South Forty Foot Drain - open	**193**
River Trent option 100Ml/d (300Ml/d transfer capacity from River Trent to Rutland Water)	**142**
River Trent option 50Ml/d (150Ml/d transfer capacity from River Trent to Rutland Water)	**103**
Fens Reservoir	**132**

The concept design for the River Trent option was based on the assumption that the transfer capacity from the River Trent to Rutland Water would need to be three times the amount delivered from Rutland into supply (see Section 4.1.4). The DO analysis shows that this assumption is conservative and has confirmed that a transfer capacity of 150Ml/d is sufficient to support a DO of 103Ml/d, enough to provide for the A2AT 100Ml/d alternative. It is also probable that a transfer capacity of 75Ml/d would be just sufficient to support the 50Ml/d alternative. This would have a significant impact on Capex, Opex and embedded and operational carbon and will need to be investigated further if the River Trent option is carried forward to gate two.

4.6 Wider benefits

As this is a pipeline transfer scheme, opportunities for wider benefits directly associated with the delivery of the new infrastructure are more limited, and mainly concentrate on enhanced mitigation of the pipeline impacts. While the A2AT transfer options have been developed with the aim of avoiding impacts on people, there is the potential that even with mitigation, there may be temporary disruption for communities with all options. The following programmes and initiatives could be considered as part of the scheme to deliver public value:

- Pipeline routes further refined and re-routed to avoid intercepting designated sites and sensitive community facilities.
- Opportunities for compensatory habitat creation or habitat reinstatement should be explored, as well as opportunities to improve the existing habitats and provide offsetting planting of trees.
- Opportunities for reinstating land to achieve potential positive community effects should also be explored; for example, by improving access to recreational and open space and improving access to community resources.

The environmental assessments and studies have confirmed that positive benefits would result from operation of the scheme through improving water transfer, water resource management and resilience of water supply against future drought scenarios. In the broader context of the WRMP and WRE regional planning process, the scheme will result in enhanced environmental outcomes through the ability to reduce impact on chalk streams in the Affinity Water supply area. The wider benefits of the A2AT should also be considered within the context of the associated upstream resource; for example, both Fens and the SLR aim to incorporate significant wider benefits for the region.

5.Environmental and drinking water quality considerations

This section summarises the initial environmental and drinking water quality risk assessments that have been completed for the A2AT solution.

5.1 Environmental assessment overview

An Environmental Assessment Report (EAR) has been undertaken on the four A2AT transfer options. The EAR was undertaken in-line with the methodology in the ACWG environmental assessment guidance[8] and will align to the regional Integrated Environmental Assessment approach that will be completed by WRE.

Three accompanying regulatory assessments have also been completed: Habitats Regulations Assessment (HRA), Water Framework Directive (WFD) Assessment, and Strategic Environmental Assessment (SEA). The regulatory assessments are summarised in the following sections.

In addition, the risk of spreading INNS associated with the options has been investigated; Biodiversity Net Gain (BNG) and Natural Capital (NC) assessments have been undertaken; the wider benefits of SLR have been reviewed; and opportunities for the A2AT options to contribute to net-zero carbon emission objectives have been investigated. These studies are summarised in the following sections and the full assessments are provided in the EAR.

5.2 Habitats Regulations Assessment (HRA)

The HRA Test of Likely Significance (ToLS) was completed at plan level for the four transfer options to assess the potential impacts on Natura 2000 sites. The HRA identified potential 'likely significant effects' for the River Trent and SLR to WRZ5 options, and a number of uncertain effects for each of the options.

The results from the Appropriate Assessments undertaken for each option are as follows:

- For the SLR to WRZ3 option a transmission pathway to the Ouse Washes Special Protection area (SPA)/Ramsar site/Special area of Conservation (SAC) has been identified where the pipeline is required to cross the River Great Ouse, but concluded that no significant adverse effects on the integrity of the Habitats Site are foreseeable if mitigation measures are observed.

- For the SLR to WRZ5 option, significant adverse effects on the Nene Washes SPA/Ramsar site /SAC have been identified that cannot be fully resolved at this stage. Options to re-route the pipeline corridor to avoid the Nene Washes will be explored as the option develops. If this is not possible, further investigation of the impacts through a detailed project-stage HRA, informed by baseline surveys, and further hydrological and noise assessments will be required.

- For the Fens Reservoir option, no transmission pathways by which a likely significant effect could reasonably occur and no key risks to Habitats Sites were identified during construction or operation.

- For the River Trent option, significant adverse effects have been identified on the Humber Estuary Ramsar site/SAC and Rutland Water SPA/Ramsar site that cannot be resolved at this stage. A project-stage HRA will be required to address these impacts fully.

Should any adverse effects on the integrity of the designated sites remain as the scheme options develop, then a derogation would be required. Derogation would only be granted if the proposal passes three legal tests: where there are no feasible alternative solutions that would be less damaging or avoid damage to the site, where the proposal needs to be carried out for imperative reasons of overriding public interest, and where the necessary compensatory measures can be secured. This will need to be considered as the scheme options develop.

It should be noted that at this stage an in-combination assessment to identify potential cumulative effects of A2AT with other non-related plans or projects has not been conducted and is planned for gate two.

5.3 Water Framework Directive (WFD) assessment

The WFD assessment provides information on the WFD screening (Level 1 – basic screening) and further assessment (Level 2 – detailed impact screening), where appropriate, for all A2AT options.

The Level 1 WFD assessment indicated that the SLR and Fens Reservoir options are anticipated to have very low risks of being non-compliant with WFD objectives and do not require further assessment.

A Level 2 WFD assessment was required for the River Trent option, which indicates that there are potentially precautionary WFD compliance risks associated primarily with the operation of additional/new abstractions on two waterbodies: Rutland Water (GB30536479) and Trent from Soar to The Beck (GB104028053110). The potential effects could conflict with achieving WFD status objectives. This is particularly the case where physical modifications or water quality are an existing limiting factor, recorded in WFD baseline data as a 'reason for not achieving good'. The potential biological effects, particularly on physico-chemical changes (for example, reduced dilution) would require further assessment. For new intakes, the concept design recognises that appropriate fish and eel screening would be required to prevent entrainment. At this stage of the scheme development, this has been considered as likely mitigation, but moderate/amber risks have been maintained until option designs and assessments are further progressed.

8 *ACWG WRMP environmental assessment guidance and applicability with SROs (Mott MacDonald, 2020)*

5.4 Strategic Environmental Assessment (SEA)

For each option, a Stage 1 assessment of the potential impact of construction and operation on each SEA criteria was completed. Stage 2 involved additional assessment of the options, considering local-level data.

The output of the Stage 1 assessment for residual effects (post mitigation) is that the options are rated the same across the SEA objectives, with the following exceptions:

- Biodiversity: the construction of both the Fens Reservoir pipeline and SLR to WRZ3 options would result in moderate negative residual effects. The Fens Reservoir pipeline would directly intersect Devil's Dyke Site of Special Scientific Interest (SSSI) and numerous SSSIs are found within 500m of the proposed option: Newmarket Heath, Balsham Wood, Nunn Wood, Hales and Shadwell Woods and Debden Reservoir. Other designated sites are present within 2km of the option that may be indirectly affected by the option. Several areas of priority habitat would be intersected by the pipeline route, resulting in direct loss of habitat and disturbance to other habitats and protected species in proximity to priority habitat, while the construction of the SLR to WRZ5 and River Trent options would result in major negative residual effects on biodiversity. The option would directly intersect the Nene Washes Ramsar/SSSI/SPA/SAC. The option would be located within 500m of Debden Water and Bassenhally Pit SSSIs, and Lattersey Field, Mare Fen and Eye Green local nature reserves. There are other designated sites within 500m and 2,000m from the option that could be indirectly affected. Several areas of priority habitat would be intersected by the pipeline route resulting in direct loss of habitat and disturbance to other habitats and protected species in proximity. To minimise disturbance effects and habitat loss, best-practice methods should be implemented, such as refining the pipeline alignment and using trenchless techniques. However, following mitigation measures, the residual effects on biodiversity would likely remain major negative for construction and moderate negative for operation. It is recommended that the outputs of future ecology surveys feed into the design development.

- The operation of the SLR and River Trent options would result in moderate negative residual effects. During operation, abstraction could deplete water resources within the River Trent affecting aquatic communities further downstream, which would result in moderate negative effects on biodiversity while the operation of the Fens Reservoir option would not impact on biodiversity.

- Water: while all options would result in minor negative residual effects on resilience and flood risk during construction, only the Fens Reservoir option would result in minor negative residual effects during operation. Regarding the impact of the options on water quality and water resources, the River Trent option is the only option that would likely result in negative residual effects (moderate negative effects during construction and neutral effects during operation). None of the other options would have an adverse effect on water resources.

- Climatic Factors: while the construction of all options would result in minor negative residual effects on carbon emissions, the operation of the Fens Reservoir and SLR options would result in moderate negative residual effects on carbon emissions while the operation of the River Trent option would result in major negative residual effects. Regarding the vulnerability to climate change risks, there are no residual effects expected from any of the options during construction. However, the operation of the SLR to WRZ5 and River Trent options would result in minor negative residual effects while the Fens Reservoir and SLR to WRZ3 options would not impact on the vulnerability to climate change.

- Landscape: the construction of all options would result in minor negative residual effects on the landscape and visual amenity. The operation of the SLR and River Trent options would result in minor negative residual effects as the section of pipeline near Sundon and the Sundon WTW would be located within the London Area Green Belt and within the Chilterns Area of Outstanding Natural Beauty, while the operation of the Fens Reservoir option would not impact on landscape and visual amenity.

Additional assessment considering local-level data has been undertaken in-line with the methodology in the ACWG guidance. The local-level data findings show that all options intersect or lie within 200m of a number of locally important wildlife sites (including Local Wildlife Sites, Sites of Importance for Nature Conservation, Sites of Nature Conservation Importance and County Wildlife Sites (CWS) and Tree Preservation Orders). Three of the four options are within 200m of Conservation Areas. However, mitigation can be put in place to reduce the potential effects on these areas.

The SEA Stage 1 findings and additional assessment show potential residual impact for all options, with the Fens Reservoir option performing slightly better and the River Trent option performing worse.

Given the wide range of other options that might be developed across the WRE and WRSE regions in combination with these options, at this stage the SEA cannot reasonably include an in-combination assessment with other SROs, water company capital investments or third-party development plans or projects. The SEA will be reviewed as the scheme develops to include potential in-combination effects. In-combination assessment will be carried out as part of the WRE Integrated Environmental Assessment to ensure that a holistic and consistent view is applied across all the options selected for further consideration by the WRE regional plan.

5.5 Invasive Non-Native Species (INNS) risk assessment

An initial INNS risk assessment was undertaken to screen the risk associated with the A2AT raw water transfer component of the River Trent option, as it was the only section that involves the transfer of raw water. The assessment compared the River Trent option against relevant EA guidance and other key legislation.

The high-level INNS assessment of the River Trent option concluded that:

- Source and receptor locations have existing man-made connections to other catchments via Canal and River Trust canals. The development of the transfer would not introduce a new connection between previously isolated catchments. Nevertheless, this outcome necessitates an INNS risk assessment, which the EA will use to decide whether subsequent mitigation is required to ensure the risk of INNS transfer is not significantly increased.

- The source waters contain eight species that are listed in at least one key piece of INNS legislation. Therefore, this option presents a legal risk with regards to their transfer to other waterbodies, which will need to be addressed through mitigation measures.

- No threat of re-classification of High Status WFD waterbodies due to the spread of United Kingdom Technical Advisory Group (UKTAG) High Impact species was identified.

- High-level screening against INNS invasion heatmaps suggest a low risk of marine INNS invasion in the source waters and a medium risk of invasion by freshwater Ponto-Caspian INNS in both source and receptor waters.

- The risk scores generated by the risk assessment tool indicate that there is a significant INNS risk associated with raw water transfer between the River Trent and Rutland Water.

The above conclusions confirm the requirement for partial treatment at the River Trent abstraction point to mitigate the risk of transferring INNS between catchments.

A similar INNS risk assessment for the other potential sources of the A2AT (SLR and Fens Reservoir) has been undertaken and is reported separately in the submissions for those schemes.

5.6 Biodiversity Net Gain (BNG) and Natural Capital (NC) assessments

High-level BNG and NC assessments were undertaken on the preliminary pipeline routes and indicative locations for the treatment works for all options. For each option, an assessment of the potential impact of construction and operation of the option on each NC stock was undertaken using the BNG metric. The NC metrics were then quantified as ecosystem services to provide monetised values for NC benefit or loss. The assessments identified the following:

- NC: all options would likely cause temporary loss of arable farmland NC stocks. However, compensation/reinstatement of arable farmland would likely result in no significant change after construction.

- BNG: all options would likely result in a loss of BNG habitat units due to the removal of habitats during construction. However, there is potential to offset this loss with the generation of new high-value habitats post construction, notably with the reservoir options.

- Ecosystem services: the pipelines for all options would likely generate the loss of NC stocks associated with the provision of several ecosystem services. Major construction impacts include the release of CO2, loss of flood regulation and loss of provision of food production due to habitat clearance. Construction would not be likely to affect the future value as stocks would be reinstated. However, the permanent loss of arable land would have a permanent impact on the provision of food provision. All the options present opportunities to improve the existing habitats along the pipeline route through post-construction remediation and replacement of low-value habitats with higher-value habitats. All options cross several Natural England habitats and Network Enhancement Zones and are therefore suitable for planting.

The conclusion of the assessments is that the best option overall in terms of BNG and NC would be SLR to WRZ3, while the least preferable option would be the River Trent.

5.7 Benefits assessment

The opportunities identified in the NC assessment have the potential to contribute to Government ambitions for environmental net gain. This could take the form of habitat compensation, creation and/or species relocation schemes. Any schemes would need to be taken forward based on a comprehensive understanding of the interaction between natural systems and social uses of land. Specific opportunities have not been developed for each option ahead of gate one, but will be considered in future project development stages as the configuration and timing of regional option choices is confirmed.

The wider social benefits of A2AT have been reviewed, considering the context of the benefits provided to society by water resource planning, including the benefits to, and views of, customers. While the A2AT options have been developed with the aim of avoiding impacts on people, for all options there is the potential that, even with mitigation, there may be temporary disruption for communities.

5.8 Assessment of opportunities for net-zero carbon contributions

A key part of delivering an efficient net-zero strategy is to focus efforts on where the largest and most efficient reductions can be made. As a starting point, it would be important to develop an understanding of the major carbon contributors from a capital and operational perspective for the scheme to help focus efforts on areas with the greatest reduction potential.

A more granular baseline will be analysed as the scheme progresses to provide a more detailed understanding of specific carbon emission sources for the scheme.

5.8.1 Capital carbon reduction opportunities

The capital carbon of the options is largely due to the embodied carbon in the transfer pipelines. While embodied carbon could be reduced by using polyethylene pipes instead of ductile iron or steel, it is not practical to do so with the large diameter pipelines (>800mm) required for this scheme. We will work with potential suppliers to identify products with low capital carbon values. The key to minimising capital carbon will be to ensure an optimised route, thus reducing material requirements, identifying the most carbon efficient construction techniques and working with construction partners to consider low or zero carbon construction plant – an opportunity which may be available as electrical and hydrogen technology matures.

5.8.2 Operations carbon reduction opportunities

The operational carbon footprint will be predominantly made up of CO2 emissions relating to generation of the electricity required to run the works and the pumping stations. A lesser proportion will relate to the production of chemicals used at the treatment works. To mitigate this, the scheme could look to generate all or a proportion of the power requirements through renewables onsite. Alternatively, the scheme could look for commercial arrangements to procure green power through a direct wire Power Purchase Agreement (PPA).

5.9 Initial drinking water quality considerations and risk assessments

5.9.1 Water Quality Risk Assessment

A Water Quality Risk Assessment (WQRA) was carried out for the A2AT solution in conjunction with the related SLR solution. The purpose of the WQRA at this stage of the scheme development is to provide a high-level review of the risks to drinking water quality associated with each concept design option. The WQRAs were carried out based on guidance developed for the ACWG[9].

The process included workshop sessions attended by representatives from the water quality teams from both Anglian Water and Affinity Water. The Drinking Water Inspectorate (DWI) also attended a meeting prior to the workshop at which the WQRA methodology was outlined and discussed. The DWI will continue to be invited to meetings post-gate one to ensure ongoing discussion at a solution-specific level.

The key outcomes from the WQRA for the A2AT are as follows:

- Careful consideration must be given to customer perception when switching from one water type to another (from groundwater-fed to mainly surface water-fed) which could lead to perceived changes in taste, odour and hardness.
- 4-log removal or inactivation of cryptosporidium must be considered in the treatment designs.
- Careful consideration must be given to bromate formation, with changes to the treatment options potentially required post gate one.
- Careful consideration must be given to disinfection by-product formation, with changes to the treatment options potentially required post gate one.
- Metaldehyde must be considered going forward on the project despite the fact it is expected to be banned in March 2022.
- Further water quality data must be gathered for the A2AT sources.

Following the completion of this preliminary WQRA, a subsequent water quality monitoring programme has been established to gather additional water quality data that will be used to further develop the WQRAs to a greater level of detail and confidence. This programme will include a review of the data against the list of limiting hazards to ensure that the preliminary list is appropriate and to determine whether any additional hazards need to be added.

5.9.2 Treatment process

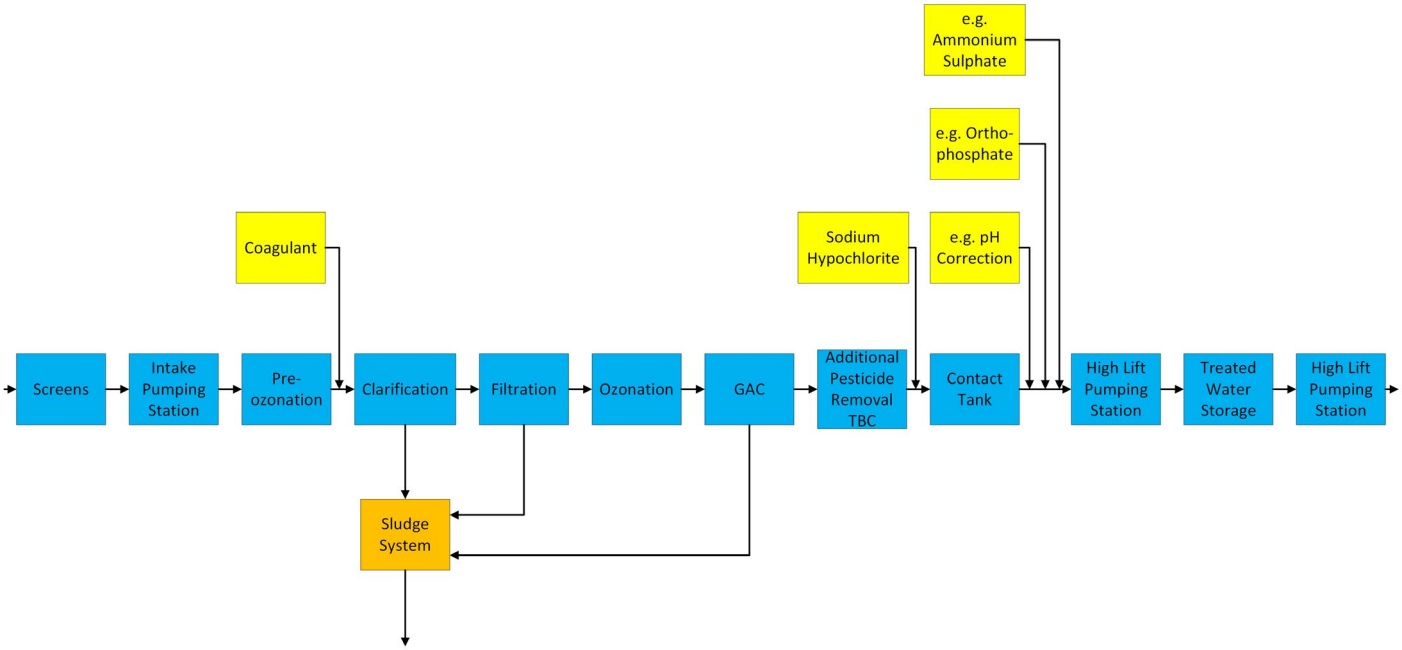
The outputs from the WQRA have been used to inform the development of the treatment requirements for the A2AT scheme. The following treatment processes (as summarised in Figure 8) have been assumed to be required for the River Trent (from Rutland Water) option:

- Coagulation.
- Clarification (either by settlement or flotation).
- Filtration (commonly rapid gravity sand filters).
- Pesticide removal.
- Ozonation.
- GAC adsorption.
- Disinfection with sodium hypochlorite solution.
- Other chemical additions such as orthophosphate for lead control, pH adjustment and ammonium sulphate to produce a chloramine residual.

While not included here, further considerations such as the capture, removal and disposal of mussels will need to be considered at later design stages. Bankside storage has not been included at this stage but may be required if water quality sampling indicates unpredictable water quality, notably sediment.

9 *ACWG WQ Risk Framework Report – Final (Strategic WQ Risk Framework FINAL Report) | 19/01/21 | Jacobs*

Figure 8: Schematic of treatment process for A2AT



6. Initial outline of procurement and operation strategy

RAPID has set out the assumption that the SRO solutions will meet the PR19 criteria for DPC and follow the DPC process route unless an alternative procurement strategy is articulated. This section presents an initial outline of the procurement strategy and describes the anticipated operation of the A2AT.

6.1 Procurement strategies

At this stage of the development, DPC has been considered as the preferred route for delivery of the A2AT scheme. Under this framework, appointees run a competitive procurement process and award a Design, Build, Finance, Maintain and Operate (DBFMO) type contract to the Competitively Appointed Provider (CAP) for a predefined revenue period. Alternative procurement strategies may be employed at a later stage if the scheme is deemed not suitable for DPC delivery and an alternative approach offers better value for customers. For delivery under the DPC route, three procurement structures have been considered:

- **Single appointee –** Affinity Water contracts with CAP and Anglian Water receives no supply.
- **Joint Venture (JV) –** Anglian Water and Affinity Water form a JV that contracts with CAP.
- **Single appointee and a Bulk Supply Agreement (BSA) –** Anglian Water contracts with CAP and holds a BSA with Affinity Water.

Following further evaluation, if the solution is deemed not suitable for DPC, there are various alternative procurement strategies such as in-house delivery, in-house delivery with a BSA, through a Regulated Third Party, through a Non-DPC DBFMO contract or other models. At this stage, we have assumed that the new conditioning plant required at either Sundon or WRZ5 hub will be delivered via DPC along with the other elements of the transfer schemes. However, there may be efficiencies in managing the delivery of this new asset in combination with the AMP7 Sundon conditioning plant currently being built by Affinity Water. Therefore, this assumption will be evaluated and refined as the scheme progresses through subsequent gates.

6.2 Eligibility assessment

The eligibility assessment for DPC is made up of a three-stage test:

1) Is the project greater than £100m whole life Totex?
2) Is the project sufficiently discrete?
3) Will the scheme deliver Value for Money (VfM) for customers if delivered via DPC?

At this stage of development, only the size and discreteness assessments have been considered. The VfM assessment will be completed as part of the gate two submission.

6.2.1 Size test

As indicated by the capex totals described previously, all configurations and options clearly pass the size eligibility test.

6.2.2 Discreteness assessment

An assessment of the discreteness of the project is summarised in Table 7.

Table 7: Discreteness eligibility assessment

Discreteness Criteria	River Trent option	SLR to Preston option	SLR to WRZ5 Hub option	Fens Reservoir option
Stakeholder interactions and statutory obligations	Low (1)	Medium (2)	Medium (2)	Medium (2)
Interoperability considerations	High (3)	Medium/high (2.5)	Medium/high (2.5)	Medium/high (2.5)
Output type and stability	Medium/high (2.5)	High (3)	High (3)	High (3)
Asset and operational service failures	Medium/high (2.5)	Medium/high (2.5)	Medium/high (2.5)	Medium/high (2.5)
Summary	Medium/high (2.25)	Medium/High (2.5)	Medium/High (2.5)	Medium/High (2.5)

6.3 DPC tender model

Under DPC, there are several tender models to split the activities and responsibilities between the appointee and the CAP. This could be at a very early (before the preferred option is selected), early (before the initial design is completed), late (after the consents have been awarded), very late (post-construction) or a split model. Broadly, a late DPC tender model appears to be to be the most appropriate for all the options under the A2AT solution. This is the most precedent model in the market and is envisaged to improve financing efficiency with no adverse impact to the overall timelines.

6.4 Operation and maintenance

The operation of the asset is linked to the procurement strategy; the chosen procurement route will confirm who will be responsible for the operation. If DPC, the CAP could operate the asset, whereas if an alternative procurement strategy is selected such as in-house delivery, the water company would be responsible. Further work will be done prior to gate two to clarify these options.

The expected demand profiles as modelled for Affinity Water indicates that the full demand (50Ml/d or 100 Ml/d depending on the scenario) is only required during low probability peak demand events. Further work will be required to determine how the transfer option would operate during normal operating periods and the requirement to maintain a base-load flow. The demand time series indicates that the 50 Ml/d option requires just 6 Ml/d on average and less than 10 Ml/d for 75% of the time. The full 50 Ml/d would only be required during severe droughts (1% time). The 100 Ml/d option has a 28 Ml/d average utilisation and only reaches 100 Ml/d for 2% of the time. Hence, it is expected that the transfer scheme would not be fully utilised except when other sources are out of service or working at full capacity, or severe drought conditions require additional water imports. There is a limit, however, to how much it is possible to turn down the flow through any treatment works, and there is also a need to maintain a sweetening flow through all of the pipelines, including the partially treated non-potable pipeline from the River Trent to Rutland Water. Depending on the treatment process design, the water treatment works will be able to operate at 20% to 30% of full capacity. Flow through the pipelines will need to be sustained at a level such that there is a period of no more than two to three days between treatment and arrival at the conditioning plant.

The equipment proposed in the concept designs is standard. No exceptional maintenance requirements are to be expected. It is assumed that all of the sites will be designed to be unmanned except for routine inspections, maintenance and deliveries.

7. Planning considerations

This section summarises the key anticipated features of the likely consenting process for the A2AT. The consenting strategy will evolve as the scheme progresses to gate two. Experience from Anglian Water's Cambridge Wastewater Treatment Plant Relocation Project, being taken through DCO planning route, and delivery of the strategic pipeline projects in AMP7 will continue to be utilised to support the development of the A2AT and the related upstream SROs.

The 2008 Planning Act, as amended, sets out criteria for Nationally Significant Infrastructure Projects (NSIPs), that must be consented via a Development Consent Order (DCO). If the A2AT infrastructure falls within these criteria, it will be mandatory for it to be authorised through a DCO. The criteria, set out at s.28 of the Act, as amended by Infrastructure Planning (Water Resources) (England) Order 2019, state that a DCO application will be required if 'the deployable output of the facility to be constructed as a result of the development will exceed 80 million litres per day'. Based on the maximum solution capacity of 100 million litres per day for the A2AT from the PR19 final determination, the A2AT qualifies as an NSIP in its own right, with consenting required via a DCO, either in conjunction with the SLR DCO application or separately.

However, there are a number of options available in respect of the A2AT, including supply from the potential Fens Reservoir. These options include the potential for a wide range of maximum deployable outputs, which could fall below the 80 million litres per day criteria. If the preferred A2AT solution were not to meet the criteria set out in the Planning Act, it may nonetheless be consented under the DCO route as "associated development" if there is a sufficient link to a NSIP. Therefore, if the A2AT is to have a capacity of less than 80 million litres per day it may still be possible and preferable to use the DCO route if it is linked to another SRO, such as the SLR or Fens Reservoir, both of which will require a DCO application.

As such, the proposed consenting approach, which will consider alternative planning routes, including under the Town and Country Planning Act 1990, will remain under review until a preferred transfer option is determined based on regional simulator output in winter 2021. For gate one it is believed the optimal consenting route for the A2AT is for its promotion as an integrated part of the SLR DCO project, under the assumption that a transfer route linked to the SLR will be promoted at gate two. It is envisaged that the route selection for the A2AT elements will be aligned with, and firmly embedded in, the SLR site selection activity, following clearly documented and robust infrastructure selection and route 'optioneering' processes.

The DCO will be delivered through comprehensive community and stakeholder engagement. Four rounds of consultation will take place on the A2AT, one round of informal consultation prior to gate two, with three further rounds of consultation taking place between gate two and the DCO submission, one informal and two statutory under Section 42 and 47 of the 2008 Act.

An Environmental Impact Assessment (EIA) will be carried out in accordance with the process mandated by the 2008 Act and relevant guidance. This will commence with EIA scoping, followed by environmental surveys, the production of Preliminary Environmental Information (PEI) and, in support of the DCO application, the delivery of an Environmental Statement. The existing environmental assessments will form the basis for any future EIA and PEI.

The DCO can also provide compulsory acquisition powers. While the Anglian Water and Affinity Water preference is to acquire land by agreement, the project will ensure that these powers can be fully exercised if required. Land referencing and landowner engagement will take place between gate one and gate two to inform this process.

Comprehensive and focused transfer routing, site selection and concept design development will ensure that risks around environmental impact assessment and compulsory acquisition will be appropriately managed, particularly in respect of the consideration of alternative transfer routes.

The scheme faces a number of risks or uncertainties in respect of the DCO process, summarised in Section 9, including:

- Uncertainty over the timing of the approval of the National Policy Statement.
- The risk of public inquiry or legal challenge in respect of the WRMP.
- Sustained objector risk, particularly if compulsory acquisition powers are sought, resulting in increased consultation and EIA effort, potential delays and higher risk of legal challenge.

8. Stakeholder engagement

This section sets out the customer and stakeholder engagement undertaken to gate one.

A detailed consultation and engagement strategy has been developed which is centred around the three key themes of:

1. **Building understanding, trust and support –** stakeholder, community and customer engagement help to build understanding and trust through a series of iterative consultation phases to engage early, be open, honest and transparent, and bring consultees along the development journey.
2. **Compliance –** central to project acceptance (Section 56 of 2008 Planning Act) is demonstrating that the consultation process has complied with, and gone beyond, standard practice to deliver a compliant and effective consultation that will stand up to scrutiny, clearly evidenced through feedback loops and consultation reporting.
3. **Reducing risk –** programme risks are being managed (see Section 9) and mitigation measures put in place to minimise the delivery risks.

The scheme is integral within the WRE region along with the associated sources, but it also forms part of the input into the WRSE regional plan, and as such the scheme has benefited through engagement with both sets of regional stakeholders.

Engagement with key stakeholders through WRE (including its constituent members) has ensured that the route selection process is both transparent and collaborative. Engagement has also been undertaken directly with the South Lincolnshire Water Partnership, although this has been predominantly focused on the associated SLR option. As route selection develops, there will be the need for a significant amount of engagement with landowners, local authorities and communities due to the nature and scale of the scheme. The engagement programme and planned activities for gate two are presented in Section 15.

8.1.1 Regional customer engagement

A programme of customer engagement was commissioned in collaboration with the other Strategic Resource Options and involving ten water companies, to examine customers' understanding of water resources and the need for regional solutions. This research programme was an industry first and ensured feedback was comparable across companies and solutions in addition to being cost efficient. The scope and the approach were agreed in advance with a coalition of representatives from the participating water company's Customer Challenge Groups, CCW and RAPID.

The programme was comprised of three parts:

- An evidence review of over 100 documents across the ten companies to compile insights from PR19 and WRMP19 research to ensure development on previously available information.
- Qualitative research with both Anglian Water and Affinity Water customers to test broad priorities, including the proposals for sharing water between companies.
- Quantitative research: This was focused on the recipient customers in the Affinity Water area with the engagement of 360 households and 80 non-households. The survey also captured customer views on high-level principles and their support for water sharing via SROs following learnings from the qualitative research, including views on reservoirs.

The key findings from the customer engagement research were:

- The evidence compiled to this point demonstrates that proposals to share water between companies are seen in a positive light by customers. There is a recognition that collaborative planning and options can be efficient and fairer because water is a communal resource.
- Customers have a firmly established view where transfer options rank in priority order for long-term planning. This ranking is towards the lower end of the scale, but it is consistent with the expectation that self-reliance will be targeted over a riskier strategy of long-term dependency on transfers.
- The deliberative and quantitative research shows there are limits to customer support. Customers are more willing to see water transfers when there is a lower potential impact on themselves, and customers are less willing to see water transferred out of their region if the recipients (companies and customers) are more wasteful. From this, a view is forming as to the general assurances that will likely need to accompany widespread plans to share water within and across regions.
- Transfer options have been relatively well represented in previous research by companies. Largely transfer via river or canal has been more appealing than pipeline options, because they are perceived by customers to have wider benefits and fewer negative impacts over the functional aspect of simply transferring water between locations.
- The previous research also shows that customers have various concerns about transfers. These include cost, disruption from construction, leaks, environmental impacts, energy use, lack of benefits to local communities and deteriorated service levels for donor customers.
- Customers want to see a clear view on the "choice" that will be faced for the A2AT, both in terms of the combination of source(s) and transfer route, and the need for and timing of other SROs, including comparative costs and the potential impacts that could be avoided.

8.2 Regional planning group engagement

The A2AT is a key component of the WRE regional plan. WRE brings together partners from a wide range of sectors including water, energy, retail, the environment, land management and agriculture, to work in collaboration to manage the regions challenges, building on the area's unique opportunities for sustainable future growth, and pioneering a new approach to managing water resources. The A2AT will be central to the planning conferences as the WRE regional plan is developed.

The A2AT will also influence the WRSE regional plan. WRSE has an on-going engagement and consultation programme to support

the development of the South East regional plan. In 2020, the focus of the programme was on the building blocks of the plan, including the planning policies and the technical methods. In 2021, the engagement broadened to focus on feasible solutions and the approach and tools to determine the best value plan, with consultation on the draft plan scheduled early in 2022. Although the A2AT is not core solution to the WRSE regional plan, the source water and the A2AT transfer have been key in explaining to WRSE stakeholders the wider regional planning approach and coordination.

8.3 Targeted A2AT technical engagement

Stakeholder engagement for the A2AT has so far been carried out jointly with the SLR scheme. This has focused on the SLWP, statutory consultees and regulators, to ensure close alignment on issues of data collection and assessment. A summary of the engagement to date is presented in Table 8.

Table 8: A2AT specific engagement

Stakeholder	Assessment summary	Activity to date
Customer Challenge Group (CCG) and Consumer Council for Water (CCW)	Focus is on protecting customer interests ensuring plans and schemes are developed with customer engagement and input.	Update session to local CCW representatives. Monthly update on progress to Affinity CCG. Currently no Anglian CCG in place.
Drinking Water Inspectorate (DWI)	Regulation of drinking water quality. Interested in the progression of this scheme as an alternative source of water into the region.	Quarterly meetings.
Environment Agency (EA)	Regulation of water resources (quantity and quality), environmental and hydrological monitoring and assessment. Delivery of wider environmental ambition and objectives.	Active engagement as member of SLWP. NAU Programme Management Group (PMG) monthly meetings. Detailed workshops on key development areas.
Highways England	Long-term planning on road infrastructure. Early engagement to align plans.	Invited to site selection workshop but not available.
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.	Attended water quality workshop. Further follow up with local inspectors needed once site selection more developed.
Local Authorities (LAs)	Responsible for the planning process regarding location and disruption of any works involving abstraction, transportation and treatment for the scheme.	Regular updates and engagement with Lincolnshire City Council through SLWP and additional ad hoc meetings. LAs have been invited to regional and company events and forums to gain general awareness of process and schemes.
Natural England	Legal and regulatory requirements with respect to the natural environment plus landscape and environmental benefits and opportunities for enhancement.	Active engagement as member of SLWP
Ofwat	Economic regulation of water industry. Ultimate approval of option progression to business plans.	Scheme updates via the RAPID meetings, plus additional meetings to update on procurement strategy.
RAPID	Regulatory alliance with responsibility for overseeing the work to examine the SROs and for administering the gated process	Scheme updates at regular intervals to RAPID team.
SLWP	The partnership is focused on finding a multi-sector water resource management solution for South Lincolnshire. Interest in the A2AT has been linked to the SLR option development.	Regular monthly meetings, including an agenda item on progress with the SLR and A2AT.

8.4 Preparing for community engagement

In preparation for the DCO application for this scheme, an independent specialist communications, PR and public affairs organisation has been engaged to provide additional support on the development of plans for community engagement.

The current plan is to begin the first phase of community engagement in spring 2022, once a preferred option has been selected. A detailed plan has been scoped to ensure alignment of all deliverables and the planning process.

9. Key risks and mitigation measures

For gate one, a qualitative risk register has been used to manage programme risk. The key risks are summarised in Table 9, alongside the mitigation measures put in place and the latest trend; these risks have been reported in the RAPID quarterly dashboards.

There are currently two notable risks for the A2AT:

- Delays to the output from the WRE RSS from summer 2021 to winter 2021, and the significant impact this has on the option selection programme for this scheme (Risk ID 56). The WRE RSS will provide a robust evidence base from which to discount the less favourable A2AT options, therefore the delay of this output has a direct impact on the gate two programme.

  Additional analysis of the A2AT option cost/benefit (AIC based on DO) in advance of WRE RSS output has been completed as a mitigation measure. This will allow less favourable options to be discounted if appropriate and minimise abortive work on less favourable solutions.

- Risk ID 24 captures the challenges associated with the development of an integrated programme, which brings together the different requirements and timescales associated with the RAPID, DCO and DPC workstreams. To provide confidence that we have a coherent and robust programme with adequate consideration of the competing demands of these three workstreams, detailed programme specific investigations are underway into delivery routes, including DPC and DCO considerations.

For gate one, costs attributed to programme risk have been estimated using the ACWG Optimism Bias methodology. An enhanced risk management process will be developed for gate two, which will consider programme opportunities in addition to risks, both of which will be costed to produce a quantified risk assessment (QRA), supporting the effective ongoing management of the programme. The QRA will be fundamental for the ongoing option development and selection of a preferred concept design at gate two.

Table 9: Programme risk summary

Risk ID	Risk details		Mitigation plan	Trend
	Risk (event)	Effect(s)		
24	**RAPID, DCO and DPC inter-dependencies**	All three elements have differing timescales, complexities and gateway requirements that need to be understood. Programme misalignment could result in delays.	Understand and overlay all three processes to enable alignment, with identification of critical path, to deliver a coherent strategy. Further detailed investigation of each workstream ongoing through to gate two.	Decreasing
56	**Development of unfavourable option (River Trent)**	Development of additional option, compromising gate two programme to select single preferred option	Undertake further analysis of transfer option cost/ benefit (Average Incremental Cost (AIC) based on Deployable Output (DO)), to consider discounting less favourable option prior to regional simulation output	Stable
4	**Source option not ready to supply the transfer**	Delays in the source option programme result in delays to transfer	Two programmes (SLR and A2AT) to be delivered in harmony, with progress monitored by PMG. Source option for A2AT should be selected in advance of gate two and proceed through subsequent gates in parallel.	Decreasing
11	**Receiving network operability**	Existing network may not be capable of receiving additional import, making transfer unviable	Transfer options to be designed to feed into the network at existing hubs. Design for gate two to consider utilisation of spare capacity in the existing network or cutting back on supply to the hub from other sources, to mitigate the risk of not being able to put the transfer scheme into operation.	Stable
12	**Water quality assessment shows high risk**	Additional pressure on Sundon treatment works and issues linked to metaldehyde, with delivery point unable to cope with additional volume of water	Considered as part of gate one design. However further work to understand and incorporate adequate mitigation measures in preparation for gate two.	Decreasing
43	**Utilising River Trent as a source of water is unviable**	Multiple competing demands for River Trent water (inc. other SROs) resulting in insufficient surplus water to be used for A2AT, either directly or via SLR	Concept design to consider alternative sources of water so that there are viable alternative source water options if the River Trent is unavailable as a source. Assumptions to be revisited in preparation for gate two. Proactively contribute to ACWG coordination on River Trent, and regular attendance at River Trent Working Group, to monitor developments.	Stable
53	**Stakeholder challenge of solution routing**	Local routing constraints flagged by stakeholder's, resulting in solution development being delayed or at worst unviable	Integration of SRO stakeholder engagement strategy with proposed engagement by both WRE and WRMP24 for partner companies.	Stable
9	**Inter-regional alignment**	Regional plans from WRE and WRSE are not aligned with regard to selection of Strategic Resource Options across the regional plans, resulting in delays.	Inter-regional alignment planned towards end of 2021, when WRE and WRSE will work together alongside SRO teams to overcome any differences in the best value planning process.	Stable
26	**Delivery route approach**	Uncertainty about potential delivery routes and necessary work required to understand respective programmes	Identification of delivery route options and programme implications for delivery of scheme undertaken for gate one, to be reviewed, and market engagement will take place in preparation for gate two.	Decreasing
42	**Legal challenge or public inquiry**	External challenge to programme resulting in delays e.g. public inquiry of WRMP resulting in delays in publishing WRMP24 or DCO grant unsuccessful	DCO programme and approach to consultation to be developed to manage and mitigate this risk.	Stable

10. Option cost/benefits comparison

10.1 Best value

As part of the regional plan, WRE will select a portfolio of demand management and supply-side options to meet the needs of all of those with an interest in the abstraction and use of water in the region over the period to 2050 and beyond. This process will involve:

- A portfolio selection using the multi-objective robust decision making (MO-RDM) process previously developed by WRE. Based on a multi-sector regional water resource simulator, MO-RDM allows the vulnerabilities of the various water resource and water supply systems in the region to be quantified and the performance of different options for meeting agreed targets to be tested. From this, the preferred set of options will be selected.

- A delivery strategy will be agreed, distinguishing between options that should primarily be delivered through water company business plans and options that should be delivered by other sectors. For the water company options, the order in which these should be delivered will be based on a least cost optimiser (EBSD), considering the strategies that are more flexible and adaptive and so better suited for dealing with the uncertainties associated with growth and climate change.

The A2AT will form part of this regional assessment as one of the key inter-regional transfers, with the MO-RDM optimisation expected to provide an indication of which transfer option will be required and the regional EBSD establishing when it should be delivered. The optimisation will consider not only cost (Capex and Opex) and PWS reliability, but also agriculture deficit, energy reliability and deviations from environmental flow requirements to ensure the best value option is selected. The regional reconciliation process will confirm whether the A2AT is required to meet the deficit in the Affinity Water area and the preferred combination of sources and routes based on the four options being progressed at gate one. To this end, the complex interaction between WRE and WRSE is being handled through conjunctive use system simulation to assess the DO implications of transferring water from the Anglian Water region to the Affinity Water supply area. Using the WRSE system simulator, a demand timeseries for the A2AT at 50 Ml/d and 100 Ml/d deficit has been generated to determine the impact that satisfying this additional demand has on the WRE regional plan. At the same time, in WRSE, a set of scenarios where the Affinity Water demand is reduced by 50 Ml/d and 100 Ml/d will be run to see how much impact that has. This iterative process will allow the performance metrics of the two regional plans to be compared to determine if the A2AT represents better value than the WRSE alternatives.

In addition, a simplified version of the A2AT scheme using apportioned costs and benefits stated in accordance with the WRSE best value criteria will be generated and run through the WRSE investment model, to examine how this performs against the regional reconciliation process.

10.2 Cost consistency

To ensure consistency in costing, the latest ACWG guidance has been followed where possible. For OB calculations, the confidence statement scoring has been carried out using the latest guidance from ACWG for SROs. This scoring was then reviewed against the project risk register to ensure that double counting of risk did not occur.

When calculating asset replacement costs, the proposed standard asset life classes for water resource planning were used from Table 4-3 in the 2020 Cost Consistency Technical Note and Methodology. The proposed asset lives were used rather than the 2012 UKWIR asset life data, as these values did not account for very long-life assets such as the earthworks required for the SLR.

Finally, recent WRMP guidelines and HM Treasury Green book guidance[10] have both been followed for the valuation of greenhouse gasses.

The overall estimate of carbon emissions has also taken on best practice, utilising PAS2080 accredited carbon data and tools. It has also taken into account guidance from the ACWG cost consistency report on consistency of data sources and scope boundaries.

10 *Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)*

11. Impacts on current plan

This section describes the impact of the SLR on current delivery plans and places this solution within the wider context of company and regional Water Resource Management Plans (WRMPs).

The A2AT is being investigated within the context of WRMP and regional planning. The term regional planning refers primarily to WRE and its own plan development but also to the wider regional plan reconciliation process that will ensure coherence is achieved between different regional plans. This process of alignment between regional plans is particularly important for the A2AT, given its inter-regional nature and its potential role in satisfying future demand in the WRSE region.

The early concept of the A2AT emerged from the WRMP19 process, during which Affinity Water and Anglian Water discussed a number of strategic options and assessed their feasibility. It was subsequently included by both companies in their investment models as a solution directly linked to the SLR. The adaptive plan developed by Affinity Water in their WRMP19 concluded that an import from Anglian Water linked to the SLR would only be required under certain scenarios (high growth and extended sustainability reductions) and as a third stage of development after the other two preferred options (in the 2060s). It would also be required as an alternative if either of the WRMP19 preferred options were not viable, or investigations altered the economics and multi-criteria analysis for the options. The potential need for the A2AT, and the associated upstream resource options (specifically the SLR), was recognised in Anglian Water's WRMP19 adaptive planning programme but does not directly feature in the current 25-year plan outlined in WRMP19.

The assumptions made to date are based upon respective WRMP19 plans; no outputs from either WRMP24 or the next regional plans are available in time for the gate one submission. One of the key assumptions is that Affinity Water's supply from SLR (up to 100 Ml/d) via the A2AT is selected by the WRE system simulator and carried forward by the regional plan reconciliation process. However, there are complex interdependencies between WRE, WRSE and WRW, and uncertainty exists around which configuration of SROs offers best value for customers and the environment. Therefore, this assumption will be revisited at gate two once the outputs of the regional plans have become available to confirm that the WRE regional modelling supports the assessment of the costs, benefits and viability.

The development of the A2AT ties in with partners' current delivery plans as well as long-term ambitions and strategies. For Affinity Water, this solution represents a strategic transfer that would allow the company to maintain a resilient, reliable and affordable water supply in its central region when confronted with the challenges posed by population growth and greater environmental protection. The A2AT would integrate with Affinity Water's long-term strategy currently being developed to underpin its WRMP and gate two submissions. A strategic project is being undertaken to allow the company to understand the detail of the behaviour, constraints and opportunities of its strategic supply network and develop strategies to accommodate changes in bulk transfer arrangements brought about by the different SROs currently being investigated.

12. Board statement and assurance

A comprehensive assurance plan has been developed and implemented across all activities undertaken leading up to this gate one submission. The assurance process is similar to the standard Anglian Water and Affinity Water risk-based assurance frameworks. It uses the Ofgem data assurance guideline risk assessment method.

The regulatory, environmental and technical risk of each activity has been assessed and a level of assurance assigned based on a 'three lines of defence' model. A third-party assurance provider has been engaged to provide assurance on the elements that are considered high risk or critical. A comprehensive project governance structure is in place to ensure the low and medium-risk activities have been appropriately managed and overseen. All key technical outputs have been delivered by specialist consultants with rigorous quality assurance and control procedures in place.

Both Anglian Water and Affinity Water Boards support this submission and have signed off the Board statement in accordance with the RAPID guidance, based on the above controls and assurance.

13. Solution or partner changes

Anglian Water Services and Affinity Water are currently working in partnership to develop a mutually beneficial solution for the A2AT scheme. This partnership arrangement between the two companies is anticipated to remain unchanged through to gate two, at which point the arrangement will be reviewed in light of scheme developments across the other inter-related RAPID SROs.

14. Efficient spend of gate allowance

This section provides supporting information to confirm the efficiency of gate one spend for the A2AT SRO.

14.1 Efficient spend

This section outlines the procurement approach and governance process that Affinity Water and Anglian Water have taken to procure services required to deliver gate one technical work on the A2AT SRO and how efficiency has been driven into the gate one process.

The governance structure between both companies includes a Programme Management Group (PMG). PMG is responsible for the management of the programme and for ensuring that all technical activity is closely aligned with RAPID's requirements to minimise any potential for scope creep and inefficient or abortive spend.

A procurement approach and governance process were agreed at the start of the A2AT SRO programme. The procurement approach has been based on the existing companies' procurement frameworks, with the following procurement options been used to select consultants:

- Mini-competition of existing framework suppliers.
- Direct selection of existing framework suppliers when there is a need for consistency or a particular skillset.
- Tender for services outside of existing frameworks.
- Direct award to specialist suppliers outside of existing frameworks.

In line with the objectives set out in the SRO Memorandum of Understanding, the PMG is responsible for the efficient delivery of the programme, which includes approving all procurement decisions. A standard proforma has been developed to facilitate this and is signed by the PMG prior to procuring any work. This documents the rationale for selecting a particular supplier or contractor, as well as detailing the scope, requirements, costs and expected outputs of each work package. Many work packages have been procured jointly for the SLR and A2AT SROs to bring efficiencies to the programme and, where possible, costs have been benchmarked against other similar work packages. For example, both the planning strategy and consultation strategy were procured jointly for the SLR and A2AT and were benchmarked against work complete for another DCO scheme being delivered by Anglian Water, the relocation of Cambridge Wastewater Treatment Plant. The project management for the programme to gate one has been very lean across both water companies and is within the recognised 10-15% of total spend.

The governance structure and procurement approaches have ensured that all costs are relevant and efficient. This has also been confirmed through external, third-party assurance of the gate one costs. In particular, the system simulator costs have only been funded for the specific upgrades to the Ruthamford system used to generate the DO assessment of the A2AT options.

14.2 Gate one costs

The cost allocation for each RAPID solution was provided by Ofwat in the PR19 Final Determination[11]. A comparison between RAPID gate one allowance and actual costs to gate one is shown in Table 10**.**

Table 10: Comparison of RAPID gate one allowance and actual costs

Stage	Total RAPID allowance (£m)	Actual or forecast spend (£m)	Difference (£m)
Gate one	1.15	0.58	0.57

The gate one spend is made up of actual costs recorded to the end of May 2021 and committed costs to gate one submission (5 July 2021). Overall, the forecast spend to gate one is £583k, with a 52/48 split between Affinity Water and Anglian Water. The difference between gate one spend and the final determination allowance is £567k. Costs have been relatively low for this scheme as a result of there being a limited number of options in the long list, and relatively limited water quality or environmental assessment requirements (Items such as the River Trent water quality and environmental assessments have been covered by other SROs).

The cost breakdown by technical workstream is shown in Table 11.

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Table 11: Breakdown of gate one costs by technical workstream

	Deliverable	Cost (£k)
1	**Concept design**	-
1.1	**Engineering** Includes initial scheme definition, development of a screening methodology and its application, concept design of infrastructure and cost estimation.	201
1.2	**Environmental considerations** Includes the initial environmental assessments of the options (SEA, HRA, WFD), INNs assessment and biodiversity net gain (BNG).	53
1.3	**Water quality considerations** Includes baseline water quality studies and the production of the water quality risk assessment.	7
2 & 3	**Initial outline of the solution procurement strategy and planning application route** Includes finance consultancy advice, and in-house staff time to produce the procurement strategy report and confirm feasibility for DPC. Also includes independent expert advice to produce Consenting Strategy and ensure programme is robust for DCO.	27
4	**Contribution to regional planning** Includes contribution to the WRE simulator upgrade which is fundamental to A2AT decisions to be made during the next stage; modelling of DO benefits; and project management support to ensure alignment between the SRO programme and the regional planning timeframe.	105
5	**External assurance** Includes production of an assurance plan to gate two, and an independent consultant to assure the process and outputs.	9
6	**Customer and stakeholder engagement** Includes the development of a stakeholder engagement plan, ongoing support from an engagement consultancy, and initial customer research.	20
7	**Environment Agency support** Includes agreed contribution to the newly established National Appraisal Unit to coordinate EA input centrally.	24
8	**Contribution to ACWG consistency studies** Includes proportion of costs for the environmental framework and a framework for climate change.	15
9	**Project management** Includes staff time from both companies and a consultant project manager; within accepted benchmark of 10-15% of costs.	122
		583

14.3 Gate two costs

A comparison between RAPID gate two allowance and estimated costs to gate two is shown in Table 12.

Table 12: Comparison of RAPID gate two allowance and forecast spend

Stage	Total RAPID allowance (£m)	Forecast spend (£m)	Difference (£m)
Gate two	1.73	1.72	0.01

Overall, the forecast spend to gate two is £1,722k, with a 52/48 split between Affinity Water and Anglian Water. The difference between gate two estimated costs and the final determination allowance is £7.94k.

The cost breakdown by technical workstream is shown in Table 13.

Table 13: Breakdown of gate two budget by technical workstream

	Deliverable	Budget (£k)
1	Solution feasibility and data collection:	-
1.1	Hydrology	11
1.2	Strategic planning	50
1.3	Engineering design	306
1.4	Site surveys (topo surveys and ground investigations)	200
1.5	Environmental considerations (inc Environmental Assessments)	180
1.6	Water quality considerations (inc water quality monitoring surveys)	47
2	Procurement strategy	90
3	Considerations of planning application route	38
4	Contribution to regional planning	50
5	External assurance	17
6	Customer and stakeholder engagement	104
7	EA and Natural England contribution (NAU and local)	80
8	Contribution to ACWG consistency studies	12
9	Project management	209
10	Specialist consultants (legal support, land agents)	246
	Risk (@5%)	82
		1,722

15. Proposed gate two activities and outcomes

The project-level plan for gate two is provided in Figure 9. The proposed programme of activities leading up to gate two will fall into three distinct phases:

- **Phase 1:** May to October 2021 – Support to WRE regional modelling prior to transfer option shortlist selection.
- **Phase 2:** November 2021 to January 2022 – preferred transfer option selected from shortlist.
- **Phase 3:** February 2022 to August 2022 – development of preferred transfer option, including routing and associated infrastructure.

In the first phase, the priority will be to ensure that the WRE regional modelling team have all of the information required to complete the modelling programme. In addition, the next phases leading up to application for a DCO will be completed to meet regulatory requirements, for instance agreeing the extent of environmental surveys that will be required as the evidence base for the Environmental Impact Assessment (EIA). Water quality monitoring will continue in line with the agreed water quality monitoring programme.

The second phase will bring together the results of the regional modelling and a multi-criteria decision-making process to inform selection of the preferred transfer option, including source of water and transfer capacity, to present at gate two. The process will be integrated with development of the SLR and Fens Reservoir schemes. In selecting the preferred transfer option, consideration will be given to whether the scheme can be developed in phases, and to the quantified level of risk.

The third phase will commence once the preferred transfer option has been selected in January 2022. Having been informed by targeted stakeholder engagement, wider engagement can commence during the non-statutory Consultation 1 (Con 1) phase in spring 2022. The purpose of this consultation will be to communicate the need for the project, as well as gathering feedback to inform design principles for the further development of the detailed site selection and transfer routing. Water quality monitoring results will enable the drinking water quality risk assessment to be updated and further refinement of the treatment process from source to tap to determine whether pilot plant trials should proceed. With a start and finish point of the route determined it will be possible to commence phase one habitat surveys and to assess potential locations of major road, rail and river crossings. Preliminary discussions with other utilities will commence, including the power network operator. A developed transfer option, including preferred routing and siting of associated infrastructure, will be presented at gate two.

At the end of the third phase, a robust plan will be in place, to be implemented during gate three, covering the proposed procurement route and approach to obtaining a DCO for the preferred scheme. The plan will be fully integrated with the plan for developing the source reservoir, if applicable. It will be centred on compiling the robust evidence base and stakeholder support required to apply for a DCO, which in turn will be the basis of the further customer-focused development and implementation of the transfer scheme.

The National Infrastructure Commission (NIC) published guidance on its design principles for national infrastructure in 2020, which was the first of its kind in the UK. The ACWG is in the process of developing a set of design principles that can be applied across all nationally significant water infrastructure projects. The four NIC pillars of Climate, People, Places and Value will be used to develop a set of principles specific to the water industry that can guide the SRO designs as they develop. This work is due to complete by the end of 2021 so that it can influence the gate two concept designs.

The Delivery Incentives Framework detailed in the Final Determination states that a penalty of up to 30% of each company's total efficient spend will be applied for late submissions or poor-quality deliverables. It is proposed that this framework be applied for gate two submissions but reviewed post-gate two to reflect the increase in allowance.

Figure 9: Project-level plan showing detailed activities up to RAPID gate two

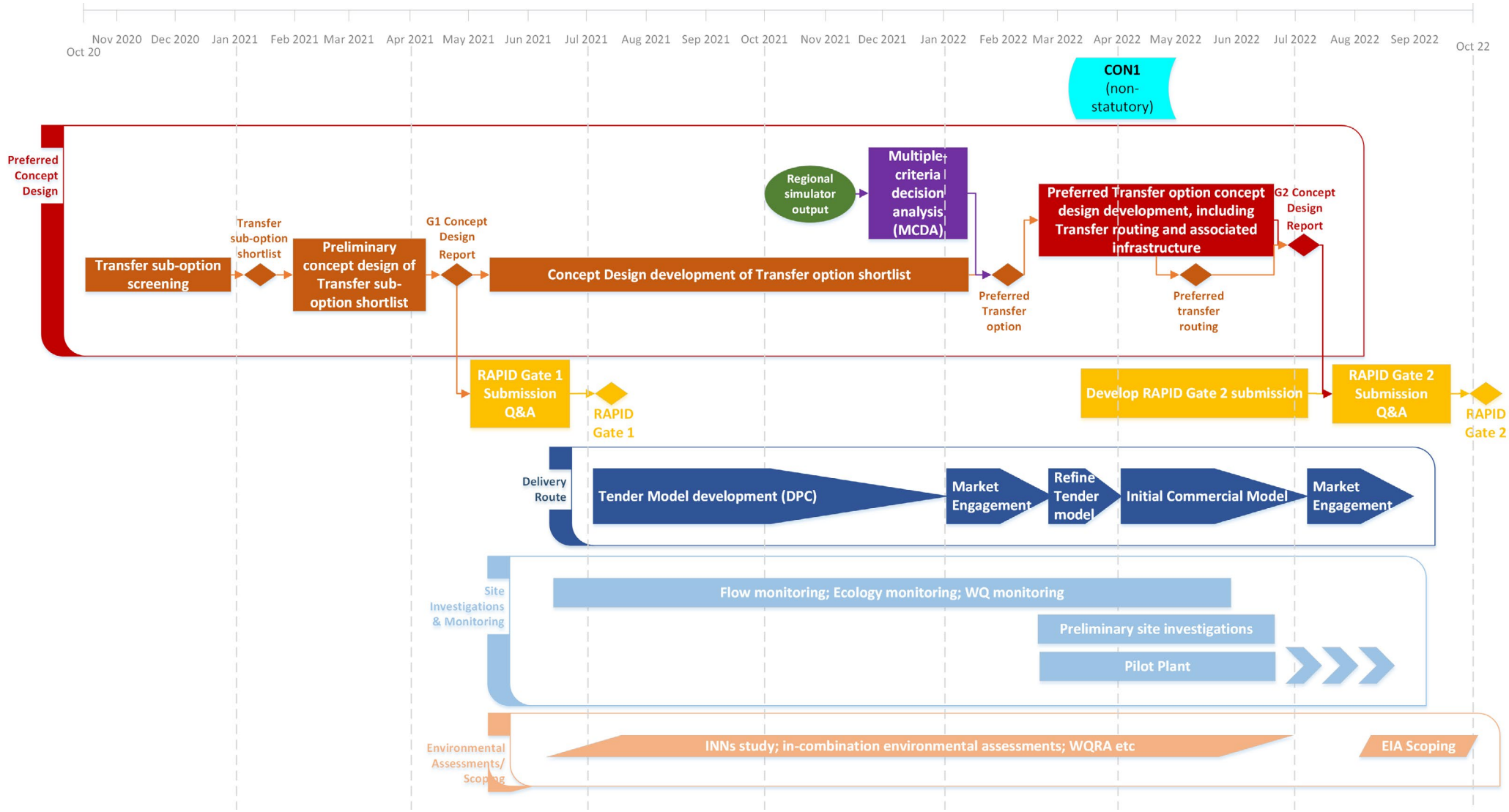

Table 14: Proposed activities for gate two

	May 21 -> Oct		Nov -> Jan 22		Feb 22 -> Oct 22
Planning and procurement	• Understand outputs that will come from regional model and agree multi-criteria option decision process to determine single option following output. • Regulatory stakeholder engagement (including EA, Natural England, DWI, SLWP). • Set up database for stakeholder engagement, identify stakeholders including landowners. • Legal advice on DCO process. • Procurement: tender model development. • Update and convert existing qualitative risk assessment into quantitative assessment. • Agree principles to decarbonise and embed carbon management into delivery of the scheme.	**Regional model output**	• Analyse regional modelling outcome to amend/inform preferred concept design and potential phasing to match forecast requirements. • Assess interaction with other SROs. • Consideration of consents and licences required. • Procurement – DPC market engagement.	**Single option selection**	• Land referencing of preferred option. • Public consultation (non-statutory). • External assurance of high/critical gate two activities. • Regulatory and non-regulatory stakeholder engagement (including landowners, local groups and local authorities). • Procurement – refine tender model and develop initial commercial model. • Procurement – DPC market engagement (2).
Engineering	• Stochastics and climate change study. • Determine transfer siting and routing method/criteria. • Determine / confirm WQ policies applicable to scheme. • Determine high-level operational philosophy across scheme. • Commence water quality monitoring. • Economic modelling. • Investigation of and confirmation of assumptions for use of existing sites and up/downstream infrastructure.		• Apply multi-criteria option decision process to determine option to take forward (including capacity). • Establish design philosophy for WTW and PS locations. • Establish pipeline corridor requirements. • Concept design of sites and pipeline routes for short list. • Consider pilot plant. • Develop operational philosophy. • Broader investigations and third-party information requests, including DNO initial enquiries and significant pipeline crossings.		• Finalise water quality risk assessment. • Engineering concept design of preferred option, to include construction and operational phases – possible ECI. • Confirmation of treatment process following water quality monitoring programme and policy confirmation. • DO assessment. • Confirm INNS transfer risk and INNS removal treatment.
Environmental	• Identify and investigate opportunity for social benefits for all options. • Agree surveys and information that will be required for EIA. • Ecology monitoring (spring-autumn) where possible. • Review INNS risk associated with transfers.		• Update HRA to include an in-combination assessment. • Further investigation into the potential BNG and NC effects. • Develop conceptual WFD model for River Trent option (if remaining). • Assess impact of River Trent option on the resilience of Rutland Water (if remaining). • Quantify environmental impact of construction.		• Update SEA and WFD. • Field work and desk studies for EIA for DCO process. • Develop plan for environmentally safe disposal of commissioning water. • Develop a sludge disposal strategy. • Quantify impact of construction vehicles. • Commence EIA scoping (August 22' start).
Engagement	• Club project across a number of SROs to explore customer preferences for recreational benefit and how transfers can add citizen value. • Utilise learning from regional engagement to inform our communication plans regarding SROs more generally. • Continue programme of stakeholder engagement.		• Club project across companies to look at acceptability of changes to water aesthetics. • Regional consultation on WRE and WRSE plans. • Detailed engagement with LAs, Highways and Historic England regarding route of transfer.		• Decision whether to run SLR and transfer as single application for DCO. • Phase one consultation on need for preferred transfer option. • WRMP public consultation. • SoCC for A2AT (Q3). • Phase two consultation on transfer route (Q4). • Ongoing engagement with stakeholders.

16. Conclusions and recommendations

The A2AT solution has progressed well to gate one and the programme has delivered against key objectives in developing a set of concept options, undertaking comprehensive hydrological analysis on upstream sources of water.

Significant work has been delivered on developing and implementing innovative processes that support our collective ambition to co-create solutions with our stakeholders, working in partnership with Water Resources East. Our programme is also fully integrated with the regional planning process.

Spend is considered to be efficient and within budget and programme risks are understood. A more robust process for risk and opportunity management is in development for gate two.

The work completed to date has not identified any reason why the solution should not progress to gate two, and it is recommended that this solution continue on the RAPID standard gated process. Anglian Water and Affinity Water look forward to continuing to work in partnership with RAPID and stakeholders to progress an innovative solution that will bring benefits to both customers and the region.

Cover photo – Pipes being laid