Strategic regional water resource solutions: detailed feasibility and concept design

Standard gate two submission for South East Strategic Reservoir Option (SESRO)

Date: 14th November 2022

Notice

Position Statement

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

Disclaimer

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

Contents

Glossary of Acronyms and Abbreviations

Term	Explanation
Scheme Partners	Affinity Water and Thames Water
AA	Appropriate Assessment (under the Habitats Regulations Assessment)
ACWG	All Company Working Group
AFW	Affinity Water
AIC	Average Incremental Cost
AOD	Above Ordinance Datum
AONB	Area of Outstanding Natural Beauty
BNG	Biodiversity Net Gain
BNL	Biodiversity Net Loss
BSA	Bilateral Service Agreement
CCW	Consumer Council for Water
CPO	Compulsory Purchase Order
DAF	Dissolved Air Flotation
DCO	Development Consent Order
DNO	Distribution Network Operator
DPC	Direct Procurement for Customers
ECI	Early Contractor Involvement
ENCA	Enabling a Natural Capital Approach
ES	Environmental Statement
GAC	Granular Activated Carbon
HRA	Habitats Regulations Assessment
ICA	Instrumentation, Control and Automation
IP	Infrastructure Provider
IPA	Infrastructure and Projects Authority
ITT	Invitation to Tender
LSE	Likely Significant Effect
LWS	Local Wildlife Site
M&E	Mechanical and Electrical

Term	Explanation
MCC	Motor Control Centre
MEICA	Mechanical, Electrical, Instrumentation, Control and Automation
Ml/d	Mega (million) Litres Per Day
NAU	Environment Agency, National Appraisal Unit
NCA	Natural Capital Accounting
NPS	National Policy Statement (on Water Resources)
NPV	Net Present Value
OA	Operational Agreement
OBC	Outline Business Case (for a DPC process)
Ofwat	Water Services Regulation Authority
PA2008	Planning Act, 2008
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PMB	Programme Management Board
PS	Pumping Station
RGF	Rapid Gravity Filter
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SESRO	South East Strategic Reservoir Option
SIPR	The Water Industry (Specified Infrastructure Projects) Regulations 2013
SoR	Statement of Response
SoS	Secretary of State for Environment, Food and Rural Affairs
SRO	Strategic Resource Option
SSSI	Site of Special Scientific Interest
STT	Severn to Thames Transfer
SWS	Southern Water Services
TPO	Tree Protection Order
T2AT	Thames to Affinity Transfer
TTT	Thames Tideway Tunnel
TW	Thames Water
WFD	Water Framework Directive
WRMP	Water Resources Management Plan
WRSE	Water Resources South East
WRW	Water Resources West
WRZ	Water Resource Zone
WTW	Water Treatment Works

1. Executive summary

1.1 Overview

1.1 The South East Strategic Reservoir Option (SESRO) is a raw water storage option in the upper catchment of the River Thames. It provides a resilient supply of raw water to the River Thames during periods of low flow. The SESRO partners, Thames Water and Affinity Water, have worked collaboratively to review this proposal and propose that it should continue to Gate 3 for further analysis and refinement.

1.2 The resource from SESRO could supply Thames Water (TW) customers both locally and in London, Affinity Water (AFW) customers in the Central Region via the Thames to Affinity Transfer and Southern Water (SWS) customers, through integration with the Thames to Southern Transfer SRO.

1.3 The six variants of SESRO are all included in the feasible option list for Thames Water's WRMP24. This includes four single phase variants and two dual phase, with the sizes unchanged from Gate 1. The wide range of alternative options at the site have been put forward to the regional WRSE modelling as alternatives ensure the best value option is selected.

1.2 Key Facts, "At a Glance"

Parameter	Summary for SESRO	Section
Site Location	The reservoir site is located just south-west of Abingdon. The largest (150 Mm^3) footprint covers an area of just under 7 km^2.	3.1
Preferred option	The option that was chosen in WRMP19 and in the WRSE emerging regional plan in January 2022 was the largest (150 Mm^3) variant. However, further modelling and analysis of associated costs and metrics has concluded with the inclusion of the 100 Mm^3 option within the draft Regional Plan (WRSE) and the draft WRMP24.	8.3
Deployable Output (DO)	The single-phase options could deliver a dry year annual average DO during a 1 in 500 year drought of between 149 (75 Mm^3 option) and 271 Ml/d (150 Mm^3 option), potentially shared between Thames Water, Affinity Water and Southern Water. For comparison, the 100 Mm^3 option has a DO of 185 Ml/d. These values have been refined from Gate 1, through the inclusion of climate change impacts.	4.2
Earliest delivery date	Depending on size, SESRO could be available during 2037. The application of programme level risk allowances could push the earliest delivery date into 2044, but mitigation is planned to minimise such risk.	7
Cost	The largest single-phase option (150 Mm^3) has an Average Incremental Cost (AIC) of £0.92/m^3 and a Net Present Value (NPV) of £1.46Bn. By way of comparison, the 100Mm^3 option has an AIC of £1.15/m^3 and an NPV of £1.29Bn.	8.1
Carbon	SESRO has a relatively high embodied carbon footprint compared to other options, largely driven by the volume of earthworks required, but mitigation opportunities are available. The operational carbon is relatively low with potential for energy recovery. Overall, the net present value of the total future carbon emissions of the scheme are estimated at between £65M (75 Mm^3), £73M (100 Mm^3) and £87M (150 Mm^3). All options are expected to provide a net benefit to carbon sequestration, changing largely arable arable land to habitats with a greater capacity for carbon sequestration.	6.6
Environmental Impacts	Although the construction phase would be expected to result in a number of adverse environmental effects, largely due to the scale of the development, it is currently believed that these can all be addressed through appropriate mitigation. This requires further site based survey, analysis and consultation to confirm	6.1, 6.2.2

Parameter	Summary for SESRO	Section
	acceptability, which will be progressed during subsequent stages. The smaller reservoir sizes would be expected to cause less construction phase environmental impact, due to the reduced scale of impact, but this needs to be balanced against their reduced water supply benefit potential. There are also potential operational phase impacts, most notably associated with WFD compliance and landscape and visual impacts requiring mitigation. The risk of WFD non-compliance has been re-assessed and an extensive mitigation package of watercourse diversion and ditch and wetland creation has been agreed in principle with the Environment Agency.	
Biodiversity Net Gain	All of the SESRO options exceed the required 10% net gain in habitats. The 75 Mm^3 Reservoir option provides the greatest gain in biodiversity units of 51.64% and the least loss in hedgerow units –10.68%. The 150 Mm^3 reservoir option provides the least gain in habitat units of 33.09%. However, this analysis is influenced by the choice of site boundary, which has not yet been refined or optimised.	6.5
Added value and benefits	All SESRO options could deliver a positive benefit to natural capital value at the site. This is particularly through enhancements to carbon sequestration and the provision of recreation and green space amenity, although offset by losses to productive agricultural land. SESRO could create employment opportunities during the construction and operation, with approximately 7,000 full-time equivalent employment years created. During operation, over 50 further jobs created. The net health benefit of SESRO (150 Mm^3) annually equates to over £3m.	8.2
Water Quality Risks	Risk assessment has identified a number of potentially driving hazards, including phytoplankton bloom, release of algal toxin by cyanobacteria, release of taste and odour generated by biological activity in the reservoir, storm-event related treatment challenges, pollution events associated with industry upstream and cryptosporidium risk. Control measures will be incorporated into the design of the SESRO system, as required, during subsequent project stages.	5
Planning Issues	All of the SESRO single-phase options would qualify as Nationally Significant Infrastructure Projects (NSIP) and would therefore need to be consented through a Development Consent Order (DCO) under the Planning Act 2008 (PA2008).	0
Procurement	SESRO's size and characteristics make it well suited to a fully competitively tendered delivery model – either DPC or SIPR. Initial analysis indicates that there is potential to deliver lower cost to customers (and increased value-for-money) under the regulated approach offered by SIPR. Ofwat have recommended that Government legislate to remove the 'size or complexity' test that existing SIPR legislation applies. Further work (alongside Ofwat and RAPID) is needed to understand the likelihood and potential timescales of such a change, in order to set out a final proposed approach at Control Point C.	7.5
Key Risks	The key risks identified for the scheme include programme risks associated with the integration of the WRSE, WRMP24 and subsequent DCO processes, risks with local stakeholder concerns and opposition, environmental risks with scheme consenting and planning risks linked to the NPS for Water Resources. Mitigation has been identified and further work to reduce uncertainty is planned for Gate 3.	7.3

1.3 Conclusions

1.4 The SESRO option that is proposed by both partners in their Draft WRMP24 and in the WRSE draft Regional plan for the south-east is the 100 Mm^3 storage reservoir, with resources shared between TW's London zone, AFW's Central Region and SWS's Hampshire region. This option is required by 2040.

1.5 Our Boards have signed the Board Statement and recommend that development of the SESRO should continue to Gate 3.

2. Background and objectives

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

Table 2.1: Summary of documents within Gate 2 submission

Document	Synopsis of contents
Gate 2 Technical Report	Overview of all technical and commercial assessments completed, as required by RAPID Gate 2 guidance
A1, Concept Design Report	Summary of all engineering design and delivery details associated with the scheme, including the water resources assessment
A2, Cost Report	Summary of the costs of the scheme and associated options (capex, opex, costed risk and optimism bias)
A3, Carbon Report	Summary of the carbon footprint of the scheme, strategy to mitigate such emissions and discussion of any renewable energy generation opportunities from the scheme
B1, Environmental Appraisal Report (aquatic)	Presenting the findings of the appraisal of aquatic environmental impacts from the scheme (and different options) and documentation of all associated water quality modelling and aquatic ecological appraisal work undertaken
B2, Environmental Appraisal Report (terrestrial)	Presenting the findings of the terrestrial environment desk-based assessments undertaken, identifying the potential impacts of the scheme, benefits assessment and opportunities for mitigation.
B3, Conservation, Access and Recreation Strategy	Overview of the potential conservation, access and recreation opportunities associated with the scheme, with an assessment undertaken of three alternative strategies based on different intensities of site use
B4, Habitats Regulations Assessment (HRA)	Results and discussion on the assessment of the scheme completed under the requirements of the Conservation of Habitats and Species Regulations (2017) as amended (Habitats Regulations)
B5, Water Framework Directive Assessment	Results and discussion on the assessment of the scheme options completed under the requirements of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
B6, Biodiversity Net Gain Report	Results and discussion on the assessment of the scheme options for biodiversity net gain, both aquatic and terrestrial, as required by the Environment Act 2021.
B7, Inputs into WRSE and WRMP24 Strategic Environmental Assessment (SEA)	Presentation of the strategic assessment of the scheme options against the environmental objectives for the WRSE regional water resources plan and WRMP24 and consideration of in-combination assessment with other local plans and programmes.
C, Drinking Water Risk Assessment	Outputs and discussion of the drinking water risk assessment completed for the scheme options
D, Stakeholder Engagement Strategy	Overview of stakeholder engagement completed since Gate 1, integrated with that initiated as part of the WRSE regional plan and WRMP24, discussion of customer engagement undertaken to support the SRO and strategy for future stakeholder and community engagement
E-1, Procurement Strategy	Discussion of future procurement strategies to deliver the SRO, value for money analysis and recommended commercial delivery models for future development
E-2, SIPR Appendix to Procurement Strategy	Further consideration of the applicability of a SIPR delivery model for SESRO

Document	Synopsis of contents
F-1, Project Delivery Plan	Overview of proposed scope and costs beyond Gate 2 looking forwards towards submission of consent application(s), future programme overview, key risks and proposed mitigation strategy
F-2, Efficiency of Spend	Discussion of cost efficiencies in delivery of Gate 2 submission and forecast costs for Gate 3
G, Planning and Consents Strategy	Overview of different consent strategies and recommended approach, documentation of River Thames consenting strategy and overview of secondary consents and environmental permits required

2.1 Background

2.1 SESRO is one of the options considered by WRSE and by Thames Water, Affinity Water and Southern Water, to meet their future demands for water supply.

2.2 In July 2021, Thames Water and Affinity Water submitted their Gate 1 report to RAPID. The Gate 1 assessment (January 2022) included the following actions and recommendations, which are all addressed by this Gate 2 submission.

Table 2.2 Gate 1 Actions and Recommendations from RAPID

RAPID Requirement	SESRO Response at Gate 2 (and cross-reference)
Actions	
Determine deployable output (DO) benefits when the South East Strategic Reservoir Option-Severn to Thames Transfer(SESRO-STT) joint options are combined with Thames to Southern transfer(T2ST) rather than supplying London only, as outlined in response to query SER004.	Section 4: Analysis of DO benefits of combining SESRO, STT and T2ST has been completed. Combining the SESRO options with the STT and the T2ST could deliver additional deployable output of up to 19 Ml/d.
Provide a landscape and visual impact assessment, the project team should engage with and work with the AONB Board on this	Section 6 and Supporting Technical Document B2: Initial desk-based assessment has been completed for Gate 2. Technical Liaison Group established to agree the scope of this work, including representatives from OCC, VoWH and North Wessex Downs AONB.
Provide a detailed assessment of interdependencies and in-combination impacts with other strategic resource solutions and other options following the output of Water Resources South East (WRSE) modelling	Section 6: In-combination assessment of environmental impacts has been completed Section 8: Discussion of SESRO position in draft WRSE Regional Plan
Recommendations	
Continue investigation of combined SESRO-STT modelling to determine any additional DO benefits and report on findings.	Section 4: Full analysis of deployable output benefits of combining SESRO, STT and T2ST has been completed for Gate 2 (see above).
Revise environmental findings of WRSE in-combination assessment	Section 6: In-combination assessment of environmental impacts has been completed
Further investigate the DO conjunctive use benefits associated with the Thames to Affinity transfer (T2AT).	This is reported in Section 4 of the T2AT Gate 2 submission.
Further consider the conjunctive use benefits of the SESRO and STT solutions, we note that SESRO and STT submissions at gate one differ on this point.	Section 4: Deployable output analysis updated for Gate 2, which includes analysis of conjunctive use benefits of combining SESRO, STT and T2ST (see above)
Provide further detail on how the Thames Water Asset Planning System aligns with or diverges from other standard carbon footprinting methods as this would improve the consistency of the submission	Section 6: Carbon assessment and mitigation analysis has been updated and completed for Gate 2. Complete report available as Technical Supporting Document A3: Carbon Strategy.

2.3 There are a range of feasible volumes for the SESRO scheme (see Section 3.1). All are developed as feasible options for Water Resources South East (WRSE) and Water Resource Management Plan (WRMP) options appraisal processes, with associated cost and environmental impact assessment. This is consistent with all other feasible options considered for the plan(s). However, for the purposes of the Gate 2 appraisal, and to ensure that sufficient progress could be made with the technical appraisal of the scheme and the assessment of key issues and constraints, focus has been on the largest (150 Mm^3 storage) option. This was the option that was selected in the WRSE emerging regional plan, published by WRSE in January 2022, hence the best available information at that time.

2.4 The 150 Mm^3 option, as the largest option for the proposed site, has formed the basis of the design work completed for Gate 2. Although all options were considered technically feasible and available in the regional planning and WRMP processes, this largest scheme contains the most constraints and issues to resolve and hence was considered a better 'starting point' for the Gate 2 design process and for the development of the indicative Gate 2 Master Plan (see Figure 3.1), enabling future iterations to smaller schemes, if required. Drafts of the WRSE Regional Plan and the WRMP24 include a smaller option for SESRO (100 Mm^3). Assuming this choice is retained in the Final plans, we will optimise the design and assessment to a smaller size during subsequent design phases and consult upon the details of this smaller scheme in due course.

2.2 Water Resource Objectives

2.5 The primary drivers for the need for additional water supply (as provided by this and other SROs) are summarised in Table 2.3 below; these are used by WRSE and by the Water Companies in WRMPs to determine the amount of additional water needed to supply customers in the future. Further details of the contributions of each driver may be found in the WRSE draft Regional Plan and in the partner companies' draft WRMPs.

Table 2.3 Primary water resource drivers and estimated additional demands for water (Ml/d)

Driver	WRSE Implication
Future Population Growth	Results in the need to supply water to more customers. Forecast methodologies are contained in the UK Government's Water Resources Planning Guidance[1]. The impacted companies should plan for future population growth. WRSE uses the latest regional forecasts produced by the Office of National Statistics, local authority housing plans and potential growth in the area between Oxford and Cambridge.
Impacts of climate change	May reduce available flows in rivers or groundwater recharge thereby reducing the amount of water that can be supplied from existing water sources.
Impacts of existing abstractions	Taking water from rivers, streams and underground sources can cause damage to the environment. Water companies need to reduce how much they take from some of their most sensitive water sources to prevent damage in the coming years and help improve them. This reduces available supply. Under the Environment Agency's National Framework for Water Resources[2], regional water resource groups are required to explore and implement the steps

[1] Environment Agency, April 2022, Water Resource Planning Guideline v10
[2] Environment Agency, March 2020, Meeting our future water needs: a national framework for water resources, p6

Driver	WRSE Implication
	required to achieve a shared Environmental Destination to reduce the most environmentally unsustainable abstractions.
Improved drought resilience	The Environment Agency's National Framework for Water Resources[2], requires companies to plan for a higher level of resilience to drought, so that restrictions such as rota cuts and standpipes will be needed no more than once every 500 years on average.

2.6 Reductions to leakage and to water consumption are also applied, as prescribed by the Environment Agency's National Framework for Water Resources[2]. These aspects are all adopted by WRSE and the partner companies, contributing to the overall future demands for water supply. There is a high level of risk and uncertainty associated with the effectiveness and timing of government led water efficiency measures, on which the WRSE draft Regional Plan and draft WRMPs are based. These will add pressure to demand if they are not delivered in line with WRSE assumptions.

2.3 Other scheme objectives

2.7 There are a number of other objectives that SESRO may be able to achieve, aligned with other societal requirements. These objectives are aligned to those developed by the National Infrastructure Commission to guide the development of NSIPs[3]. Further information on these Design Principles and vision for the SESRO scheme may be found in Supporting Document A1: Concept Design Report. The indicative Gate 2 Master Plan for the scheme, as discussed in Section 3 of this report, shows the development of the scheme against these objectives. The discussion of wider benefits in Table 4.2 shows the range of possible initiatives that are being explored to help deliver some of these additional objectives.

3. Solution design, options and sub-options

3.1 Solution description

3.1 The South East Strategic Reservoir Option (SESRO) is an 'off-line', fully bunded raw water storage reservoir in the upper catchment of the River Thames.

3.2 Water would be abstracted from the River Thames during periods of high flow and stored in a reservoir, to be released back into the River Thames when there is a need to augment the flows in the River Thames. Water released from SESRO could be re-abstracted by existing or new infrastructure further downstream to supply customers of Thames Water and Affinity Water.

3.3 SESRO also incorporates the future flexibility to abstract water direct from the reservoir, treat it on site and then transfer potable water either to the south to serve Southern Water[4] or else to support TW's Swindon and Oxfordshire supply zone[5].

[3] National Infrastructure Commission, February 2020, Design principles for national infrastructure
[4] Thames to Southern Transfer, another SRO project, jointly funded by Thames Water and Southern Water
[5] The additional transfers and associated water treatment facilities are not included within the SESRO core scheme, although a provision of land allocation within the scheme is identified for such future use

These elements will continue to be explored as the scheme develops and the timing and magnitude of each is confirmed in the final WRMPs.

3.2 Options considered

3.4 SESRO is one of various raw water storage reservoirs that have been considered for WRMP24 by Thames Water. Alternative options have been passed through an appraisal process[6] and feasible options costed and assessed as part of WRMP24. Building on work undertaken for previous WRMPs, appraisal of alternative reservoir sites has been completed and reported within the document suite for Thames Water's draft WRMP24.

3.5 Several size variants of the SESRO scheme have been included in the Thames Water WRMP24 Constrained List of options and submitted as options to WRSE, as follows:

- 150 Mm^3 capacity reservoir
- 125 Mm^3 capacity reservoir
- 100 Mm^3 capacity reservoir
- 75 Mm^3 capacity reservoir
- 30+100 Mm^3 capacity phased reservoir
- 80+42 Mm^3 capacity phased reservoir

3.3 Option configuration and operation

3.6 The combined river intake / outfall Structure would be located on the western bank of the River Thames upstream of Culham. Abstracted water would pass through a tunnel and pumping station and jetted into the reservoir at the base of an inlet tower.

3.7 Water being discharged back into the river would pass through an outlet tower and the same tunnel before flowing over a stepped gravity weir at the outfall, which would maximise aeration whilst avoiding scour to the River Thames.

3.8 The current conceptual design provisionally allows for the inclusion of the outfall for the Severn to Thames Transfer (STT) SRO project within the SESRO outfall, providing a more efficient combined solution should both schemes be implemented.

3.9 The intake for the reservoir would operate under strict conditions imposed by the Environment Agency's future environmental permit for the scheme. This would be sought as part of the scheme's consenting strategy. These parameters have been developed in collaboration with the Environment Agency during the various previous iterations of the scheme in previous WRMPs and are used as the basis of the water resource and environmental appraisal undertaken at Gate 2:

3.10 The need for water to be released from the reservoir would be triggered by conditions in the lower River Thames, governed by the Lower Thames Operating Agreement[7]. It is expected that the release would primarily be triggered during periods of low flow.

3.4 Key assets required

3.11 The key components or assets required to deliver the scheme are as follows:

[6] Thames Water WRMP24, Reservoir Feasibility Report Update.

[7] Further information may be found in Supporting Document G: Planning and Consents Strategy

- Provision of a fully bunded raw water storage reservoir in Oxfordshire, 5km south-west of Abingdon.
- Pumping station at the toe of the embankment (on the north-east side of the reservoir) including both inflow pumps and outflow energy-recovery turbines.
- Conveyance tunnel to transfer flows via the pumping station to and from the intake / outfall structure on the River Thames near Culham.
- Auxiliary drawdown channel (ADC) linking the reservoir siphons to the River Thames, to allow drawdown of the reservoir in emergency scenarios. This could also form a navigable channel and as plans progress for the SESRO scheme there is an opportunity to engage with the promoter of any rehabilitation of the Wilts & Berks Canal for an ADC to form part of their scheme.
- Main access road into the site (from A415, Marcham Road) and diversion of the existing East Hanney to Steventon Road.
- Temporary rail siding to facilitate delivery of certain construction materials by freight train.
- Public access, parking and recreation facilities, public education facilities, landscaping and creation of aquatic / grassland habitats.
- Local stream channel diversion to both the east and the west of the reservoir and construction of compensatory floodplain.

3.12 To provide a first illustration of how the engineering requirements of the scheme may be integrated with the expected environmental mitigation and with possible recreational uses of the site, an indicative landscape and environment led Master Plan for the largest SESRO option has been developed for Gate 2 (see Figure 3.1). This vision will be subject to change and refinement if SESRO progresses through scheme promotion, through future consultation, environmental assessment and associated design iterations, but provides an initial overview of how the largest SESRO option could be conceptualised. This level of indicative detail is considered appropriate for the SESRO Gate 2 submission. It may exceed that available or presented for other SROs, due to the maturity of the scheme (it has been considered in many previous strategic plans and subject to various previous public consultations) and the level of public interest in the scheme, as demonstrated by the consultation on the WRSE emerging regional plan and the SESRO Gate 1 submission (see section 9). As noted in paragraph 2.4, the 150 Mm^3 option, as the largest option for the proposed site, has formed the basis of the design work completed for Gate 2. Although all options were considered technically feasible and available in the regional planning and WRMP processes, this largest scheme contains the most constraints and issues to resolve and hence was considered a better 'starting point' for the Gate 2 design process and for the development of the indicative Gate 2 Master Plan.

3.13 This indicative Gate 2 Master Plan has been informed by the design principles and vision for the scheme and driven by the initial desk-based environmental assessments that have been completed (see Section 6.1) and by initial community feedback. These are demonstrated in Table 3.1 below.

3.14 We aim to develop this indicative Gate 2 Master Plan once the volume and / or phasing of the preferred scheme is confirmed by WRMP24 and as we progress more local, community engagement on the specific design and use of SESRO.

Table 3.1 Summary of key aspects of the Indicative Gate 2 Master Plan

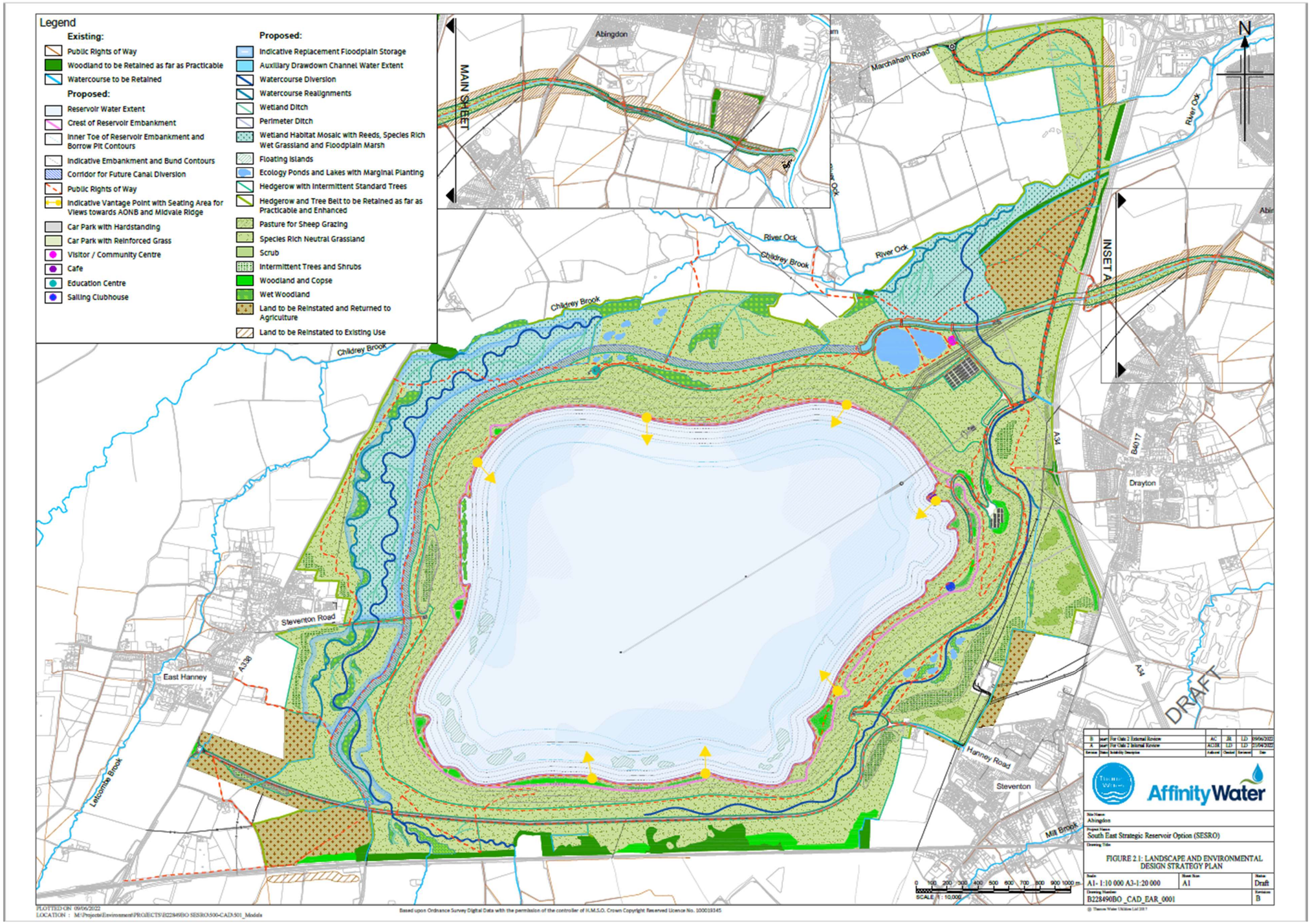
Design Philosophy	Indicative Gate 2 Master Plan 'response'
Provide value to local communities	Provide **recreational and access opportunities** for local communities. **Small scale water-based recreation**, under controlled conditions (such as via a sailing club or similar), could be provided in the north-east corner, co-located with the main access routes into and out of the site. This corner, furthest from the local villages, could be a much busier part of the site, dedicated to the more intensive recreational uses. The access and recreational concept for the site is intended to be modest, at this early stage, and to maximise environmental benefit and to minimise disturbance and disruption to the closest villages. The wetland focused western part of the site, adjacent to **East Hanney** could be designed to be a **quieter, less disturbed** part of the site, to maximise the environmental benefit. Some local access and parking could be provided on this western side for the benefit of East Hanney. Visitor footfall to the south-east corner of the site, around **Steventon**, could also be discouraged to **minimise disturbance.** However, the indicative master plan has been currently developed to **allow local access** from both villages to the circular **footpath and cycle path networks**, along with **limited local parking**.
Manage visitors to the site to minimise local disruption and maximise environmental benefit	'Zoning' of the site into different areas, to implement the **habitat creation and mosaic of biodiversity net gain** required and also to help manage the flow of visitors into and around the site and to help **protect the more sensitive areas**. Access into and out of the site could be configured to **minimise disruption to local traffic networks**, as far as possible, making best use of the adjacent trunk main and A-road network. This enables the main access road to come into the site from the north, directing the majority of visitors and operational traffic to the north-east corner of the site, furthest from the existing villages of East Hanney and Steventon. A **modest visitor 'hub'** could be provided at this location, adjacent to the main parking areas, with a **small café on the embankment crest** overlooking the views of the Ridgeway towards the south.
Focus on the aquatic environment	The management of water on site, either drainage, stream diversion or floodplain compensation is designed to make best use of the existing topography of the site. This could enable the **lower lying western areas** to be **dedicated** as a conservation and biodiversity led sector, providing **extensive wetland habitat** creation. A small **education centre** is envisaged to the north of this sector, providing educational opportunities for the local school communities. We have suggested the possibility of integrating this wetland creation, with **conservation led features** along the west and south-west sides of the main reservoir, including **lagoons and small floating platforms for wildfowl**.
Enable access for all	The network of footpaths and cycle paths across the site could provide enhanced **integration with the existing Public Rights of Way network** and provide access to all across the site and **link up with all surrounding routes and villages**. The new paths across the site could include a crest path around the reservoir, various circular routes around the embankment and multiple access points up to the crest. The footpaths around the quieter western sector could be designed to integrate into the wetland areas.

3.15 The design development undertaken for Gate 2 aligns to the design principles set out by the All Company Working Group Gate 2 methodology on design[8], with further details provided in Supporting Document A1: Concept Design Report. This methodology provides a guiding framework for the design of the SROs to ensure consistency and best-practice.

[8] All Company Working Group (ACWG) Design Principles, Process and Gate 2 Interim Guidance, December 2021, Fereday Pollard

Figure 3.1 SESRO 150Mm3 option, Indicative Gate 2 Master Plan

note, the details of this plan are subject to change through future community engagement and consultation, further environmental assessment and associated design development; it will be adjusted, as required, once the size of the preferred scheme is confirmed by WRMP24



3.5 Interactions with existing assets and other SROs

3.16 There are significant potential resource sharing, physical and operational interactions between SESRO and other SROs and local water supply schemes, which may need to be integrated together in the final scheme design, depending on the final timing between schemes. These are summarised in Table 3.2 below.

Table 3.2 SESRO interactions with other SROs and existing assets

SRO or existing asset(s)	Physical interface at SESRO site	Shared water resources	Operational integration	Timing implications*	Comments
Severn to Thames Transfer (STT) SRO	Y	Y	Y	2050	DO benefit of combining (see section 4.2 below)
Thames to Southern Transfer (T2ST) SRO	Y	30%	Y	2040	
Thames to Affinity Transfer (T2AT) SRO	-	30%	Y	2040	
Supply to Thames Water's Swindon and Oxford (SWOX) and Slough, Wycombe and Aylesbury (SWA) supply zones	Y	Y	Y	2050	Supplied from SESRO and STT combined hub
Potential integration with Farmoor Reservoir	Y	Y	Y	2050	Part of TW's Environmental Destinations[9].

** in accordance with WRSE draft Regional Plan and draft WRMP24*

3.17 These interactions and the implications for SESRO are summarised in Table 3.3 below. The exact integration of these different aspects has not yet been decided and will not be until the exact timing between them is finalised in the Final WRMP. However, it is probable that some of the aspects noted above may need to be integrated into the DCO for either SESRO or the STT, in order to deliver the schemes in the most cost efficient and the least environmentally and socially disruptive way.

Table 3.3 Interactions of SESRO with other SROs and with other local supplies and sources

Interaction	Implication for SESRO
STT	The route of the STT pipeline passes close to the SESRO site. The two schemes could be joined via a connecting valve chamber west of the A34 crossing, linking the STT pipeline and the SESRO intake pumping station. This means that either scheme could be delivered first, depending on the outcome of the WRMP process. The lower section of the STT pipeline follows the approximate route of the SESRO ADC and discharges to the River Thames at the same location as SESRO. The concept design currently allows for the lower sections of the STT pipeline to be constructed at the same time as the ADC, located in the towpath of the canal. This would minimise construction disruption, avoid the need for multiple road crossings and reduce the land area required for the two schemes. A single outfall structure could accommodate the discharge from both schemes. If STT precedes SESRO, then this configuration will need to be revised, but the current approach reflects the timing of the schemes within the draft WRMP.
T2ST	The proposed site for the water treatment works (WTW) for the T2ST is currently located on the SESRO site, adjacent to the intake pumping station. The site for this works would either need to

[9] In the draft WRMP the reductions at Farmoor are within the Medium scenario (15Ml/d reduction in Deployable Output by 2050) and High scenario (35Ml/d reduction in Deployable Output by 2050).

Interaction	Implication for SESRO
	be safeguarded within the SESRO site design, to enable future construction when required under separate consent by a third party, or else included within the SESRO scheme, depending on scheme timing. The initial sections of treated water main to Southern Water would pass to the east of the SESRO embankment, before crossing the Great West Railway. It is expected that the initial section of this treated water main would need to be constructed as part of the SESRO scheme, to avoid destroying new habitat that would be created as part of the SESRO scheme. The SESRO indicative Gate 2 Master Plan has been developed to ensure such a pipeline route is available through the site, into which the T2ST SRO could then connect, as required.
SWOX Supply and Farmoor	The proposed site for the water treatment works for the local SWOX supply is currently located on the SESRO site, adjacent to the intake pumping station. The site for this works would either need to be safeguarded within the SESRO site design, to enable future construction when required under separate consent by a third party, or else included within the SESRO scheme, depending on scheme timing. The initial sections of treated / raw water main(s) to SWOX and Farmoor would pass to the north, crossing the River Ock floodplain. The SESRO indicative Gate 2 Master Plan has been developed to ensure a route for these main(s) is available. The optimised option for meeting the SWOX supply and the abstraction reduction at Farmoor Reservoir has yet to be developed.

3.6 Scalability

3.18 The SESRO options enable a degree of scalability and future phasing, but this is within the constraints of the main option chosen. For each of the single phase options, once built, these would not enable easy future expansion and no such facility is currently built into the concept design. The two phased options are available, which would enable the assets, and hence the available deployable output, to be phased if that is the best value solution. The phased options do tend to be more expensive (see Section 8.1) as they involve more earthworks, overall, for the volume of storage created, and would need to be developed in multiple construction phases thereby extending the time of the construction phase impacts.

3.19 The integration with other schemes would enable scalability in the future. For example, the STT connection could be enabled for future use but not commissioned immediately, which would enable future integration with transfers from the Severn to maximise the potentially available additional DO (see Section 4.2.1). Equally, the SWOX supply or the T2ST WTWs could be developed in a modular fashion, depending on future need for the water. The design of these aspects of the scheme will be developed during the next design phase, depending on the outcome of the WRMP24 process.

4. Water resource assessment

4.1 Utilisation

4.1 The long-term utilisation of the SESRO scheme has been established using the WRSE Regional System Simulation (RSS) model, providing a very long timescale of possible hydrological and hence operational conditions. The operational utilisation includes the impacts of climate change. Data is presented for the 150 and 75 Mm^3 options, to

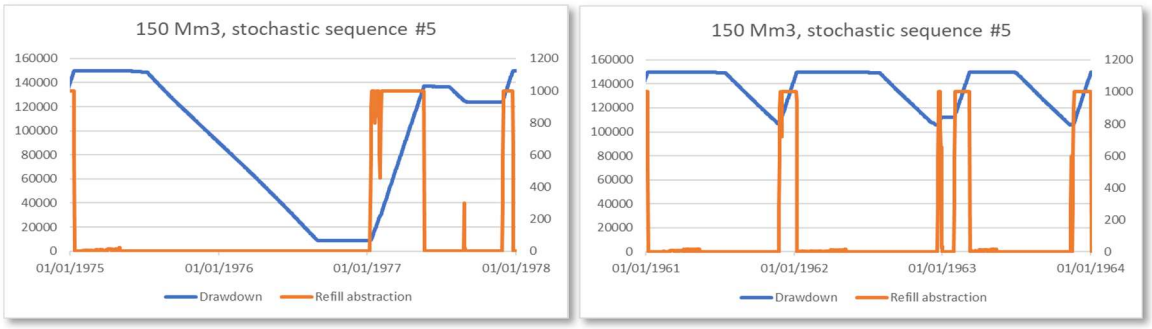
provide an indication of the range of scheme utilisation between the smallest and largest single phase scheme variants[10].

4.1.1 Reservoir Refill

4.2 During winter periods (October to March), the 150 Mm^3 option would, on average, need to abstract from the River Thames for approximately 20 - 30% of the time. This reduces to very low frequency of abstraction during summer periods. The same pattern is also true for the 75 Mm^3 option, but the frequency of abstraction operation is reduced to approximately 10 – 15% per year.

4.3 Following drought periods, which result in longer periods of reservoir release to meet demands for water and hence a lower and deeper drawdown period, abstraction refill occurs for longer during the subsequent refill season as greater volumes are required to refill the reservoir. However, even after a long period of extreme drought and drawdown, refill is still achieved within 5 months. This is illustrated in Figure 4.1 below for one of the synthetic stochastic hydrological sequences. Refill would tend to be faster for the smaller reservoir sizes, due to the reduced volumes of storage.

*Figure 4.1 SESRO drawdown and refill – extreme drought (left) compared to standard operation (right)**



* *Note, primary y-axis is drawdown (Ml) and secondary y-axis is refill abstraction (Ml/d)*

4.1.2 Reservoir Release

4.4 On average, over the long-term, the 150 Mm^3 option would be releasing up to 45% of the time during the summer (April to September) and up to 30% of the time during the winter. This reduces slightly for the 75Mm^3 option.

4.5 In terms of indicative operational pattern during the year, the reservoir would normally start to release in July and then operate as long as required to meet demands. The modelling suggests that during a normal year, the release would occur July – November, with releases taking place over much longer periods during more extreme droughts, to feed higher demands and reflect lower hydrological flows.

4.1.3 Reservoir Drawdown

4.6 As a consequence of this refill and release pattern, the drawdown in the reservoir, which is the reduction in water level in the reservoir due to the release of water into

[10] It should be noted that the utilisation of the smallest element of the phased option (30 Mm^3) has not been analysed in detail, as this option has not been selected by any of the strategic plans. The operation of the other phased elements (42, 80 or 100 Mm3) are all encompassed within the 75 – 150 Mm3 range that has been analysed. Further work would be progressed on these aspects should any of the phased options be selected in further iterations of the WRSE regional plan or WRMP24.

the River Thames, can also be predicted during normal year and extreme drought conditions. Probability analysis of this data allows us to estimate how often the water levels would be expected to be below a particular depth.

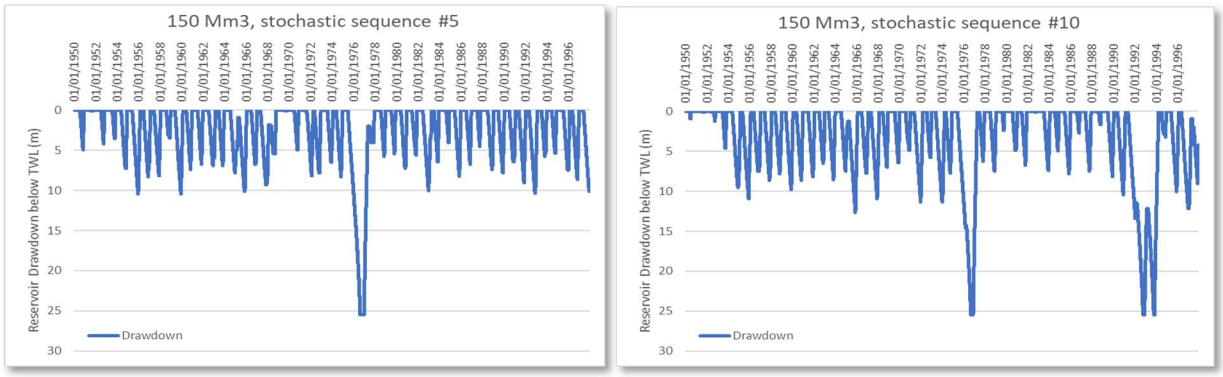
4.7 For the 150 Mm^3 option, during summer periods (April to September) there is approximately 50% likelihood that the reservoir would be retained full throughout the summer. During the summer, there is only a 15% chance of drawdown over 4m.

4.8 For the smaller 75 Mm^3 option, the drawdown pattern is similar, but less extreme. Indicatively, during the summer, there is only a 5% chance of drawdown over 4m.

4.9 The likelihood of extreme drawdown is very low indeed. A drawdown of over 10m is only expected for between 2.5 and 5% of the time, overall, for the 150 Mm^3 reservoir and certainly not during every year.

4.10 The timeseries analysis suggests that during more 'normal year' operation, the drawdown would be in the region of 7 – 7.5m at most, with more drawdown only occurring during more extreme drought events. An illustrative plot of the long-term drawdown from Top Water Level (TWL), Figure 4.2, shows this more clearly.

*Figure 4.2 Illustrative long-term timeseries of reservoir drawdown**



**simulated reservoir drawdown for two of the median climate change influenced stochastic hydrological sequences (5 and 10), indicative of the expected long-term pattern of use. For context, maximum drawdown to emergency storage level is 25.4m.*

4.11 We have developed a relationship between the maximum drawdown expected in any given year, compared to the return period of the River Thames flow. As the return period of the summer low flow period increases (i.e. as drought severity increases) so the level of drawdown increases. A hydrological drought with a return period of 1 in 20 years results in drawdown of about 9m, increasing to a drawdown of 20m for a 1 in 60 year drought.

4.1.4 Sensitivity to maximum climate change impacts

4.12 The analysis presented previously is all based upon a median estimate of the impacts of climate change in the 2070s on rainfall and river flows. Under the most extreme climate change scenario:

- utilisation patterns tend to be similar;
- the probability of years with long refill periods (>100 days) falls by about 15%;
- the probability of release increases slightly, with the probability of a year having more than 100 days of release rising by approximately 5%;

- this has a knock-on effect on water levels and drawdown, with the likelihood of drawdown greater than 4m rising by about 10%.

4.2 Water Resource Benefit

4.13 The Deployable Output (DO) of the options have been calculated using the WRSE RSS model. The same approach and methodology developed and adopted by WRSE[11], has been used by the SRO. The DO identifies the amount of water that could be delivered by each of the options during a 1 in 500 year return period drought, with demand restrictions applied to meet agreed levels of service. The stated minimum levels of service applied for Thames Water DO analysis are as quoted in the draft Water Resources Management Plan (WRMP24) documentation.

4.14 The Dry Year Annual Average (DYAA) DO[12] for Gate 2 is derived to take account of the estimated impact of future climate change in the 2070s (see Table 4.1 below). This scenario is the median of the 28 different climate change scenarios from WRSE[13].

Table 4.1 SESRO, 1 in 500 year drought DYAA Deployable Output values for all options

Option	1 in 500 year DYAA DO (Ml/d)
150 Mm³	271
125 Mm³	229.5
100 Mm³	184.6
75 Mm³	149.2
30 + 100 Mm³	65.5 + 173.1
80 + 42 Mm³	155.1 + 68.9

4.15 These values have been provided to WRSE, for use in the latest round of modelling to inform the WRSE draft Regional Plan and draft WRMPs.

4.2.1 Combined analysis of SESRO, STT and T2ST

4.16 Building on the work completed for RAPID Gate 1, further sensitivity modelling has been completed to explore the potential benefit of combining the SESRO, Severn to Thames Transfer (STT) and Thames to Southern Transfer (T2ST)[14].

4.17 This modelling enables the following conclusions to be drawn:

- Linking SESRO and STT provides additional base DO of 7.6Ml/d (1.2%). Linking the schemes means that STT water can be used to refill SESRO during the rare periods when the London support is not activated.
- Climate change has a greater (but minor) negative impact when the SROs are separate rather than linked, just 3.2Ml/d at the 1:500 return period. Therefore,

[11] WRSE, Aug 2021, Method Statement: Calculation of deployable output, post consultation version

[12] For baseline DO and all options for Thames Water in London, we consider only the DYAA planning scenario. Primary WR risk for London is prolonged drought and resultant impacts on water levels in the storage reservoirs; hence the focus on average dry year conditions rather than peak periods.

[13] Therefore, it does not represent a 'worst case' but is a reasonable mid-point estimate of future water availability from the SRO

[14] A single variant for each of the three SRO schemes was selected for this modelling on the basis of outputs from emerging WRSE draft Regional Plan: SESRO 150Mm³, STT 500Ml/d pipeline + 328Ml/d support and T2ST 120Ml/d.

the combined DO benefit of linking SESRO and STT is 11Ml/d when median climate change impacts are included on top of the base BO benefit.

- The option combination that results in the highest conjunctive use benefit and hence the most efficient system is the combination of the STT, SESRO and T2ST. If SESRO and STT are combined, then this could result in a net total benefit of 19 Ml/d if combined with the T2ST (i.e. additional 8 Ml/d from T2ST link).

4.3 Long-term Opportunities

Resilience

4.18 The different options have been assessed by WRSE using a series of standard resilience metrics. These metrics are then used in subsequent 'Best Value Planning' analysis to derive the WRSE draft Regional Plan and hence inform draft WRMP24. The resilience metrics[15] for SESRO are largely the same across all reservoir options. They show that the options have a high degree of reliability and adaptability, reflecting resilience to transient shocks and stresses and a high level of ability to help manage unforeseen future operational complexity, but a relatively low evolvability, reflecting the limited ability of the options to respond to unplanned or longer-term changes to the supply requirements as their ability to adapt, once constructed, is limited. However, SESRO has been shown in the WRSE draft Regional Plan to be able to provide part of a more adaptable regional solution to meet more severe future situations, when considered conjunctively together with the STT.

Opportunities for additional benefits

4.19 The SESRO options also provide a wide range of opportunity for additional benefits, which might be realised through use of additional funding from third parties.

4.20 A number of the elements that would enable integration with other SROs are considered to be critical components either due to timing of need or that they would be difficult to upgrade at a later date, hence they have been incorporated into the Indicative Gate 2 Master Plan design from the outset. Each of these elements will be explored during subsequent project development stages once the need and sequencing of schemes is confirmed in the Final WRMP.

4.21 The elements that have been considered for SESRO at Gate 2 are listed in Table 4.2 below. The non-critical elements are not yet included in the core SESRO options at this stage, as the costs, impacts and benefits of each have yet to be fully explored.

[15] Further details of the WRSE resilience framework can be found at: Resilience Framework | Water Resources South East (engagementhq.com)

Table 4.2 Additional opportunities offered by SESRO for benefits realisation or asset integration

Opportunity	Category	Description	Benefits	Impacts / Issues	Primary Funding
Farmoor raw water pipeline	Critical component	Providing raw water pipeline to balance resources between SESRO and Farmoor Reservoir, to allow reduced abstraction at Farmoor during low flow periods	Enhanced flow (and resulting environmental benefit) to the Oxford Watercourses	Land and environmental impacts from new pipeline; additional costs; timing of need will drive level of integration with SESRO	Thames Water, included in draft WRMP
SWOX supply pipeline and water treatment works (WTW) at SESRO	Critical component	New water supply pipeline to link SESRO resource to local supply centres in Swindon and Oxford (SWOX) zone	Supply resilience; could be integrated with raw water pipeline to reduce impacts and costs; Construction of WTW with SESRO would reduce impacts	Land and environmental impacts from new pipeline; additional costs; timing of need will drive level of integration with SESRO	Thames Water, included in draft WRMP
Integration with Severn to Thames Transfer (STT)	Critical component	Construct lower sections of STT pipeline into towpath for SESRO ADC + use same river discharge structure for both schemes	Cost savings through integrated construction; minimise environmental impacts and land take	Asset ownership and access arrangements for maintenance; additional cost; timing of need will drive level of integration with SESRO	STT SRO
Integration with Thames to Southern Transfer	Critical component	Construct WTW and initial section(s) of T2ST pipeline within SESRO site when constructing SESRO	Reduced cumulative environmental impacts; habitat loss if constructed separately	Asset ownership and access arrangements for maintenance; additional cost; timing of need will drive level of integration with SESRO	T2ST SRO
Additional storage would help manage outage in lower Thames reservoir system	Opportunity for Thames Water	Thames Water's lower Thames reservoirs require periodic maintenance. This requires outage (drain-down) of the asset in question, but reducing available storage increases risk to customer supply	Provision of additional strategic storage in the Thames catchment would enable Thames Water to plan outage and critical maintenance at their lower Thames reservoirs with greater certainty and lower risk		SRO
Flood resilience for Abingdon	Opportunity for additional third party benefit	Use of SESRO access road to attenuate flood flow in River Ock to help protect properties in Abingdon from flooding	Commercial and residential properties within Abingdon protected to a higher degree from fluvial flood risk	Impacts on properties upstream of new access road; complex commercial arrangements for operation	Environment Agency
Flood resilience for River Thames	Opportunity for additional third party benefit	Retaining 'spare' capacity in SESRO at start of winter, to pump peak flood flows into reservoir (if required)	Potential for approximately 550 Ml/d (2.5%) reduction in very high flood flows for River Thames downstream of SESRO; no additional infrastructure required and no impact on DO	Possible water quality risks to reservoir; operational control rules need to be agreed	SRO
Alternative alignment of Hanney Road	Opportunity for additional third party benefit	Alternative routes for the diverted Hanney Road, which enables traffic to bypass Steventon	Possible improved traffic congestion in Steventon	Additional costs; additional land take and impacts	SRO and / or Oxfordshire County Council
Wilts and Berks Canal	Opportunity for additional third party benefit and environmental benefit	Development of the safeguarded route through SESRO site, to construct an additional section of Wilts and Berks Canal restoration	Additional recreational value; biodiversity gain		Wilts and Berks Canal Trust
Renewable energy generation	Opportunity for additional third party benefit	Implementation of renewable energy generation into SESRO site (particularly floating solar photovoltaic cells)	Replacement of existing solar energy generation capacity that is lost through reservoir development	Potential environmental impacts; manage integration with other recreational uses of the site	Third party renewable energy generator
Integration with possible future Wantage and Grove Railway Station	Opportunity for additional third party benefit	Integrate SESRO with future plans for a new railway station for Wantage and Grove, served by the Great West Railway	Public transport links to SESRO, enabling reduced carbon footprint for visitors and potentially lower levels of road traffic; SESRO could be part of future business case for railway station thereby enhancing public transport links for wider area and communities	Limited additional negative impacts, although this requires further analysis	SRO and / or Oxfordshire County Council and / or South and Vale District Councils

4.4 Infrastructure Resilience

4.4.1 Asset flood resilience

4.22 The current concept design for SESRO does include a number of assets which would need to be located in areas currently at risk of flooding, within Flood Zones 2 and 3. This includes the main reservoir site itself and also the inlet / outlet structure.

4.23 As part of the WRMP24 assessment process, flood risks and the location of the site relative to flood zones 2 and 3 were considered as part of the relative assessment of feasible alternative reservoir sites.

4.24 Fluvial flood risks have been assessed for the SESRO site using an updated version of the Environment Agency's hydraulic model of the River Ock. Further details of this work can be found in Technical Supporting Document A1: Concept Design Report.

4.25 A large area of floodplain would be lost due to the proposed development, and this can be addressed through incorporating a 'level-for-level' compensatory flood storage (CFS) area into the design. This CFS area will ensure that the existing fluvial flooding situation is not worsened by the development and flood risks to adjacent and downstream properties are not increased. Additionally, the access road to the inlet / outlet structure would need to be retained above the local flooding level which would ensure operational access at all times.

4.26 The Auxiliary Drawdown Channel (ADC) is designed to safely convey the required emergency drawdown flows from the reservoir to the River Thames. However, the current concept design does pose a number of potential flood risk issues in the lower sections, as it crosses the River Thames floodplain. The initial proposed solution will be further modelled, investigated and refined during the next stage of the project to optimise the design and location of the works reflective of these flood risks. This work will be done in close liaison with the Environment Agency.

4.27 Groundwater flooding has been identified as a potential risk due to construction of SESRO. We have assessed the risks from groundwater flooding, due to water within the superficial deposits[16] being affected by the proposed reservoir development. Although hydrogeological information for the superficial deposits is scarce, groundwater is reported to flow in a north to north-easterly direction, with the groundwater surface estimated up to 2.5m below ground level.

4.28 An initial groundwater model was built and further details of this work can also be found in Technical Supporting Document A1: Concept Design Report. Results from this initial, indicative modelling indicate that:

- Baseline groundwater levels are controlled by surface and near surface drainage.
- Introduction of the reservoir footprint into the model, but without inclusion of any of the planned drainage works, leads to a theoretical increase in groundwater levels generally across the study area, with areas to the east most affected.

[16] Superficial deposits in the study area are up to 10m thick and include Alluvium, River Terrace Deposits (sands and gravels) and Head deposits. The Ampthill Clay Formation, Kimmeridge Clay Formation and the Gault Clay formation form a low permeability base to the superficial deposits aquifer.

- When the planned drainage measures are simulated in the model, groundwater levels are reduced by the presence of the proposed toe drain, flood storage area and watercourse diversions and through the inclusion of the proposed groundwater drain around the embankment. When these measures are included, the increased risk of groundwater flooding is reduced to a low level.
- Limited (approximately 5cm maximum) impacts on groundwater levels (and hence flood risk) are simulated for Steventon, East Hanney and West Hanney. However, the initial findings from the model do indicate that the presence of the reservoir may lead to a local increase in groundwater levels around Drayton.

These initial findings require further investigation and model refinement during subsequent design stages, as more ground data becomes available through site investigations.

4.29 It should be noted that there is considerable uncertainty in the conceptual understanding of the hydrogeology at this stage and hence with the numerical modelling. The modelling is not yet constrained by nor calibrated accurately to observation data. Future Ground Investigation plans will be designed to reduce this uncertainty and enable future model refinement.

4.4.2 Wider flood improvement opportunities

4.30 As noted in section Table 4.2, there are two main opportunities where the SESRO scheme could be configured or operated differently to help deliver additional flood resilience to surrounding areas and properties:

- Use of the main access road to create an on-line flood storage reservoir on the River Ock, which could help protect properties in Abingdon from flooding and
- Changing the operating protocols of the scheme, to abstract during peak flood periods to help attenuate the downstream flood hydrograph.

4.31 Extensive modelling work has been done to see what works would be required to attenuate sufficient flow upstream of the access road to maintain flows within the River Ock channel through Abingdon and prevent flooding. This is technically feasible, but carries a number of resultant impacts and issues that require further analysis and consideration during subsequent project stages before any conclusions on the overall viability of this proposal may be reached.

4.32 For the second opportunity, this alternative operational approach would not require any additional infrastructure and would not adversely affect Deployable Output. However, it would potentially require additional pumping costs and alternative operational protocols to be set-up. Modelling suggests that this alternative pumping arrangement could result in a reduction of up to 550 Ml/d (2 – 2.5%) to the peak of large floods at Culham. However, the benefits to downstream areas in the Thames catchment need to be carefully considered and quantified before these alternative arrangements are implemented. Additional controls may be required to manage intake water quality during flood periods.

4.4.3 Reservoir emergency drawdown arrangements

4.33 Guidance from the Environment Agency (EA) / Department of Rural Affairs (Defra)For a large reservoir such as the SESRO, a maximum installed drawdown capacity of 1m depth per day is recommended.

4.34 The **Reservoir safety**Construction, , maintenance, and modification of large, raised reservoirs in England must be carried out in compliance with the Reservoirs Act 1975[19] (referred to below as "the Act"). To reflect the requirements of the Act, the activities that have been or will be implemented as part of the development of the SESRO scheme are summarised in Table 4.3 below.

Table 4.3 SESRO reservoir safety activities

Area of activity	Proposed approach by SESRO
Construction of new reservoirs	Design and construction of the reservoir to be supervised by an appointed Construction Engineer, from either the "All Reservoir" Panel or the "Non-impounding" Panel. Appointments to these panels are made by the Secretary of State (Defra) following applications vetted by the Reservoirs Committee, a committee of the Institution of Civil Engineers. The threshold of competence for such panel appointments is very high, reflected in the small number and extensive experience of those engineers appointed.
Design responsibilities	A comprehensive Preliminary Design of the SESRO (150Mm^3 option) was developed in 2005-2008, and a Construction Engineer was appointed by Thames Water Ltd to supervise that design work. Subsequent design work has been done under the supervision of an All Reservoir Panel Engineer. The project partners would re-appoint a Construction Engineer in advance of the next major stage of dam analysis and design, in line with their statutory requirements. The design of the SESRO has and will continue to follow international best practice, to ensure the highest possible standards of dam safety and security are met.
Reservoir Advisory Panel	For large new dam projects, international best practice and UK guidance advocates the establishment of a panel of specialists to review key elements. Such a 'Reservoir Advisory Panel' (or "RAP") was set up during the Preliminary Design phase of the SESRO and has been recommenced in 2022 to review recent work. The chair of this panel has already been re-appointed to review the design updates for Gate 2 and to recommend appointees to the future RAP. The individual appointed is a very well-respected All Reservoirs Panel Engineer with over 45 years of experience worldwide.
Security	There is a need to ensure the constructed infrastructure is robust and secure. In keeping with other reservoir sites, access to vulnerable assets will be tightly controlled. Access points, namely at the pumping station and riverside shaft, shall be tightly controlled as per all other Thames Water / Affinity Water infrastructure. The emergency drawdown siphons would be almost entirely buried, with the stilling chambers made secure by local access barriers / fencing. Thames Water currently allows safe public pedestrian access at Farmoor Reservoir and the Walthamstow wetlands site and similar arrangements are envisaged for SESRO. However, vehicular access to the dam crest at SESRO shall be controlled to manage the risk of damage.
Updated embankment design and stability analysis	Advances in specialist software has enabled several key analyses to be reviewed and updated for Gate 2. For the perimeter embankment and its clay foundation, several models have been developed to determine the stability of the embankment slopes and to determine how the stresses in the dam form and change during construction and operation. Models completed show the dam to be stable during construction and operation, with long-term settlement and movement well within acceptable performance criteria.
Application of best practice to	Thames Water has an exemplary record of safety at its existing 59 reservoirs which fall within the remit of the Reservoirs Act 1975. Thames Water is fully compliant with the Reservoirs Act.

[17] Guide to drawdown capacity for reservoir safety and emergency planning, DEFRA Doc ref: SC130001, 017

[18]

[19] as modified by the Water Act 2003 and Schedule 4 (Reservoirs) of the Flood and Water Management Act 2010

Area of activity	Proposed approach by SESRO
existing dams and reservoirs	The Environment Agency produces a biennial report of dam incidents, and Thames Water has not featured within it, reflecting its excellent systems and safety performance.

5. Drinking water quality considerations

5.1 Overall, the risk assessment has identified a number of potentially driving hazards, including phytoplankton bloom, release of algal toxin by cyanobacteria, release of taste and odour generated by biological activity in the reservoir, storm-event related treatment challenges, pollution events associated with industry upstream and cryptosporidium risk. Feasible control measures have been identified to manage any risks to safe drinking water supply from SESRO and these will be incorporated into the design of the SESRO system, as required, during subsequent project stages.

5.2 The Water Quality Risk Assessment (WQRA) has been drafted in the All Companies Working Group (ACWG) approved spreadsheet tool and reviewed in a collaborative strategic WQRA workshop, with technical water quality representatives from both Partner Companies. The Gate 2 WQRA spreadsheets follow on from the Gate 1 WQRA work, with the addition of the following new information and data.

- Additional water quality sampling from the River Thames (Dec 2020 to Feb 2022)
- Water quality modelling work (Infoworks model of the River Thames) and algal modelling (PROTECH reservoir model)
- A review of emerging substances

5.3 The WQRA process considered options for the direct use of the reservoir water (e.g. to SWOX or the Thames to Southern Transfer) and also indirect use, through release back to the River Thames and subsequent re-abstraction further downstream.

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

5.5 The key driving hazardous events[20] identified in the SESRO WQRA spreadsheets were:

- Potential for phytoplankton bloom in SESRO (at the same time when releases occur);
- Potential for release of algal toxin by cyanobacteria in the reservoir;
- Release of taste and odour generated by biological activity in the reservoir;

[20] Driving hazardous events are those that result in a worsening of water quality that present an increased risk to drinking water. Although they generally occur for a small proportion of the time, they drive the control measures required to protect drinking water.

- Storm-event related treatment plant challenges causing dirty/discoloured water and pathogen breakthrough. High pesticide concentrations can also occur during such events;
- Pollution events associated with industry upstream;
- Cryptosporidium risk associated with new source in the catchment such as an outbreak in livestock or human population upstream of a sewage works.

5.6 Control measures have been identified for all driving hazards, which will be incorporated into the design of the SESRO system, as required, during subsequent project stages.

6. Environmental assessment

6.1 Introduction and Overview

6.1 Environmental appraisal of the options includes desk-based assessment across key environmental specialisms, informal Water Framework Directive (WFD) assessment, informal Habitats Regulations Assessment (HRA), review of inputs into the Strategic Environmental Assessment (SEA) undertaken by WRSE and for WRMP24, analysis of biodiversity net gain (BNG), appraisal of risks from Invasive Non-Native Species (INNS) and, finally, carbon footprint and mitigation analysis. Reporting of the analysis undertaken on Natural Capital Accounting (NCA) may be found in Section 8, as a key benefit of the SESRO options.

6.2 The overall status of each part of the environmental appraisal is provided in Table 6.1 below along with comments and a summary of the change in project delivery risk for each compared to Gate 1. Subsequent sections then explore each aspect in turn.

Table 6.1 Summary outputs from environmental appraisal undertaken for Gate 2

Appraisal Area	Status at Gate 2	Comment	Change in risk from Gate 1
Terrestrial environment	Amber	Impacts identified but mitigation considered feasible; further work required, including baseline survey, to confirm	→
Aquatic environment	Amber	Further work to focus on R. Ock to confirm current conditions and a wider range of hydrological scenarios for R. Thames	→
WFD	Amber	Further work to focus on current condition of River Ock watercourses and design of bypass channels and wetlands	↓
HRA	Green	No LSE, either alone or in-combination. To be kept under review as project progresses.	↓
SEA inputs	Amber	Landscape impacts changed from moderate to major negative impact compared to Gate 1. All other areas unchanged.	→
BNG	Amber	10% BNG thought feasible for all options; however, shortfalls in BNG for hedgerows to be addressed in future design iteration	↓
INNS	Green	Standard INNS mitigation and biosecurity measures have been identified, to be considered as part of subsequent design stages	→

Appraisal Area	Status at Gate 2	Comment	Change in risk from Gate 1
Carbon	Amber	Construction phase carbon mitigation to be developed; options for energy generation to be developed through scheme design	

Key:

Green: No significant issues, but some standard mitigation may be required
Amber: Potential issues and impacts, but mitigation considered feasible and further work required
Red: Major issues identified, without known mitigation

6.2 Environmental Appraisal

6.2.1 Introduction

6.3 Initial studies and desk-based appraisals have been completed, along with a preliminary review of mitigation opportunities. These have helped inform the development of the indicative Gate 2 Master Plan (see Section 3.4).

6.4 The project is at an early stage of development, prior to any significant environmental baseline data collection and before scheme-specific stakeholder engagement and consultation has been undertaken. Therefore, the initial appraisal, risks and associated potential mitigation proposals are indicative only at this stage and will subject to change and update as the understanding of the baseline environment evolves, the design of the scheme iterates to reflects this knowledge and the feedback received through future engagement and consultation.

6.2.2 Aquatic Environment: Summary conclusions

6.5 The summary conclusions of the modelling work and desk-based assessments completed for Gate 2 are included in Table 6.3 below. Further details may be found within Supporting Technical Document B1: Aquatic Environmental Appraisal Report.

Table 6.2 Summary outputs from aquatic environmental desk-based assessments for Gate 2

Topic Area	Summary conclusions at Gate 2
Hydrology	• Notably or exceptionally low flows in the River Thames would not occur as frequently if SESRO was developed. • The impact of abstraction at the higher flows to refill SESRO also has a low level of impact over a long-term dataset. • Increases in velocity could be managed through the development of a release regime with incremental increases and/or decreases in flow. It is expected that increases (during augmentation) or decreases (during abstraction) in water levels and velocities could be further mitigated through the existing operation of level management structures. • For the River Ock, modelling shows an 8% reduction in flows in the lowermost Childrey Brook, due to existing flows being diverted to further downstream. Overall, there is a slight

Topic Area	Summary conclusions at Gate 2
	(2%) flow reduction at the bottom-most part of the Ock catchment as a result of reduced catchment (i.e. rainfall falling into the reservoir rather than the river itself).

Fluvial Geo-morphology	• Because the newly designed river diversions and interconnecting wetland ditches will be (a) of significantly better quality and (b) greater in quantity (i.e. watercourse length) than the baseline watercourses that will be diverted/replaced as part of the proposed scheme, the quality of the fluvial geomorphology within the study area will experience an improvement relative to the status quo.
	• A net total of 57.57 km of watercourse would be diverted/replaced as part of the proposed scheme.
	  • 43.67 km of ditch habitat, with over 83% of total ditches within the study area being diverted/replaced. Based on the data available, but in absence of detailed field studies, many of these ditches are assumed to be of poor condition.
	  • 13.90 km of riverine habitat, which is over 85% of the total river length within the study area. Most of these rivers have been artificially modified to at least some extent and have been classified as being in moderate or good condition.
	• To achieve the required 10% Biodiversity Net Gain, the scheme is required to enhance 17.41 km of watercourse (16.44 km of river and 0.97 km of ditch) and create 31.05 km of new watercourse (25.65 km ditch and 5.40 km of canals and culverts).
	• To the west of the site in particular, gains for aquatic and terrestrial flora and fauna are expected to be large as a result of proposals for a large area of interconnecting aquatic habitats including wet woodland, wetlands and running watercourses.

Water Quality	• Impacts of SESRO on water quality in the River Thames are largely positive: improving or making no change in river concentrations compared to the WFD thresholds. This is primarily the result of SESRO 'improving' concentrations of key water quality parameters compared to the influent water from the River Thames, because of normal reservoir attenuation, biological uptake, and sedimentation processes. In addition, the released water provides greater dilution of downstream inputs from tributaries and discharges. • The modelling predicts a slight increase in ammoniacal nitrogen, immediately downstream of the reservoir. However, this needs to be caveated by the high degree of uncertainty in predicting reservoir ammonia concentrations since this chemical is highly dynamic in nature and can show a high degree of temporal variability. Ammoniacal nitrogen levels are also very low in the River Thames at the moment, indicative of WFD 'High Status' and no change to status is predicted. • A marginal increase in BOD is also simulated further downstream for some scenarios at some times of the year, which is likely to be the result of increased velocities and reduced loss (decay) within the river. It is noted that BOD does not contribute to WFD status, is currently at very low levels in the River Thames and does not appear to affect dissolved oxygen levels. • In the River Ock, all water quality effects are expected to be positive notably in the diverted Cow Common Brook, which will become the Western Watercourse Diversion. The only exception is an increase for ammonia and orthophosphate in the lowermost Childrey Brook, related to loss of flow from the catchment and routing of rainfall and local watercourse flows to the River Ock downstream of Marcham Mill (i.e., downstream of Childrey Brook confluence). This results in a reduced dilution of upstream point source inputs. It is anticipated that this can be mitigated during scheme design.
Aquatic Ecology	• Within the Ock catchment, the majority of identified effects are currently considered likely to be either negligible or result in minor adverse or minor beneficial effects that are unlikely to affect the overall ecological integrity of affected Reaches. • Some effects have the potential to result in benefits that are considered likely to improve the overall ecological integrity of affected Reaches; notably the planned diversion, realignment and creation of watercourse habitats around the proposed site. This is in the

Topic Area	Summary conclusions at Gate 2
	context of a current baseline which is affected by poor aquatic habitats and (at times) poor water quality with very few records of aquatic species with conservation interest[21]. • Identified adverse effects with risks to the overall ecological integrity include potential flow reduction on the lowermost part of the Childrey Brook and primary productivity/food-chain effects within some reaches of the River Thames. • Flow changes within the River Thames as a result of SESRO have the potential to be both beneficial and adverse (at different times and for different species) for the existing baseline ecology and may affect the overall ecological integrity of the affected Reaches. The modelling assessment presented has focused on lower flow years, which makes the assessment conservative, and more typical 'average' years should also be considered. Overall, the proposed discharge regime for SESRO is considered ecologically acceptable. Further work on the combined effects of other SROs in combination with SESRO, which might raise discharge levels above that for SESRO alone, are discussed in Thames Water's WRMP24, Section 7. • The change in hydrology where historical low flow periods will no longer occur is broadly seen as a positive. The velocity work also suggests that there remain areas of refuge in the margins as flows increase. Eutrophication risk assessment and phytoplankton bloom assessment work have not identified any areas of concern and some of the water quality changes, notably temperature, are again considered beneficial.
INNS	• The Invasive and Non-Native Species (INNS) risk assessment results highlight the risk of unmitigated recreational activities for INNS transfer, especially activities within water body. The risk is largely the same for all SESRO options, irrespective of size. • A key challenge of INNS risk management is balancing the risk of INNS transfer with providing accessible public assets. Recreational access to SESRO would not be excluded purely on the basis of INNS risk management requirements; therefore, some INNS risks will inevitably remain, balanced against wider recreational aspirations, and mitigated where possible based on available biosecurity measures. • A list of INNS mitigation and biosecurity measures have been identified, to be considered as part of subsequent design stages.

6.2.3 Terrestrial Environment: Summary conclusions

6.6 The summary conclusions of the desk-based assessments, in terms of initial assessment of significant adverse impacts and indicative mitigation proposal(s) are included in Table 6.3 below. Further details may be found within Supporting Technical Document B2: Terrestrial Environmental Appraisal Report.

[21] It should be noted that current ecological data in the Ock catchment is, however, limited to historic, some site walkover surveys from Gate 2 and Environment Agency surveys which are spatially discrete.

Table 6.3 Summary outputs from terrestrial environmental desk-based assessments for Gate 2

Topic Area	Initial assessment of risk(s) at Gate 2	Indicative mitigation consideration(s)
Air Quality	• High risk of dust soiling impacts at sensitive human receptors during construction • Medium risk for human health impacts during construction	• Develop dust mitigation and control measures as part of the air quality management strategies as set out in the CEMP or equivalent management plan. • Regular (daily) on-site and off-site dust monitoring throughout construction phase, with cleaning to be provided, if necessary, in accordance with industry standard guidance • Proactive site management, including recording all dust and air quality complaints, identify cause(s) and take appropriate measures to reduce emissions in a timely manner • Proactive planning of the construction site to minimise risk of nuisance, such as plan site layout so that machinery and dust-causing activities are located away from receptors, as far as is possible, and cover, seed or fence stockpiles and earthworks as soon as is reasonably practicable • Application of best-practice approaches to all pre-construction site demolition and clearance works • Application of measures to control vehicle track-out from site, including a wheel washing system and water-assisted dust sweeper(s), as required.
Biodiversity	Risk of an adverse impact on • non-statutory designated sites, • various Habitats of Principal Importance (HoPI), • a single ancient tree (crack-willow) and • various protected and priority species.	• Following current best practice guidelines, surveys for protected species should be conducted. Depending on the survey results, legal compliance may require various species-specific mitigation measures, additional survey, and obtaining European Protected Species Mitigation Licences (EPSML). The habitats currently depicted in the indicative Gate 2 masterplan for SESRO (see Section 3.4), are considered suitable to provide mitigation for the protected species that could be impacted by SESRO. The created habitats may be suitable for displacement of species or translocations under licence. These findings are indicative only at this stage and the exact mitigation requirements will be confirmed as the scheme progresses, through baseline survey, further technical appraisal and consultation. • Cuttings and Hutchin's Copse Local Wildlife Site (LWS) is located within the indicative location for SESRO and is an important site for nature conservation. As far as reasonably practical, SESRO should be designed to avoid or reduce direct impacts to the LWS. This should include siting the new railway siding outside of the LWS. Should the LWS be unavoidably impacted by SESRO, appropriate mitigation proposals will be required, to be agreed with the Local Planning Authority/local council who has designated the site. • Create bespoke mitigation strategy for the loss of the ancient crack willow. This could involve additional tree planting, ideally with seeds from the veteran tree, and may also involve translocating the tree or parts of the tree itself as standing or fallen deadwood. Ideally the deadwood habitat will be retained within the indicative location for SESRO. Mitigation proposals for the veteran tree would be agreed with the Local Planning Authority. • The current concept design (see Section 3.4) has been produced to maximise the biodiversity value of SESRO, post-construction. Habitats to be created include HoPI such as hedgerows, rivers, neutral grassland, coastal and floodplain grazing marsh, wet woodland and reedbeds. It is likely that the area of HoPI to be created will be higher in biodiversity value at maturity than the areas lost. However, it is recommended that loss of HoPI is avoided where design allows or reduced as far as reasonably practical. Any losses of deciduous woodland, hedgerows, traditional orchards, wood pasture and parkland, or coastal and floodplain grazing marsh HoPI would be incorporated into the BNG planned for the created habitat. • Any hedgerows lost should be compensated for prior to construction, to address the potential net loss of biodiversity for linear features noted in section 6.4. New hedgerows should be planted within retained habitats to link up existing linear vegetation so that there is a no-net-loss in connectivity across the landscape.
Historic Environment	• Confirmation of existence of locally, regionally and nationally important archaeological remains, although exact details are uncertain at this stage, with need for further detailed studies.	• Where feasible, mitigation would be incorporated by design to remove the need for erasing or damaging an historic environment asset. This embedded mitigation approach seeks to preserve assets in situ (in place). • Impacts to the archaeological and palaeoenvironmental remains which are likely to be abundant throughout the indicative location for SESRO will primarily be mitigated through preservation by record. This will entail the creation of an archive from the physical hand excavation and recording of archaeological and paleoenvironmental features. • Geophysical survey of all the accessible parts of the indicative location for SESRO will be carried out to inform subsequent phases of archaeological trial trenching. Geotechnical ground investigation would also benefit from geoarchaeological coverage in order to assist in developing a deposit model for the site and identifying the presence of relict palaeochannels and other organic remains in the buried environment. • All archaeological work must be carried out in accordance with a method statement (WSI) approved by the Oxfordshire County Council archaeological advisory service prior to commencement on site. For a scheme of this scale, a strategic WSI will be required.
Landscape and Visual	• Negligible to medium adverse impacts on the high sensitivity North Wessex Downs AONB during construction; no change to small adverse after 15 years of operation • Small to large adverse Impacts on medium sensitivity landscape receptors (e.g. local character areas): during both construction; and after 15 years of operation	The indicative Gate 2 Master Plan (see section 3.4) has been developed in line with the following high-level landscape mitigation principles. These should be used to guide any future development of the operational design of the chosen SESRO scheme: • Avoid features that break the skyline and other visually dominant elements within the open landscape, and, where it is not possible, establish strategically placed screen planting. • Avoid features that introduce lighting (including floodlighting), noise and traffic movement, which would affect Dark Skies and tranquillity of AONB. • Use 'soft' engineering solutions in preference to 'hard', including the shaping and re-grading of embankment crest and slopes and river channels to blend into the existing contours and provide slopes with a natural appearance • Explore opportunities for planting on areas of deeper landscape fill on the embankments, above the engineering earthworks, where this would comply with safety and security requirements for the reservoir. • Sensitive design of buildings and structures, including through careful use of colours, materials and non-reflective surfaces. • Allow views out over open water and countryside from the existing and proposed PRoW and cycle path network, including views and new vantage points towards the scarp of the North Wessex Downs AONB to the south, as well as the Midvale Ridge to the north. • Consider advanced planting to intercept views from sensitive visual receptors, including from the AONB and to promote early habitat restoration. • Retain and restore field patterns with hedges and trees along filed boundaries, making reference to the Oxfordshire Historic Landscape Characterisation. • Enhance existing hedgerows to be retained that are in poor condition, by gapping up. • Planting of new hedgerows, hedgerow trees and trees in fields and small blocks of wet woodland along watercourses, including native willows and black poplar, to reflect the landscape character of NCA 108: Upper Thames Clay Vales, drawing on best practice developed in Aylesbury Vale and Cotswold Water Park.

Topic Area	Initial assessment of risk(s) at Gate 2	Indicative mitigation consideration(s)
		• Development of new wetland habitats surrounding reservoir and along watercourses, along with waterside access and waterborne recreation, which are characteristic of the River Floodplain LCT which is found within the northern and eastern extent of the indicative location for SESRO. In addition, a range of relatively standard construction phase mitigation measures will be developed, to help minimise construction phase impacts.
Noise	• Potentially significant adverse noise impacts for Abingdon associated construction of the Auxiliary Drawdown Channel • Potentially significant adverse noise impacts for Drayton associated with construction of screening mounds • Potentially significant adverse noise impacts for Steventon and East Hanney associated with various construction activities and materials handling	• Embedded mitigation, namely the earth screening mounds incorporated into the current concept design for SESRO, have been considered in the noise assessment. The screening mounds vary in height from approximately 2m when located close to sensitive properties, up to approximately 10m where they are positioned between sensitive receptors and the reservoir embankments. • Additional standard construction phase noise mitigation would be considered, including: o where possible works would be programmed to take place on weekdays (or Saturday mornings, where necessary) o Construction plant would be operated and maintained appropriately. All vehicles and plant would be switched off when not in use; o Vehicle and mechanical plant would be fitted with effective exhaust silencers; use of silencers on pneumatic tools; o Construction plant (e.g. generators) and activities would be positioned so as to minimise noise at sensitive locations (where practicable) o The use, where necessary, of effective sound reducing enclosures or barriers; o Haul roads would be well maintained and avoid steep gradients; o Consideration would be given to the use of low amplitude vibration settings or non-vibratory compaction techniques close to sensitive properties. Piling methods adopted during construction would be selected to minimise potential noise and vibration impacts where practicable, for example adopting auger bore (continuous flight auger (CFA)) methods rather than vibratory piling methods where ground conditions allow; o Community engagement would be established and would give notice of when construction activities would take place and their duration, as well as the measures in place to reduce nuisance; and o Prior to any works commencing, structural surveys would be undertaken at properties identified to be subject to vibration impacts during the works. The surveys would be used to determine whether a building is in any way structurally unsound and also inform construction working methods. o Noise and vibration monitoring before and during construction would be undertaken where appropriate, based on the findings of the contractor's risk assessments and agreement with the local planning authority (Oxfordshire County Council and Vale of White Horse District Council).
Soils, geology and land contamination	• Significant adverse loss of Best and most versatile (BMV) land of ALC grade 2 and 3a land • Potentially significant adverse effects to human health through exposure, mobilisation or leaching of potential existing contamination on site	• To reduce the potential effects of the loss of agricultural land, the development should re-use topsoil and subsoil whenever possible. The soil could be used to improve the quality of agricultural land elsewhere and result in a neutral or beneficial effect. • A Soil Management Plan (SMP) should be developed which sets out the approach to the management and re-use of soil resources and how to maintain the condition of the high grade soil during handling and placement. • The quality of soil and groundwater across the site should be assessed and if necessary, a remediation strategy should be developed to mitigate the risks posed by elevated levels of contamination.

6.3 Water Framework Directive Assessment

6.7 A project-specific, Water Framework Directive (WFD)[22] assessment has been completed for Gate 2, based on the enhanced level of design detail available compared to Gate 1 and incorporating the findings of additional studies. As such, it provides greater confidence and certainty on the likely WFD impacts of SESRO. Further details may be found in Supporting Technical Document B5.

6.8 The initial impact screening that was applied has identified five waterbodies that have an 'activity impact' score of greater than 1 (i.e. they should progress for level 2, more detailed appraisal):

- Ock and tributaries (Land Brook confluence to Thames) (GB106039023430);
- Cow Common Brook and Portobello Ditch (GB106039023360);
- Childrey Brook and Norbrook at Common Barn (GB106039023380);
- Sandford Brook (Source to Ock) (GB106039023410);
- Thames (Evenlode to Thame) (GB106039030334).

6.9 The Level 2 WFD assessment provides an outline of the potential impacts associated with the current indicative scheme, noting that the design and any associated mitigation requirements will be further developed during subsequent project stages.

6.10 Under the Level 2 assessment, there are two water bodies that have a maximum risk score of 3[23] prior to mitigation in at least some of the options, namely:

- Childrey Brook and Norbrook at Common Barn (GB106039023380) (150, 30+100, 80+42 Mm³); and
- Cow Common Brook and Portobello Ditch (GB106039023360) (all options).

The other water bodies all have a lower pre-mitigation risk score of 1 or 2. A summary of the proposed mitigation and post-mitigation risk scores for these highest risk waterbodies are shown in Table 6.4 below.

Table 6.4 Summary output from WFD Level 2 Assessment (high risk waterbodies only)

Waterbody	Pre-mitigation WFD risk	Primary risk driver	Proposed mitigation and associated commentary	Post-mitigation WFD risk
Cow Common Brook and Portobello Ditch (GB106039023360)	3	Loss of physical habitat within waterbody catchment	• Divert the Cow Common Brook around the footprint of the reservoir via the Eastern and Western watercourse diversions, improving the hydromorphological, ecological and water quality of the channel. This should mitigate for the direct loss of channel length and habitat. • Hydrological and water quality modelling also suggests that there is a small reduction in flow which has a localised knock-on impact on the water quality. This impact is judged to be insufficient to trigger a concern	1, WFD compliant

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

[23] A score of 3 means that 'Impacts when taken on their own have the potential to lead to a significant effect and permanent deterioration of WFD status. Potential for high impact on preventing target WFD objectives from being achieved.' For Childrey Brook and Norbrook at Common Barn water body and Cow Common Brook and Portobello Ditch water bodies they are both at risk of failing WFD objective 1, prior to any mitigation which is 'to prevent deterioration of any WFD element of any water body – in line with Regulation 13(2)a and 13(5)a.'

Waterbody	Pre-mitigation WFD risk	Primary risk driver	Proposed mitigation and associated commentary	Post-mitigation WFD risk
			for WFD deterioration and becomes imperceptible on the River Ock around Abingdon with impacts being diluted accordingly as a result of increased flow contribution from other tributaries.	
Childrey Brook and Norbrook at Common Barn (GB106039023380)	3	Reduced inflow to the waterbody catchment	• Realign and improve the hydromorphological, ecological and water quality of Hanney ditch • Creating additional wetland habitat in the catchment. • This should compensate for channels affected by the reservoir footprint	1, WFD compliant

6.11 The options with smaller reservoir footprints (< 125 Mm^3) do not have the footprint of the reservoir directly located within the Hanney Ditch waterbody catchment. Therefore, there is more space for the Western Watercourse Diversion (see Section 3.4) so that there is minimal direct impact on Hanney Ditch, although there is still a reduction in water inflows. The smaller options therefore have a pre-mitigation risk score of 2. The same mitigation brings the score down to 1.

6.12 Overall, the ACWG Level 2 assessment concluded that with the proposed mitigation all WFD water bodies would be compliant and therefore should not require derogations in line with Regulation 19.

6.4 Informal Habitats Regulations Assessment

6.13 The informal Habitats Regulations Assessment (HRA) sets out the potential for likely significant effects (LSE), during construction and operation of SESRO, on National Network Sites. Reference is made to any potential LSE in relation to the six considered reservoir capacity options, alone, and in combination with other plans and projects in accordance with All Companies Working Group (ACWG) guidance. Further details may be found in Technical Supporting Document B4: Habitats Regulations Assessment.

6.14 The Informal HRA concludes:

- The following National Network Sites were identified for assessment by applying the screening criteria:
  - Cothill Fen SAC;
  - Hackpen Hill SAC; and
  - Little Wittenham SAC
- The assessment of LSEs of the project on these three sites has concluded that no LSEs will occur on any of them as a result of the construction and operation of any of the SESRO options alone, because potential effect pathways were absent.
- Therefore, because of this lack of impact pathways, at this stage it is not feasible for the SESRO options to act in combination with other plans and projects to have an LSE on any of the National Network Sites identified. However, this will be kept under review as the project progresses and future updates to the HRA, as required to support future consent submissions, will ensure this conclusion remains correct.

- Therefore, no LSE on any of the National Network Sites identified as a result of the construction and operation of the project alone or in combination with other plans and projects, was concluded for all six SESRO options.

6.5 Biodiversity Net Gain

6.15 To ensure that the SESRO scheme complies with national, regional and local planning policy[24], an assessment of the biodiversity net gain (BNG) has been updated for Gate 2. This report uses the Department for Environment, Food and Rural Affairs (Defra) Biodiversity Metric 3.0 Calculation Tool[25], based upon the indicative Gate 2 Master Plan shown in Figure 3.1 and adjusted spatially for the smaller options. It should be noted that the analysis presented here is a function of the indicative scheme boundaries used for the WRMP24 options (in terms of land areas) and has not yet been fully optimised down to minimise the land-take required for each scheme. Ultimately, the scheme boundary, and hence extent of BNG, will be spatially optimised to deliver the environmental mitigation required to be compliant with relevant policies and legislation. Therefore, the values noted below should be treated as indicative only at this stage.

6.16 All options exceed the required 10% net gain in habitats. A summary of the assessment results is presented in Table 6.5.

Table 6.5 Summary of BNG assessment

Reservoir Option	Biodiversity Units	Total Net Unit Change	Total % Change
150 Mm³	Habitat Units	1629	33%
	Hedgerow Units	-96	-22%
	River Units	70	16%
125 Mm³	Habitat Units	1768	37%
	Hedgerow Units	-86	-20%
	River Units	102	24%
100 Mm³	Habitat Units	2005	45%
	Hedgerow Units	-52	-13%
	River Units	99	25%
75 Mm³	Habitat Units	2196	52%
	Hedgerow Units	-43	-11%
	River Units	129	35%
100+30 Mm³	Habitat Units	2265	46%
	Hedgerow Units	-85	-19%
	River Units	74	17%
80+42 Mm³	Habitat Units	1942	39%
	Hedgerow Units	-105	-24%
	River Units	64	15%

[24] These policy obligations include: National Planning Policy Framework, 2021; The Vale of White Horse Local Plan, (Policy 45) adopted in 2016; the Environment Act 2021 – the provisions of the latter are likely to be in force when SESRO applies for consent.
[25] Natural England (2021). *The Biodiversity Metric 3.0: Auditing and Accounting for Biodiversity – Technical Supplement. Natural England.* It may be noted that v3.0 has now been updated to v3.1, but the previous version is used for the Gate 2 assessments due to the timing of the issue of the newest version. This approach was agreed with regulators.

6.17 Through the creation of the reservoir, wildlife ponds, wetland mosaic with wet woodland and species rich grasslands, the options could achieve an overall gain in biodiversity of between 33% (150 Mm^3 option) and 52% (75 Mm^3 option).

6.18 Under the current indicative preliminary landscaping and planting proposals, none of the SESRO options will achieve ≥10% BNG for linear features such as hedgerows and tree lines. The 150 Mm^3 option has identified a loss of 22%. Further modifications to the masterplan and design are expected to identify additional areas of hedgerow and other linear features which can be retained or enhanced and further opportunities for habitat creation are considered likely.

6.19 All options could achieve ≥10% BNG for rivers and streams, ranging from +15% to +35%, through the creation of wetland ditches and the realignment of rivers to meandering planforms. This would be a significant improvement from the network of agriculturally modified watercourses currently on site.

6.20 Overall, the 75 Mm^3 Reservoir option provides the greatest potential for gain in biodiversity units of 52% and the least loss in hedgerow units –11%. This is likely to be because the 75Mm^3 option is the smallest of the six options but still has a relatively large indicative scheme boundary where habitats of high biodiversity value can be created. In reality, this scheme boundary would be likely to be optimised down should this option be progressed, to meet legislative requirements only and minimise land-take, hence the final BNG values would be expected to be lower.

6.6 Analysis of carbon

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

6.22 We have followed the IEMA emissions reduction hierarchy to identify carbon mitigation opportunities, which aligns well with PAS2080.

6.6.1 Assessment of capital carbon

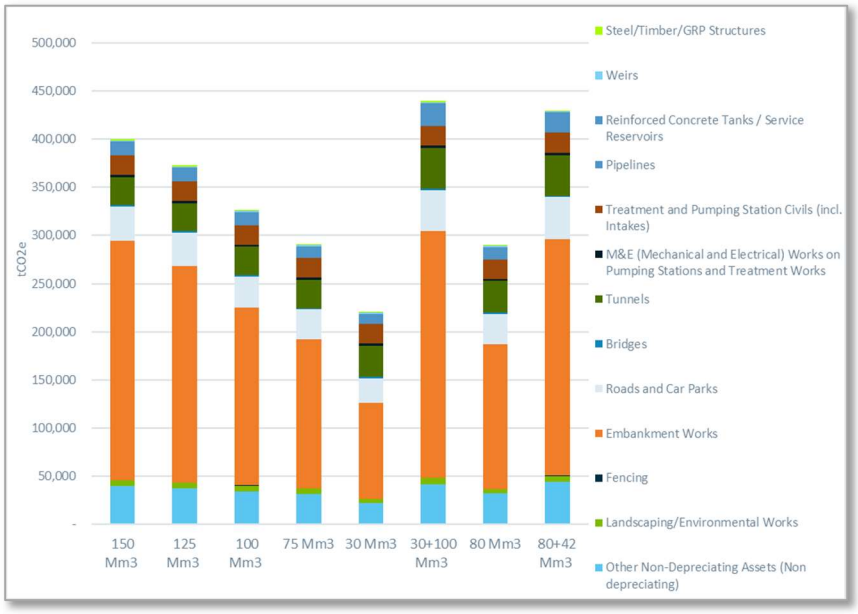
6.23 Figure 6.1 shows the total capital carbon for the options, broken down by asset categories to help identify those aspects which contribute highest emissions. The capital carbon emissions are higher for the larger reservoir options, largely due to the increased amount of embankment works required. The capital carbon 'hotspots' are summarised in Table 6.6 below.

Table 6.6 Capital carbon hotspot summary

Element	Summary at Gate 2	% total capital carbon
Embankment works	Balance between excavated material and volume required to form reservoir, which removes the need for export and disposal off-site and associated emissions. Includes emissions associated with the import of other materials via rail freight - gravel and sand (drainage materials) and stone riprap (wave protection).	39 – 55%
Roads	Assumes a (conservative) concrete haul road construction. Alternative construction methods for paved and unpaved haul roads be considered during subsequent project stages to minimise capital emissions.	14 – 19%

Element	Summary at Gate 2	% total capital carbon
Tunnels	Between intake pumping station and the river intake/outfall structure.	6 – 12%
Structures	The main structures required for SESRO are the river intake / outfall structure, the pumping station and the reservoir inlet / outlet towers.	5 – 7%

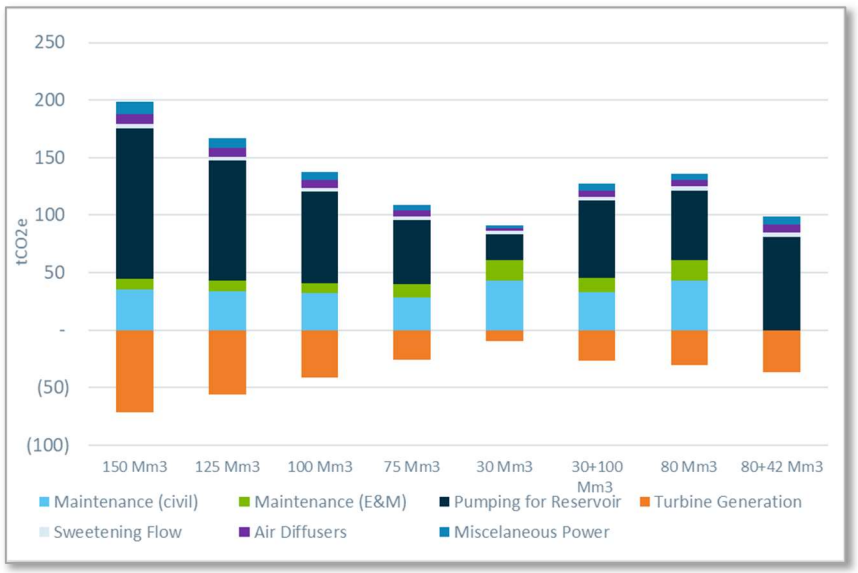
Figure 6.1 Capital carbon emissions for SESRO options



6.6.2 Assessment of operational carbon

6.24 Figure 6.2 displays the total operational carbon emissions for all options.

Figure 6.2 Total Annual Operational Carbon for all options (at 2040)



Note: 2040 BEIS grid carbon intensity factor of 0.015kgCO2e/kWh for single phase variant and the Phase 1 component of the dual phase variants. 2060 BEIS grid carbon intensity factor of 0.007kgCO2e/kWh for Phase 2 component of the dual phase variants. The construction of SESRO is likely to only be completed by the late 2030s at the earliest, meaning that the 2040 carbon intensity of power consumption is most representative of SESRO's initial operational carbon. The Phase 2 component of the dual phase variants would come later in the assessment period, hence uses the 2060 grid carbon intensity factor.

6.25 The operational carbon for this SRO is dominated by the power requirements to pump water from the river into the reservoir (66% of emissions), but offset by the

energy generated through two energy recovery turbines when water is released from the reservoir to the River Thames.

6.26 The significance of power related carbon emissions is expected to decrease as grid decarbonisation projects take effect. For the 150Mm^3 SESRO variant the first year of operation could be 2038. By this time, it is expected that carbon emission intensity should be approximately 13% of its current level. Furthermore, by 2050 the forecast indicates a reduction to 5% of current levels.

6.6.3 Assessment of whole-life carbon

6.27 To align with costing[26], the whole-life carbon assessment has also been assessed over the same timeframe. Table 6.7 provides a summary of the whole life carbon results for all SESRO variants. The capital carbon emissions of the reservoir account for ~75-80% of emissions, with a further ~14-19% associated with capital replacements of the assets. Operational carbon contributes only a small proportion (1%) of the whole-life carbon, with power accounting for just under half of that.

6.28 Whole life carbon emissions have also been monetised[27]. The monetisation of carbon has been built into the WRSE regional planning appraisal approach to account for the carbon impact of different schemes, depending on timing. Table 6.7 also summarises the whole life carbon NPV over 80 years of each of the option sizes, based upon the central estimate of the carbon cost range modelled. The central values have been used in the WRSE regional planning appraisal process.

Table 6.7 Summary of the whole life carbon emissions and net present value whole life carbon costs

Option (Mm^3 storage)	150	125	100	75	30	30+100	80	80+42
Whole life Carbon footprint (tCo2e) – ***based on estimated long-term average utilisation, as discussed in Section 8***								
Capital and Replacement Carbon	479,939	451,378	403,152	366,035	285,762	507,413	362,222	504,747
Operational Carbon	5,624	5,103	4,664	4,114	3,286	5,913	4,464	6,057
Total	**484,356**	**455,498**	**407,008**	**369,522**	**288,777**	**511,810**	**366,046**	**508,860**
Whole life Carbon footprint (£M) – ***based on estimated long-term average utilisation, as discussed in Section 8***								
Total whole life carbon	**87**	**82**	**73**	**65**	**50**	**82**	**65**	**86**

6.29 An initial assessment has also been carried out of the natural capital value of the impacts on carbon sequestration due to the replacement of the existing (largely agricultural) landuse at the site with the reservoir proposals. Further details may be found in Supporting Document B2: Terrestrial Environmental Appraisal Report (section 9) and summarised in Section 8.2 of this report.

6.6.4 Opportunities for carbon reduction

6.30 The mitigation efforts have been split into two areas:

- Opportunities directly under the control of the design team, including areas which can reduce emissions through design decisions.

[26] Whole life costs have been assessed over 80 years, to include a 6-year planning and development period followed by a 9-year construction period ending in 2038. This is followed by 65 years of operation.
[27] using BEIS Green Book Data Tables 1-19, Table 3

- Longer term opportunities where the scheme and sector may influence external systems and supply chains to decarbonise major components of the scheme.

6.31 The SESRO options have various opportunities for carbon reduction in the design of the scheme (see Table 6.8) some of which have already been built into the Gate 2 concept design. These will be explored further as the design develops.

Table 6.8 Opportunities for carbon mitigation through design

Characteristic	Opportunity
Opportunities already incorporated into Gate 2 concept design	
Cut and fill balance	SESRO has been designed to have a balance between the volume of clay that would be excavated from the borrow pit and the volume of clay that is required to form the main reservoir embankment and landscaping. This is a key feature of the design which needs to be maintained throughout future development stages because it avoids the carbon which would be emitted if clay needed to be imported or exported from the site.
Import of construction material by freight trains	There would be a requirement for significant quantities of sand, gravel and riprap to be imported to the site for construction. Due to the site's close proximity to the Great Western Mainline Railway (London to Bristol) the design includes for a temporary railway siding to allow this material to be brought to the site by train rather than Heavy Goods Vehicles.
Hydropower turbines	The Gate 2 concept design includes for two hydropower turbines for renewable energy generation during periods when water is released from the reservoir to the River Thames.
Pump sizing	The initial sizing of intake pumps has been set to allow them to operate as efficiently as possible given their expected use.
Future opportunities to "build clever" and "build efficiently"	
Non-diesel powered or automated plant	Use of alternative construction plant could significantly reduce the fossil fuel emissions. Opportunities to consider shared use of this plant with other infrastructure schemes. Maximise use of automation to increase the efficiency of earth movement and therefore reduce associated carbon emissions.
Reuse of materials	For example, the existing Steventon Road and East Hanney Road will need to be demolished, and the material could be reused within the site for temporary haul roads.
Reuse of existing solar panels	The construction of SESRO could require removal of solar farms that are currently located at the site. There may be an opportunity for the panels to be moved to a new location. The remaining design life of the solar panels would need to be taken into consideration.
Low carbon construction materials	Low carbon concrete and steel, and sewage sludge ash to make low carbon aggregate. This opportunity is considered as a high impact option, however the feasibility of these materials in different parts of the construction should be further assessed.
Workforce	A workforce management plan should be developed to consider opportunities to reduce emissions from workforce commuting.
Dual purpose infrastructure	There is a potential opportunity for the A415 to SESRO access road to also be used as an embankment for a Flood Storage Reservoir, as discussed in Table 4.2.
Further renewable energy generation	Hydropower turbines are already incorporated into the design; however, there is also potential for other renewable energy generation. Initial consideration has been given to other renewable energy opportunities. However, there are several aspects that require more detailed consideration before deciding if these can be incorporated.
Water quality monitoring	Real time water quality modelling could be used to optimize the use of the air diffuser network and the sweetening flow pump.
Low and decarbonised electricity procurement	Organisations can procure green electricity through their suppliers which, when market-based reporting, can be used to zero out the power generation emissions of grid electricity. This requires the purchase of Renewable Energy Guarantees of Origin (REGO) certificates and comes at a premium over standard electricity tariffs in most cases.
Possible EV charging	Possible opportunity at the visitor centre and main car parks to enable EV use for visitors and staff.

Characteristic	Opportunity
Self-sufficient buildings	Designed with net zero carbon objectives.
Carbon sequestration	The indicative Gate 2 Master Plan for SESRO includes for planting around the site which will provide some carbon sequestration. The impact of this planting and land-use change has not yet been fully quantified but will be developed during subsequent stages of design development alongside considering overall natural capital value generated from the scheme.

6.32 Engagement and challenge with the supply chain can help deliver products with the lowest carbon intensities possible. Future design phases will include engaging with the supply chain to understand the carbon intensities of different products and plant types, developing appropriate material carbon intensity specifications and ensuring the procurement process for the scheme has steps in place to ensure that materials and products meet carbon intensity specification requirements. We currently estimate that whole life carbon savings of between 42 – 61% could be realised and that these potential savings could be worth £67M in terms of carbon costs. Further work is proposed after Gate 2 to determine which measures provide the most cost-efficient carbon reductions.

6.7 Changes to inputs into WRMP24 SEA

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

6.34 Therefore, the inputs to the WRMP24 SEA act to update and refine the findings of previous regional SEA work. This assessment also benefits from and incorporates findings from concurrent investigations and a full assessment table may be found in Appendix C within Supporting Document B7. In summary, at Gate 2, the only significant change from the Gate 1 assessment is the significance of the construction phase impacts on landscape and visual. This has been increased from a moderate negative to a major negative impact. The additional significance comes from the enhanced analysis done for Gate 2, considering the effects on individual local landscape character areas in conjunction with the appraisal of effects on the North Wessex Downs AONB.

6.7.1 In-combination Assessment

6.35 The 'in-combination' or cumulative effects assessment (CEA) has been completed for the largest (150 Mm^3) option (see Supporting Document B7), as this currently

represents the largest footprint of all of the SESRO options and therefore provides a benchmark for the smaller alternatives. It is possible that the development of the phased options could extend over a longer overall timeline, hence construction phase impacts could be longer duration, but would be experienced over two separate time periods, with lower levels of activity during each. Therefore, overall, the impacts of the 150 Mm^3 option are considered greatest.

6.36 Analysis of major planning allocations and approvals within a 2km buffer of the indicative location for SESRO was conducted using information from the Vale of White Horse District Council Local Plan (2031)[28]. From this initial and high-level cumulative assessment, specific disciplines and receptors of potential concern were identified including rail and road noise, setting impacts upon listed buildings and scheduled monuments, landscape impacts upon Upper Thames Clay Vales NCA, degradation of grade 3 and 4 Agricultural Land Classification (ALC) and overlap with existing Flood Zones. These will all need to be addressed during subsequent Environmental Impact Assessment, should promotion of one of the SESRO options progress.

6.37 The CEA is, however, somewhat limited by the unknown timing for both the other developments and the delivery of SESRO. Taking into consideration the expected commencement of construction of SESRO being in the early 2030s, the majority of those other developments may have already been completed and therefore there would be no cumulative construction effects. The cumulative impacts assessment will need to be reviewed and updated if the SESRO project progresses when delivery timescales are confirmed.

7. Programme and planning

7.1 Project Plan

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

7.2 The earliest start date for water to be available from the largest variants of this scheme is 2037/38. This constraint is incorporated into the WRSE and WRMP24 option information. Under this unconstrained programme, the construction start date would be in 2029.

7.3 The programme outlined here is based upon a number of critical assumptions and dependencies, which guide the development of the detailed project plan. These dependencies are tabulated in Supporting Document F-1: Project Delivery Plan. The programme is on currently track to deliver the SRO when required, by 2040, in accordance with the more detailed programme analysis included in supporting document F-1: Project Delivery plan.

[28] https://www.whitehorsedc.gov.uk/vale-of-white-horse-district-council/planning-and-development/local-plan-and-planning-policies/local-plan-2031/

Figure 7.1 SESRO, Overview Project Plan

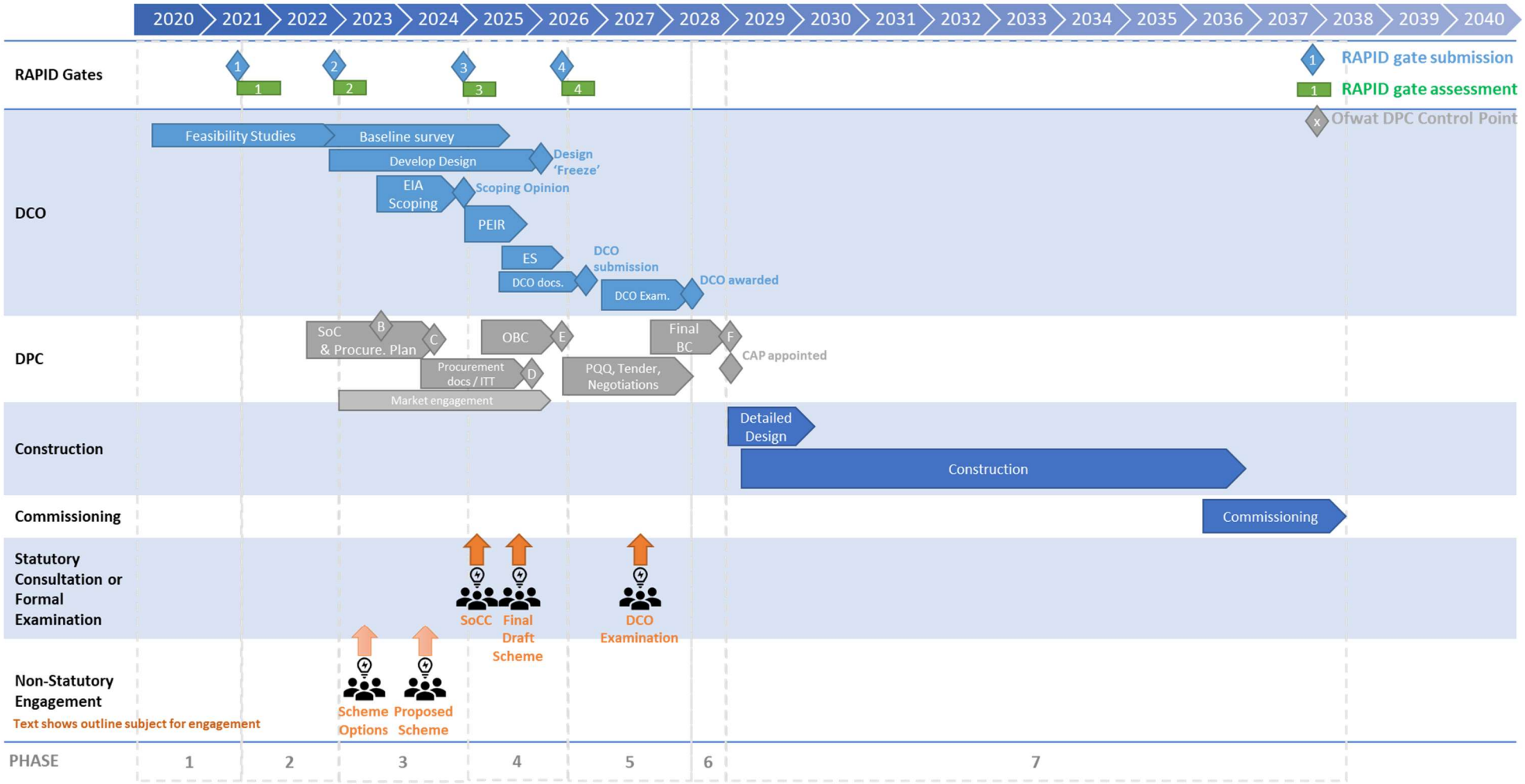


Table 7.1 SESRO, Project Phasing

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

7.4 At this relatively early stage in the project life-cycle, it is difficult to accurately predict programme risk elements that might cause delay. Therefore, in line with the recommendations of the Treasury Green Book[29], the schedule has been adjusted to account for unknown risks in the delivery of future activities. The effect of this risk allowance is a delay of up to 5 years in project delivery, with a theoretical latest delivery of 2043/44. The mitigation measures to manage these programme risks will be developed during the next stage of the project to ensure effective and timely management.

7.5 Based upon the proposed scope of works outlined above and detailed in Section 7.4 below, we propose that the target dates for future RAPID gates should be timed as follows, subject to agreement of required outcomes with RAPID:

- Gate 3: January 2025
- Gate 4: April 2026

7.6 Our recommendation is that Gate 3 is based upon the achievement of the outcomes listed in Table 7.1. Should a programme delay cause any of these outcomes to be delayed (for example, delay through the need to re-consult on the final WRMP24) then we would propose the Gate 3 and Gate 4 target dates be adjusted accordingly. We would seek to discuss this approach with RAPID, if required.

7.2 Overview of planning and consenting strategy

7.2.1 Planning consents

7.7 The SESRO Gate 1 report identified three potential primary consenting routes for SESRO – namely planning permission under the Town and Country Planning Act

[29] HM Treasury, 2013, "Green Book supplementary guidance: optimism bias"

1990, Development Consent Order (DCO) under the Planning Act 2008 (PA2008) and a Hybrid Act of Parliament.

7.8 The qualifying thresholds for water industry Nationally Significant Infrastructure Projects (NSIPs) are defined in the Planning Act 2008[30]. All of the SESRO options qualify as NSIPs, requiring a DCO or Private Bill consenting route.

7.9 The other consenting option available for SESRO is a Private Act of Parliament. Hybrid Bills are promoted only exceptionally and it would need to be demonstrated that other available consenting routes are unsuited to the task. This is not considered to be the case for SESRO. Further discussion of the rationale for discounting a Private Bill and the benefits of DCO as consenting route for SESRO may be found in Supporting Document G: Planning and Consents Strategy. A DCO under the PA2008 process is the preferred consenting route for SESRO, even for the phased options, which would be consented as a single DCO if required.

7.2.2 Secondary Consents

7.10 A wide range of secondary licenses and consents will be required to deliver the SESRO, alongside the DCO. The initial list may be found in Supporting Document G: Planning and Consenting Strategy. The required consents and licences will be retained under active review as the project progresses.

7.2.3 Environmental Permitting

7.11 The current arrangements for permitting and managing abstraction and discharges on the River Thames are complex, with multiple large surface water abstractions and river regulation arrangements. However, the combination of SROs which could potentially interact within the River Thames can be permitted and managed through standard environmental permits and operating agreements.

7.12 A summary of the abstraction and discharge permitting strategy may be found in Supporting Document G: Planning and Consents Strategy.

7.13 SESRO has a number of features that will require environmental permits:

- Abstraction from the River Thames near Culham
- Discharge / regulation of the River Thames
- Management of regulation volumes and timing via a Section 20 agreement
- Other discharges: for emergency drawdown or from the water treatment works.

Section 20 Operating Agreements

7.14 An operating agreement will be required for SESRO because of its interaction with the management of the River Thames and the Lower Thames Operating Agreement, which has been managed under a Section 20 agreement since 1989. Initial work suggests that relatively minor changes to the Lower Thames Operating Agreement may be possible but a more holistic view of how these permits and management tools may be developed will be needed depending on the sequence of SROs to be constructed. This remains uncertain until confirmed by the final WRMPs.

[30] Reservoirs with storage exceeding 30 Mm^3 or with a deployable output of more than 80 Ml/d qualify as NSIPs

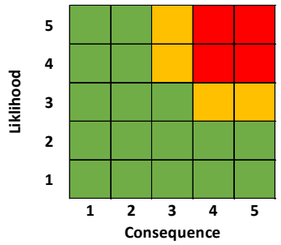
7.3 Risk Management

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

7.16 The latest view of the highest qualitative project risks and associated mitigation measures are shown in Table 7.2 below.

Table 7.2 Summary of key highest risks within the qualitative risk register and associated mitigation proposals

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



Risk Theme	Details	Pre-mitigation Risk	Proposed Mitigation	Post-Mitigation Risk
Programme	Dependency between Final WRMP24 publication and statutory DCO consultation – Final WRMP24 should be published (or direction to publish received from SoS) before statutory consultation progressed for subsequent DCO.		Mitigated via proactive stakeholder engagement for WRMP24 and close alignment of the scheme need, timing and scale to Regional (WRSE) Plan and WRMP24. Current critical path programme analysis suggests that delay on final WRMP24 to Mar '25 will not delay subsequent DCO.	
Environmental	There is a risk to hydromorphology and aquatic receptors due to the discharge effect from reservoir flow.		The effect of the discharge to be assessed through 1D and 2D hydrodynamic modelling and velocity analysis and continued development of design of abstraction / discharge structure to minimise localised impacts. Consideration of water quality management and mitigation for reservoir, informed by complex CFD and algal bloom predictive modelling.	
	There is a risk in attaining WFD compliance in either the River Thames water body or the River Ock waterbodies.		Ongoing water quality and aquatic ecology monitoring; Hydrodynamic modelling and water quality assessment will help update mitigation strategy and WFD assessment, as appropriate	
	Abstraction and discharge impacts from SESRO might have impacts on fish habitat and migration habits in the affected reaches		Ongoing water quality and aquatic ecology monitoring; Hydrological and water quality assessment and modelling; Continued development of design of abstraction / discharge structure to minimise localised impacts. Fisheries impact assessment at Gate 2 as explicit part of Aquatic Environmental Appraisal Report.	
	Challenges in ensuring that scheme can deliver the required BNG.		Work completed for Gate 2 suggests that sufficient ditch habitat can be created on-site to manage this BNG risk without the need for off-site works, but to be confirmed as site baseline data is extended in next phase of works. Further assessment of BNG requirements will be required as scheme design progresses to determine exact length of linear terrestrial habitat required and incorporate into scheme requirements.	
	Stakeholder perceptions on landscape impacts		Initial landscape and visual impact assessment, including close liaison with Natural England and North Wessex Downs AONB to ensure design sympathetic to AONB management strategy. Development of initial landscape and visual impact assessment for Gate 2 and build principles into Master Plan, in close liaison with OCC, VoWH and AONB landscape specialists.	
Planning and Land	Failure to secure all of the powers and land rights sought in the DCO – which would render implementation more difficult at the very least.		The Book of Reference and Land Plans will be kept under regular review. A fully-articulated case will be made to justify the compulsory acquisition powers and land rights sought in the DCO.	
	The DCO application is not accepted for examination.		Extensive pre-application engagements and consultation will be undertaken to pass the 'adequacy of consultation' test at the DCO acceptance stage. The DCO application will comprise a comprehensive array of documentation produced by experienced practitioners in accordance with relevant regulations including the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 and the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.	

7.4 Gate 3 Proposals

7.4.1 Gate 3, proposed objectives and timeline

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

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

7.4.2 Gate 3, proposed work breakdown structure

7.18 In order to deliver these outcomes, we are proposing work across a number of technical workstreams. A detailed work breakdown structure may be found in Supporting Document F-1: Project Delivery Plan, and an outline of the proposed work packages is provided in Table 7.3. The cost of each of these tasks has been estimated to provide the overall project cost forecasts shown in Section 11.

Table 7.3 Proposed work packages for Gate 3

Workstream	Key activities
Environmental Assessment	• Ongoing environmental appraisal of options and alternatives and assessment of preliminary mitigation requirements, to inform development of initial preferred scheme • Develop EIA Scoping Report, submit to PINS and receive formal EIA Scoping Opinion
Survey and Monitoring	• Commence environmental and engineering baseline data collection and survey. This will include geotechnical and groundwater investigations and monitoring and a wide range of baseline environmental surveys to inform future development of PEIR and EIA.
Design Development	• Complete remaining options technical appraisal for key aspects of the project • Further design refinement to reflect the outcomes of the WRMP consultation process, survey data collection and stakeholder feedback at engagements, resulting in development of initial Design and Access Statement • Further refinement of reservoir water quality and algal models to help inform scheme design and water quality risk assessments
Water Resource Assessment	• Alignment of scheme need, timing and scale to Revised Draft WRMP24 (or Final, if available); Further modelling of alternatives or 'what if' scenarios, if required. • Development of decision-support tools to confirm licensing strategy
Commercial Strategy	• Undertake Strategic Outline Case, initial Value for Money Assessment, Procurement Plan and submit for approval at Ofwat Control Points B and C.
Stakeholder Engagement	• Further public engagement on WRSE and WRMP24 strategic water resource plans • Initial plans for informal engagement shared and agreed with relevant stakeholders • Undertake Non-statutory informal engagement(s) on scheme options
Planning and Land	• Ongoing liaison and negotiation with affected landowners, including licences and compensation payments • Notification of project as a DCO to PINS and regular engagement throughout

Workstream	Key activities
	• Secure planning permissions for baseline survey work, as required • Input into initial chapters of EIA Scoping Report and lead liaison with PINS
Legal support	• Ad hoc support as required on legal issues, statutory land access if required, permitting or document review
Project Management and Governance	• Mobilisation of long-term scheme delivery team, including lead roles on commercial strategy, engineering, project controls, land, consents and engagement strategy • Day-to-day management and coordination of all tasks and activities to ensure compliance with safety, quality, time and cost requirements • Assurance and submission for RAPID Gate 3

7.5 Procurement, ownership and operational strategy

7.5.1 Introduction

7.19 SESRO is a nationally important asset that will contribute to improved drought resilience across the south east of England. Given the scale of the capex value, construction period and operating life of the scheme, selecting the appropriate delivery route is important to achieving the best outcome for customers and other stakeholders. The delivery and procurement strategy builds on the Gate 1 conclusions, including a more detailed assessment of eligibility under different procurement routes, development of an initial operating model and commercial structure, and a detailed plan to progress the procurement strategy beyond Gate 2.

7.20 We have also considered the potential options for the role of Promoter[31], and have reviewed those options against the current approach of joint promotion between Thames Water and Affinity Water. Further details of the work completed may be found in Supporting Technical Document E-1: Commercial and Procurement Strategy and E2: SIPR Appendix to Procurement Strategy.

7.5.2 Preferred procurement option(s)

7.21 We have assessed SESRO in relation to three potential models for delivery and operation, including in-house delivery and two competitively tendered models: Direct Procurement for Customers (DPC) model[32]; and Specified Infrastructure Projects Regulations (SIPR) model. This has included a more detailed assessment of the scheme in relation to Ofwat's size and discreteness criteria for DPC; an initial assessment of whether SESRO meets the 'tests' for specification under SIPR; and an initial analysis of the value-for-money (VfM) offered under different routes. We have also considered the potential financeability to Thames Water and Affinity Water under different delivery models, and the impact of different procurement options on implementation timescales.

7.22 We note that SESRO was cited by ministers[33] in 2020 as a potential scheme that could benefit from the extension of the SIPR, and 'specification' under those regulations is an option that has been considered for the largest schemes. RAPID

[31] The company/ies that own and drive activity to prepare the scheme for future delivery
[32] Our assessment of tender models has concluded that a 'Late' model should be assumed for DPC
[33] https://hansard.parliament.uk/Commons/2020-06-10/debates/0D026C95-49D7-464C-9242-7B00C2A9B1FD/WaterIndustry?highlight=south%20east%20strategic%20reservoir%20option#contribution-F3241329-9150-4E23-98AE-8F86FE2EC2BE

guidance for Gate 2 further requires an assessment of whether schemes could benefit from a licensed approach under the SIPR regulations, and from separating the procurement of main works from the procurement of the financing (as was seen at Thames Tideway Tunnel). We have undertaken an initial assessment whether SESRO meets the criteria for SIPR as set out in current legislation[34] – in particular, whether the scheme is of a size or complexity that would threaten the existing undertaker's core operations. The key conclusions with regard to these two primary procurement routes (DPC and SIPR) are summarised in Table 7.4 below.

Table 7.4 Summary of key conclusions regarding DPC and SIPR delivery routes

Procurement Route	Gate 2 conclusions
DPC	• SESRO clearly meets the DPC £100m totex size threshold for DPC delivery set out in Ofwat's PR19 methodology, as well as the £200m size threshold set out in the draft PR24 methodology[35]. • SESRO is a relatively standalone raw water storage asset, with well understood, relatively straightforward interactions with Thames Water's (and Affinity Water's) broader water supply system, and as such, SESRO passes the DPC 'size' and 'discreteness' criteria. We therefore consider it potentially suitable for 'Late' DPC procurement, subject to confirming value for money and a detailed analysis of credit rating impacts at a future Gate. • To inform our initial view of value for money, we have also undertaken initial modelling, which indicates that DPC has the potential to deliver lower costs to consumers than in-house delivery, if DPC delivers capex and opex efficiencies in line with PR19 assumptions. Value for money will need to be confirmed at future Ofwat Control Points.
SIPR	• SESRO is one of the largest SROs in terms of capex. However, the SIPR 'size or complexity' test sets a high hurdle, and based on our work to date, we are not confident that the Secretary of State would consider that SESRO meets this test, given the availability of DPC and in-house alternatives. • The 'scale' and construction risks of SESRO are significantly smaller than for the Thames Tideway Tunnel (the only project currently specified under SIPR), which cost approximately £4.6bn and involved tunnelling under central London. • Our analysis of the impact of in-house delivery on Thames Water's financeability also suggests that while SESRO is a very large project, it could potentially be delivered in-house, although that would require additional equity to be raised to maintain gearing and would be subject to a detailed analysis of credit rating impacts.

7.23 Thames Water have commissioned further advice on SIPR from Agilia Infrastructure Partners (Supporting Document E-2). This work has identified several key characteristics of SESRO (notably its size, the duration of construction, and its high capital gearing) that make SESRO potentially well suited to a SIPR approach, including a separate competitive procurement of the construction supply chain and finance.

7.24 Our initial modelling suggests that procurement under the SIPR regime offers potential to deliver improved value for money to customers compared with both 'standard form' DPC and in-house delivery options. This is in part because SIPR is assumed to enable similar capex and opex efficiencies as DPC, as well as relatively low financing costs.

[34] The Secretary of State or the Authority may exercise the power if they are of the opinion that i) the infrastructure project is of a *size or complexity* that threatens the incumbent undertaker's ability to provide services for its customers; and ii) the infrastructure project is likely to result in better *value for money* than would be the case if the infrastructure project were not specified

[35] Creating tomorrow, together: consulting on our methodology for PR24. Appendix 5 – Direct procurement for customers, July 22

7.25 Overall, while we are not confident that SESRO would meet the 'size or complexity' test, we conclude that value for money for customers (the second criteria) may be optimised if SESRO is procured under the SIPR regime. We note that Ofwat has made a recommendation[36] to the Secretary of State for Business, Energy and Industrial Strategy (BEIS) that the 'size or complexity' test be modified or removed from SIPR legislation, so that SIPR can be applied to a broader range of schemes where a licensed approach would offer value for money. Further work (alongside Ofwat and RAPID) is needed to understand the likelihood and potential timescales of such a change.

7.26 We therefore recommend that the SIPR model be taken forward for further consideration as the preferred delivery model for SESRO, but that an enhanced DPC model be retained as an alternative, and that both models be subject to further analysis and market testing. A final decision on procurement strategy will be required prior to Gate 3, at Control Point C in 2024, as shown in Figure 7.1.

7.5.3 Implementation timescales

7.27 The WRSE draft Regional Plan and draft WRMPs indicate a required date for SESRO of 2040. Based on an estimated construction and commissioning duration of approximately 10 years, the required contract award date for SESRO is approximately 2029. The estimated time to appoint a CAP under a DPC commercial model is 2-3 years, from Gate 3 when the preferred procurement model will be confirmed. The SIPR model under TTT took longer (c. 5 years), however this may be due to particular factors including the agreement of a Government Support Package which may not be required for SESRO. This suggests that there is likely to be sufficient time to implement either a SIPR or DPC model for SESRO without introducing unacceptable programme risk.

7.5.4 Next steps to confirm the preferred procurement model

7.28 Further work is required to test value for money assumptions. In particular, this will focus on engaging with the construction supply chain and investor community to better understand how key scheme risks are likely to be priced under DPC and SIPR, how a DPC deal would be structured, the benefits that SIPR may deliver which cannot be achieved under DPC (and any associated trade-offs in terms of the administrative and regulatory costs under SIPR) and the opportunities for driving greater SESRO-specific capex and opex efficiencies under either SIPR or DPC. This insight would be used to confirm the procurement route at Ofwat's Control Point C in 2024. It should be noted that the continued uncertainty about the possibility of legislative change on SIPR might delay the agreement of a Procurement Strategy at Control Point C, and hence necessitate delaying Gate 3 until this was satisfactorily resolved. This risk will be kept under review after Gate 3.

[36] Competition stocktake report final (ofwat.gov.uk)

7.5.5 Operating and Commercial Arrangements

7.29 SESRO is a relatively passive asset, and its operations could be codified and automated based on a set of externally-driven parameters such as reservoir and river levels. We have explored two broad options for operation of SESRO:

- 'Independent' operation, where SESRO would be controlled under a pre-determined code (overseen by Ofwat), based on existing operational drivers/constraints. Under these arrangements, Thames Water, Affinity Water and Southern Water (plus any additional parties who wish to 'import' water from SESRO in the future) would have direct agreements with the SESRO operator.
- Operational control by Thames Water, with Bilateral Service Agreements (BSA) between Thames Water-Affinity Water and Thames Water-Southern Water. Thames Water would ultimately determine how each BSA could be modified or additional BSAs agreed.

7.30 It is too early to definitively conclude which option is more appropriate at this stage. It is also possible that the operating regime of SESRO may change over time and may differ markedly from currently anticipated usage once it becomes a 'live' source for different water companies to incorporate into their overall water supply system.

7.31 Future commercial arrangements for SESRO are likely to include a fixed capacity charge, and variable volumetric charges, where the capacity charges will be significantly greater than the volumetric charges. The apportionment of such charges has not yet been analysed or agreed. Further analysis of future usage of SESRO under different scenarios will enable agreement as to the most appropriate SESRO operating and commercial arrangements.

7.5.6 Forward plan

7.32 We propose early market engagement with investors and the construction supply chain to further understand approach to and pricing of key commercial risks and gain further insight into the potential structure of both DPC and SIPR models. This will be used to inform more detailed financial modelling to provide robust evidence for the comprehensive value for money assessment required at Control Point C, which is scheduled for mid-2024. This would confirm the preferred procurement model and associated plan.

7.5.7 Partnering Arrangements

7.33 The current proposed approach for SESRO post-Gate 2 is for:

- Thames Water, Affinity Water and Southern Water, who are identified as key beneficiaries in the WRSE draft Regional Plan, to jointly sponsor and fund the scheme's construction
- Thames Water to act as 'promoter' and take single point accountability for development and ultimate delivery of SESRO under the preferred competitive procurement model (SIPR / DPC).

7.34 These changes reflect Infrastructure and Projects Authority (IPA) governance 'best practice' and the latest WRSE modelling, but are yet to be formally agreed with Southern Water. We propose that all parties work to finalise these arrangements,

including legal heads of terms setting out agreeing clear responsibilities and accountabilities between the various organisations to streamline governance, decision-making and delivery. Any changes to funding and governance post Gate 2 will be agreed with RAPID prior to implementation.

8. Solution costs and benefits

8.1 SRO Cost Estimates

8.1.1 Introduction

8.1 The costing approach has been developed in line with the All Company Working Group (ACWG) guidance on cost consistency[37] and using a standard SRO template for capturing the Quantitative Costed Risk Assessment (QCRA) and calculating Optimism Bias (OB)[38]. Further detail may be found in Supporting Document A2: Cost Report.

8.2 Net Present Value (NPV) and Average Incremental Cost (AIC) have been derived from the Capex and Opex estimates using the standard calculation template provided by the ACWG. NPV and AIC have been calculated for 100% utilisation and the current estimated operational utilisation scenario (see Section 4.1), which allows accurate assessment of intake pumping power, aeration use and energy recovery on release.

8.1.2 Capital and Operating Cost estimates

8.3 Estimates for base capital cost, costed risk, optimism bias and operational cost are summarised in Table 8.1, which also provides a comparison to Gate 1. The scope of this estimate, and associated design assumptions and exclusions, are as summarised throughout Supporting Document A1: Concept Design report. All costs are standardised to a 2020/21 cost base, for consistency with WRMP24 data tables. It should be noted that the Gate 1 values have also been adjusted to the same cost base (2020/21) to allow for comparison with Gate 2.

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

Option Name	Units	150 Mm3	125 Mm3	100 Mm3	75 Mm3	30 + 100 Mm3	80 + 42 Mm3
Option Benefit	MLD	271	230	185	149	239	224
Capex (20/21 prices)							
Base Capex	£m	1,455	1,363	1,244	1,144	1,563	1,554
Costed Risk	£m	335	314	286	263	359	357
Optimism Bias	£m	406	380	347	319	436	434
Total Gate 2 Capex	£m	2,195	2,057	1,878	1,726	2,358	2,345
Total Gate 1 Capex	£m	2,002	1,868	1,732	1,601	2,290	2,273
Change G1 to G2	%	9.64%	10.12%	8.42%	7.83%	2.97%	3.18%
OPEX (20/21 prices)							

[37] Mott MacDonald, August 2020, "Cost Consistency Methodology, Technical Note and Methodology"
[38] ACWG (2021), Appendix A-1 - Optimism Bias and QCRA Template - Rev C.xlsx

Option Name	Units	150 Mm3	125 Mm3	100 Mm3	75 Mm3	30 + 100 Mm3	80 + 42 Mm3
Gate 2 Fixed	£m/ annum	3.80	3.74	3.66	3.57	4.38	4.36
Fixed: G1 to G2	%	-16.15%	-9.85%	-3.28%	3.47%	-15.35%	-16.07%
Gate 2 Variable	£/ML	10.06	9.52	9.11	8.03	11.10	10.28
Variable: G1 to G2	%	7.96%	-2.68%	-12.01%	-21.75%	-11.00%	-21.14%

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

Table 8.2 NPV and AIC estimates for SESRO options and comparison to Gate 1 equivalents

80 year planning period costs and benefits	Units	150 Mm3	125 Mm3	100 Mm3	75 Mm3	30 + 100 Mm3	80 + 42 Mm3
Option Benefit (DYAA)	MLD	271	230	185	149	239	224
Option Benefit (DYAA)	Ml	1,587,370	1,344,286	1,121,504	906,438	855,567	1,131,941
Capex NPV	£m	1,398	1,316	1,230	1,137	1,240	1,341
Estimated Utilisation (38%) *							
Opex NPV	£m	67	65	65	62	63	72
Total NPV	£m	1,465	1,381	1,294	1,199	1,302	1,413
AIC	£/m³	0.92	1.03	1.15	1.32	1.52	1.25
Maximum Utilisation (100%) **							
Opex NPV	£m	76.907	72.829	71.152	66.645	68.117	78.671
Total NPV	£m	1,475	1,389	1,301	1,204	1,308	1,420
AIC	£/m³	0.93	1.03	1.16	1.33	1.53	1.25
Gate 1 AIC (20/21)	£/m³	0.80	0.90	1.03	1.20	1.35	1.145

Note * 38% utilisation is assumed for these calculations to enable comparison between options: 1 in 500 year deployable output for 365 days / year, based upon output of long-term water resources modelling (see Section 4.1). There is no comparative AIC for Gate 1 as these utilisation calculations were not available at Gate 1.

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

8.5 Key aspects of the comparison between Gate 1 and Gate 2 include:

- Option benefit has been reduced following more detailed Deployable Output modelling which accounted for climate change (see Section 4.2).
- The base capital cost has changed slightly following updates to quantity estimates (see Supporting Document A2: Cost Report, section 2).
- At Gate 1 the P50 costed risk was ~20% of the base capital cost. Identification of additional risks has resulted in an increase to 23% of base capital cost. This includes potential need for further onsite habitat creation and / or offsite land purchase to respond to Biodiversity Net Gain (BNG) requirements.
- Optimism bias has been revisited and updated since Gate 1.
- Changes to both fixed and variable operating costs, associated with updates to energy requirements and abstraction licence costs, details of which can also be found in Supporting Document A2: Cost Report (section 5.1).

8.2 SRO Benefits Estimates

8.6 This section provides an overview of some of the key potential benefits provided by SESRO, including environmental and carbon benefits, via a Natural Capital Assessment (NCA), recreational benefits via a Conservation, Access and Recreational strategy and socio-economic benefits through a six-capitals assessment framework.

8.2.1 Natural Capital Assessment

Overview

8.7 The Natural Capital Assessment (NCA) focuses on the changes to natural capital stocks and the benefits derived from the ecosystem services that they provide. The results of the NCA have been in translated into 'Natural Capital Metrics'. Further details of the NCA can be found in Section 9 of Supporting Document B2: Terrestrial Environmental Appraisal Report.

8.8 The approach enables the quantitative assessment and monetisation of various ecosystem services to show the benefits (positive) or disbenefits (negative) of each option, and hence comparison between them.

8.9 Based upon this assessment, the following key conclusions may be drawn:

- All options demonstrate an overall positive impact; the most substantial benefits are likely to come from the recreational and amenity value of the scheme.
- Based on central transfer values, the 75Mm^3 SESRO option is expected to yield the largest natural capital benefit. This is likely due the scaling of habitat types to estimate the future habitat baseline, which was underpinned by the assumption that smaller reservoir footprints allow a greater proportion of habitats to be created. This reflects the findings of the BNG assessment in Section 6.5, although the same caveat with regard to indicative site boundaries at this early stage should be noted.
- The results broadly align with those from the Gate 1 assessment, although differences in air pollutant removal and natural hazard regulation are seen; explained by the change in woodland areas.

Carbon sequestration

8.10 The NCA analysis also includes an assessment of the impacts of the reservoir proposals on carbon sequestration. In qualitative terms, arable land is generally considered to be a source of carbon emissions rather than a sink. Each option involves a substantial area of land, particularly arable and horticulture, being taken out of agricultural use and partially replaced with land capable of sequestering carbon. Woodland is likely the most substantial carbon store and carbon sequestering habitat present. Net losses of woodland habitat are expected under each option, though the carbon impacts are likely to be counteracted by the potential for the creation of new habitats, such as the substantial area of floodplain wetland mosaic and native species-rich hedgerow with trees. This can be seen from the indicative Gate 2 Master Plan in Figure 3.1.

8.11 Quantitative assessment and monetisation of the natural capital value of this change estimates that the present value benefit would be positive for each SESRO option.

This increase is based on the conversion of arable land to habitats with a greater capacity for carbon sequestration, such as woodland, floodplain wetland mosaic and hedgerows. On this measure alone, the smallest SESRO option is predicted to provide the largest benefit, valued at £3.1M, and the largest SESRO option the lowest at £1.9M (central estimates).

8.2.2 Recreational benefits

8.12 A study into the potential conservation, access and recreational (CAR) opportunities for SESRO has been completed for Gate 2 (see Supporting Document B3: CAR). This outlines the process undertaken to identify and explore potential uses of SESRO beyond the basic supply of raw water for supply.

8.13 The CAR Strategy presents three potential future scenarios for SESRO (high, medium and low) which include different conservation, access and recreation options. The low visitor scenario would provide an attractive recreational asset enjoyed primarily by the local community, while the high scenario would be considered a tourism destination, which may attract visitors from further afield. At this stage of the RAPID Gated process the CAR Strategy has not identified a preferred scenario. However, the proposed scenarios are intended to influence the concept design of SESRO as part of the Gate 2 submission; the indicative Gate 2 Master Plan (Figure 3.1) is based upon the low scenario and aligned to the recreational and access elements that are costed within the option used in the Water Resources planning process for WRMP24. As noted in section 3, we aim to develop the recreational uses of the site once the size of the preferred scheme is confirmed by WRMP24 and as we progress more local, community engagement on the specific design and use of SESRO.

8.14 Future studies will also include analysis of how each aspect could be funded, either direct by TW customers if considered a critical aspect for scheme consenting or else via other funding or partnering arrangements. These options have not yet been explored for Gate 2 whilst the scale and detail of the scheme is still being finalised.

8.2.3 Wider socio-economic cost and benefits assessment

8.15 The wider benefits (and disbenefits) assessed here include Economic Activity, Health, Education, Financial Asset Value and Customer Bills. The Six Capitals framework[39] is used for this assessment.

8.16 Further details of the methodology and outcomes of the assessment may be found in Section 10 of Supporting Document B2: Terrestrial Environmental Appraisal Report. The summary findings of this assessment are included in Table 8.3 below. Ultimately, the opportunities created at SESRO should lead to long-term benefits of a far greater magnitude than the short-term disbenefits. There will be significant employment, economic activity, education, and health benefits.

Table 8.3 Summary of SESRO socio-economic cost - benefit appraisal

[39] Value Reporting Foundation, 2021. International <IR> Framework.

Workstream	Key activities
Overview	SESRO will provide a broad range of long-term benefits in Oxfordshire, providing opportunities to improve physical health, access to STEM learning opportunities, provide employment and grow the local economy.
Employment	Employment provided by SESRO during the construction and operation will lead to further benefits for the economy through more jobs being created. ▪ 4,297 full-time equivalent employment years created by SESRO's construction ▪ 2,741 are estimated to be created through further economic activity. An estimated 56 jobs would be created in total due to SESRO's operation.
Gross Value Added (GVA)	The benefits to the economy in the form of additional employment can also be expressed in terms of GVA as it shows SESRO's contribution to the economy. An estimated £252m of GVA over 10 years construction is significant given the size of Berkshire, Buckinghamshire and Oxfordshire's construction sector.
Health and Wellbeing	The increased range of physical activities at SESRO will propose significant health benefits to the visiting population locally and in Oxfordshire. More people use SESRO than the existing site for physical activities and it would create a more inclusive and accessible environment. The net health benefit of SESRO annually equates to £3,117,000.00 which, over a 60-year period discounted in accordance with Green Book health guidance, equals £125,993,000.
Education	The education value of SESRO has been quantified in terms of the potential annual willingness to pay by educators to visit the facility with school children for STEAM field trips. This value should not be considered solely indicative of the total benefits of education, a much greater economic value will be felt with the long-term economy.
Cost of living	As the area has low levels of deprivation it is likely that only a small proportion of the population will be significantly affected by a change in cost of living. This can be addressed through targeted mitigation.
Local community disbenefit	From this assessment, it is expected that SESRO will generate some disbenefits for local communities. Potential short term disbenefits include disturbance to a small number of local businesses. However, initial desk-based investigation suggests that most of these could be relocated to a new site and operate as normal due to the nature of the businesses. Suitable compensation and mitigation packages will be developed for all affected. There is also a potential long term disbenefit of an increase to customer bills, which may affect Thames Water customers as part of securing future water supply.

8.3 Best Value Planning

8.17 The WRSE Best Value Plan has been derived using the published methodology and metrics[40]. The draft Water Resource Management Plan 2024 (WRMP24) for each of the partner companies 'reflects' this draft regional plan, so far as is appropriate for individual water companies.

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

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

8.20 Best value metrics have been determined for the SRO scheme. The metrics considered in addition to cost and carbon emissions are Natural Capital (NC),

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

Biodiversity Net Gain (BNG), SEA benefit, SEA disbenefit, resilience: reliability, evolvability and adaptability, and customer preference.

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

8.22 The draft WRSE regional plan shows:

- In the reported pathway of the preferred plan, the SESRO 100 Mm^3 variant is selected for use by Thames Water, Affinity Water, and Southern Water from 2040. The scheme is later used conjunctively alongside the Severn-Thames Transfer.
- The 100Mm^3 option variant is used in 8 of the 9 pathways of the WRSE best value plan, but with differences in utilisation between the three recipient companies in different future scenarios, and across the planning period.
- The SESRO 150 Mm^3 option is used within the cost-efficient plan.

8.23 Further discussion on the rationale for the choice and timing of this option may be found within the partner companies' draft WRMP24 documents.

9. Stakeholder and customer engagement

9.1 Stakeholder and Community Engagement

9.1.1 Summary of activity since Gate 1

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

- activity to inform the development of the WRSE plan to ensure stakeholders understand how SESRO fits into the strategic water resource planning framework.
- SESRO specific discussions focused on legal, regulatory and strategic issues. This collaborative engagement, primarily with regulators and strategic stakeholders, facilitated agreement on scope and methodological approaches.

9.2 In addition to these project driven undertakings, RAPID received a wide range of representations to its draft Gate 1 assessment of SESRO, which we have taken into consideration in developing our Gate 2 submission. A summary of the topics and responding action, from a SESRO project perspective, is presented in Supporting Document D: Stakeholder and Customer Engagement Strategy.

Activity to inform the WRSE regional plan

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

9.4 There was heightened awareness and interest in Oxfordshire in relation to SESRO and in response, in addition to WRSE led activity, Thames Water and Affinity Water hosted a series of activities:

- A pre-briefing for elected members and officers of Oxfordshire County Council and Vale of White Horse District Council ahead of the launch of the consultation
- Meetings with local MPs to provide a briefing on SESRO and the WRMP process

- Meetings with elected members and officers at Oxfordshire County Council and at the wider County Council forum, ADEPT, to engage on water resource matters
- Meetings with Group Against Reservoir Development to discuss their technical challenges, as well as offering to attend their community events
- Drop-in events in Steventon, Oxfordshire to provide the opportunity for the local community to talk about water resources, the SE emerging plan and SESRO.

9.5 WRSE received over 1,150 written responses to the consultation. Over half of the individual responses to the consultation on the emerging plan focused on specific water resources options, such as large new reservoirs, strategic water transfers, and water recycling schemes, with approximately 500 responses expressing opposition to SESRO[41].

9.6 At the community 'drop-in' sessions arranged in the local area around the SESRO site, a large number of representations were made verbally on the regional plan and the inclusion of SESRO within the WRSE emerging Regional Plan. We have listened to the points raised in the consultation, and through dialogue with stakeholders and the local community, and ensured these points are addressed by the further work to develop the long-term water resources plan.

9.7 We will refine the scheme to reflect these concerns and engage proactively with the local community as the design develops.

Technical Liaison Groups

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

- Quarterly update meetings have been held with RAPID to discuss the programme, outputs, risks and issues.
- A number of Technical Liaison Groups (TLG) have been established. The purpose of the TLGs is to enable collaborative working with regulators and technical stakeholders throughout the Gate 2 process.
- We have also held 'one-to-one' meetings with specific individuals and groups to discuss and resolve issues of particular detail on the scheme. The findings have been built into the Gate 2 submissions.

9.1.2 Strategy after Gate 2

9.9 The community engagement strategy for SESRO has been developed to advise stakeholders of the different stages that will be followed to deliver the project and the opportunities for providing comments.

9.10 There are multiple processes running in parallel around the SROs, such as the WRSE regional plan, partner company WRMPs and the future potential for DCO submissions

[41] Opposing responses were received from Oxfordshire County Council, Vale of White Horse and South Oxfordshire District Councils, Group Against Reservoir Development (GARD), Wantage and Grove Campaign Group, CPRE and other environmental and campaigning organisations, together with individual Councillors, Parish Councils and many individuals resident in the area local to the proposed reservoir site.

for individual schemes. In response, future engagement will provide a clear explanation of the overall decision-making context for SESRO and the particular purpose of individual rounds of consultation and engagement. Amongst other things it is hoped that this will assist stakeholders to align their responses with matters in hand whilst being reassured that there will be fair opportunities to raise additional concerns in subsequent rounds of consultation and engagement.

9.11 It is proposed, that in addition to the proposed consultation associated with the Water Resources Management Plan (WRMP24) in late 2022, a number of further engagement and consultation opportunities are planned for 2023 onwards. The timing of future engagement may be adjusted as the scheme promotion develops and as a result of the consultation and engagement undertaken on WRMP24, but the indicative programme at this stage outlined in Table 9.1 below.

Table 9.1 Indicative engagement plans after Gate 2 showing opportunities for stakeholder participation

Phase	Planned activity	Summary
2023 – 2024	Community engagement	Likely to be focussed on the preliminary design ideas for the scheme including aspects such as access, construction phase, landscaping and recreational use.
	EIA Scoping Report	A formal report submitted to the Planning Inspectorate (PINS), to request a Scoping Opinion on the subsequent EIA. Published on PINS's website and they will undertake engagement with statutory consultees on the Scoping Report.
	RAPID Gate 3	The project partners would comply with the requirements of RAPID Gate 3.
2025 - 2026	Statement of Community Consultation (SoCC)	Project partners' engagement with the relevant prescribed authorities on the proposed formal approach to community consultation for the subsequent DCO application. This would take account of comments and would be published for information prior to the formal DCO statutory consultation.
	Statutory consultation for the DCO	Feedback sought on the design and environmental assessment of the proposed scheme to be submitted for DCO application.
	RAPID Gate 4	Prior to the DCO submission, we will publish the information we submit to RAPID Gate 4.
After 2026	Examination in Public for the DCO, after Gate 4	Opportunity for stakeholders to make representations on the proposals and become interested parties in the formal DCO Examination to be managed by the Planning Inspectorate (PINS).

9.12 Engagement by the project team with technical stakeholders and regulators will continue on a regular basis throughout subsequent project stages.

9.2 Customer Preference and Engagement

9.2.1 Introduction

9.13 For Gate 2, our collaborative customer research[42] has progressed on the themes we identified at Gate 1:

- Exploring what customers view as 'best value' – enabling us to assess how different schemes 'perform' in terms of the customers preferences.

[42] We have undertaken a collaborative programme of customer engagement across several water companies. Further details may be found in Supporting Document D: Stakeholder and Customer Engagement Strategy

- Looking at how we can make schemes more acceptable to customers, we looked to dive deeper on views regarding public value of different schemes.
- Looking at how customers perceive and understand changes to their source of water, including taste-testing.

9.2.2 Findings relevant to SESRO

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

9.15 The majority of participants were in favour of the inclusion of 'added value' additions to the project (environmental, economic and social). When costs and bill impacts were raised, customers consider that cost-benefit considerations should play a major role in future planning. The other key findings of the public value research were as follows, against each we have identified our current response:

- The disruption to daily life during the long construction period and cost leads to doubts about how worthwhile investment in a reservoir is as a solution.
- The large amounts of space required to build reservoirs also raises concerns about the destruction of local habitats and damage to the environment.
- Learning about the creation of new habitats and green spaces in the construction phase goes some way in addressing these concerns, leading to a perception that they have a 'net-positive' impact on the environment.
- Additional benefits (e.g. leisure spaces, education opportunities) created through reservoirs further build on this view of net-benefit once constructed.

9.16 As with feedback from previous and future engagement and consultation exercises, we will refine the scheme to reflect these research findings and engage proactively with the local community as the design develops during subsequent stages.

10. Board statement and assurance

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

10.1 Assurance approach and findings

10.2 The assurance framework used for this submission has been developed jointly by TW and AFW, to provide up to three levels of assurance across each element of the work. Due to previous stakeholder commentary on this SRO, all areas of this Gate 2 submission were considered high risk and hence received three levels of assurance.

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

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

- The Gate 2 submission is consistent and aligned to the regulatory requirements for Gate 2 as set out in Ofwat's final determination and subsequent additional feedback.
- For the information within their scope, the information contained within the Gate 2 submission has been derived using methodologies, assumptions, and input data suitable for Gate 2 and is therefore reliable .
- The assurance scope is appropriate for the submission.
- Their opinions and feedback have been appropriately considered.
- Progress on the solution to date is commensurate with the Final Determination timeline of being 'construction ready' for AMP8.
- For the information within their scope, that the work carried out to date is of sufficient scope, detail and quality which would be expected of a large infrastructure scheme of this nature at this stage.
- The expenditure that has been incurred in generating the Gate 2 submission is efficient and relevant to the development of the submission.

10.2 Board Statement(s)

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

11. Efficiency of expenditure for Gate 2 and forecast

11.1 Gate 2 costs

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

11.2 For accurate comparison with the Final Determination allowance, as requested by RAPID, actual costs are deflated back to a 2017/18 cost base[43] (see Supporting Document F-2: Cost Efficiency Report).

11.3 Overall, the forecast spend to Gate 2 represents a saving of just over £21.5M against Ofwat's Final Determination (FD)[44] allowance, allowing for the underspend at Gate 1 (see Table 11.1). Discussion of this efficient delivery of Gate 2 is provided in subsequent sections. All required outputs for Gate 2 have been delivered, along with the agreed early activity to enable timely and efficient delivery of Gate 3.

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

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

Table 11.1 Gate 2 forecast total cost for each partner company

Company	Forecast Total Cost to RAPID Gate 2 (£M, 2017/18 prices)	Ofwat FD Allowance for Gate 2 (£M, 2017/18 prices)	Previous underspend on Gate 1 (£M, 2017/18 prices)	Saving (£M)
Thames Water	4.84	12.23	7.13	14.52
Affinity Water	2.39	6.02	3.51	7.15
TOTAL	**7.23**	**18.26**	**10.65**	**21.67**

11.4 In accordance with the latest gate 2 guidance from RAPID, more detailed cost breakdowns are provided for any category where the costs exceed £500k. This breakdown may be found in Supporting Technical Document F-2: Cost Efficiency Report, Section 2.2. For SESRO, this applies to:

- Programme and project management
- Feasibility Assessment and Concept Design
- Environmental Assessment
- Procurement Strategy

11.5 The breakdown of costs to Gate 2 is shown in Table 11.2, in accordance with the reporting template provided by RAPID. All costs are split 33% to AFW and 67% to TW.

11.6 We can confirm that we have completed all of the Gate 2 tasks that were proposed at Gate 1.

Table 11.2 Gate 2, Cost Breakdown (as per RAPID template)

Category	Sub-Activity (if required)	Expenditure (£, 2017-2018 prices)	% of Total Expenditure	Description of Activity
Programme & Project Management		£1,076,283	14.9%	Programme Manager, Project controls and programming support, Assurance, Project Director and Executive governance
Feasibility Assessment and Concept Design		£1,051,011	14.5%	Engineering design and all associated studies (e.g. flood risk, rail and access feasibility), Network Rail costs, client technical direction, dam safety engineer, cost and carbon estimating
Option benefits development and appraisal		£396,457	5.5%	Water resources modelling, DO assessment, long-term utilisation analysis, hydrological losses, WRSE investment modelling (sensitivity), cost-benefit analysis and NCA
Environmental Assessment		£2,781,265	38.5%	EA and NE costs, water quality modelling, 2D modelling of weir pools, reservoir physical and algal modelling, WFD and aquatic ecological assessments, desk-based assessments of high risk environmental issues, initial HRA, BNG assessment, licensing strategy, microclimate impact assessment, visualisation tool
Data Collection, Sampling, and Trials		£272,704	3.8%	Aquatic ecological surveys, water quality survey (R.Thames and R.Lea), algal surveys and experimentation, Aerial photographic survey
Procurement Strategy		£505,736	7.0%	Strategic review of procurement routes, client governance, external advisory services and steering group on commercial matters
Planning Strategy		£497,372	6.9%	OCC costs, strategic planning review and DCO strategy, land access and acquisition advice
Stakeholder Engagement		£244,816	3.4%	Customer research and preference studies, stakeholder lead for both partner companies, PR support for engagement process, support to WRSE engagement processes
Legal		£403,190	5.6%	Legal advice on various issues and policies
Other		£0	0.0%	
Total		**£7,228,833**	**100%**	
Gate 2 Allowance	*Including Gate 1 underspend*	**£28.9m**	-	
Gate Underspend		**£21,671,167**	**73.57%**	

11.2 Efficiency of Gate 2 costs

11.6 The efficiency of the spend to Gate 2 has been assured through a series of control mechanisms on the procurement, delivery and reporting of the required technical services, which are summarised in in Table 11.3 below:

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

Table 11.3 Gate 2, Principles of cost efficiency

Principles	Efficiency achieved	Contribution
The work that we have completed was aligned to RAPID's requirements.	Costs apply only to work packages that were directly required to deliver Gate 2 or to mobilise for timely and efficient delivery of Gate 3 and beyond. This results in a very targeted scope of work. Additionally, the Gate 2 allowance is very high relative to the level of technical information and insight already available. As for Gate 1, but to a lesser extent, robust previous investigations could still be relied upon and hence costs were significantly lower than might have been the case for less well developed schemes. This has continued to contribute to the overall efficiency of the SESRO Gate 2 spend.	Very high
Standard methodologies for key areas	Shared methodologies continued to be developed for Gate 2, across numerous SROs. Application of shared methodologies reduces technical work effort (standardised, templates, outputs etc) and prevents need to assure bespoke methodologies, driving consistency with other SROs for Gate 2 submission.	Medium
Integrated use of WRSE modelling capability	The WRSE Investment Model has been used to help explore the sensitivity of the need and timing of this specific SRO. Use of WRSE data and models helps reduce technical work effort, prevents the need for additional models to be developed and reduces the time required to assess options for Gate 2.	Medium-Low
Implementation of common procurement principles	Standardised rules for the procurement of services on behalf of multiple project partners has helped to provide best value for money. This has been delivered through the continued application of a prioritised hierarchy of standard procurement approaches, helping to drive competition and efficiency into external procurement by the best placed project partner. This also allows shared governance over technical services between the project partners, which drives accountable efficiency into the process.	Low
Adoption of competitive procurement and qualitative benchmarking	Many of the key external support services has been procured using competitive approaches, with the majority going via framework mini-bid processes. Overall, we have procured 28% of the value of the work packages for Gate 2 via either competitive tendering or mini-bidding on existing company frameworks. 64% was procured using direct award on company frameworks to ensure competitive rates. Where direct award was used (for the remaining 8%) e.g. highly specialised technical work, qualitative benchmarking and challenge using professional judgement against similar previous work packages ensured efficiency.	Medium – High
Procurement of aligned work-packages across multiple SROs	Several work packages have been procured on behalf of multiple SROs, to drive efficiency into both procurement and delivery (economies of scale for contractors, fewer contracts to let and manage and fewer consultancy interfaces). These approaches apply to 59% of the value of Gate 2 work packages.	High
Application of rigorous PM controls	Robust cost control implemented by the Project Manager and overseen by the Programme Management Board (PMB) helps prevent 'scope creep' and cost escalation.	Medium

11.7 A breakdown of which of these efficiency principles, as discussed in Table 11.3 above, were applied to each of the procured work packages may be found in Supporting Technical Document F-1: Project Delivery Plan.

11.8 A simple qualitative comparison across the other Thames Water SROs shows that the spend for each of the technical categories is relatively similar, supporting the previous conclusion that the Gate 2 spend is efficient and aligned with other similar SROs. However, there are some outliers to this, including:

- The proportion of the costs assigned to environmental assessment is thought to be slightly higher than for other Thames SROs, although very similar to the STT. This is because the scale and complexity of the environmental issues for these schemes is higher than for the other Thames SROs and hence a higher percentage of the spend is required to understand these risks and issues.
- The proportion of the costs assigned to Data Collection, Sampling, and Pilot Trials is slightly lower than for other Thames SROs. This is reflective of the limited access that is available to the reservoir site at this formative stage (hence limited survey effort that is possible) and also the sharing of many of the River Thames monitoring activities across multiple SROs (e.g. water quality, ecology etc) which results in lower costs through more efficient delivery.

11.9 Taking a more lead role in the day-to-day delivery of the SESRO project after Gate 2, will require the mobilisation by Thames Water of a Programme Management Office and all associated 'client-side' functions necessary to deliver a 'mega-project' the scale of SESRO alongside the other Thames Water SROs. This has been done (and agreed with RAPID) ahead of Gate 2, in order to ensure the team is fully mobilised and systems established in time to progress Gate 3 work in November 2022. The PMO has been established to provide a consistent approach across the variety of functions needed to manage the SRO portfolio effectively. This team is required, based upon collective and corporate experience of similar sized projects in both the water sector and elsewhere, to ensure efficient and effective robust delivery of subsequent project stages.

11.3 Gate 3 Forecast costs

11.10 The forecast costs for Gate 3 are based upon a thorough appraisal of the work breakdown structure for Phase 3 of the project, as outlined in Section 7. The project costs are based upon a combination of benchmarking to similar work undertaken during previous phases, involvement of the existing supply chain and expert judgement, but not formal tender at this stage. The forecast should therefore be treated as an estimate. It will be reviewed regularly throughout Gate 3, as work package scope and costs are agreed with suppliers. Governance by Thames Water as the scheme promoter after Gate 2 will ensure adherence to RAPID Final Determination allowances.

11.11 The forecast costs to Gate 3 are £41.6M (2017/18 prices), inclusive of estimated risk and contingency. The breakdown of this cost may be found in Supporting Document F-2: Cost Efficiency Report.

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

12. Conclusions and recommendations

12.1 Conclusions

Feasibility and cost

12.1 The different options for SESRO are all technically feasible. They have been reviewed and provided as costed options to the WRSE regional best value planning process and as feasible options for WRMP24. In the WRSE draft Regional Plan and the draft WRMP24 for both Affinity Water and Thames Water the 100 Mm^3 option for SESRO is selected in the reported pathway, to be available by 2040.

12.2 As expected, the highest NPV for a single-phase option is for the largest (150 Mm^3) at £1.465Bn but this option also delivers water at the lowest unit cost, with an AIC of £0.923/m^3 for the estimate long-term utilisation profile. For comparison, the selected 100 Mm^3 option has an AIC of £1.15/m^3 and an NPV of £1.294Bn. This can be compared to an NPV for the smallest single-phase option (75 Mm^3) of £1.199Bn and an AIC of £1.323/m^3. The phased options are the least cost-effective.

Water Resource Planning

12.3 Taking account of the impacts of future climate change, the different sized options deliver a deployable output of between 65 Ml/d and 271 Ml/d for London, which can potentially be shared regionally. A DO benefit of approximately 11 Ml/d is found by combining the SESRO and STT options, and there is expected to be a material conjunctive use DO benefit to London of approximately 50% when operating SESRO with the T2AT (see T2AT SRO Gate 2 submission, section 4). If the STT is combined with SESRO and then used as the water source for the Thames to Southern Transfer, an additional DO benefit of 19 Ml/d is identified.

Environment

12.4 There are expected to be a range of adverse environmental impacts from SESRO, which need to be addressed through scheme design and mitigation. However, the desk-based assessments completed for Gate 2 do not suggest that any of these impacts is unresolvable given the scale and importance of SESRO in the WRSE regional resilience plan. Further work has identified that all SESRO options should be compliant with the requirements of the WFD through the application of a robust mitigation strategy and the limited duration of the impacts on the existing waterbodies.

12.5 SESRO does have a relatively high embodied carbon footprint during the construction phase. However, there are a range of mitigation opportunities that have been identified, both during design and via supply chain engagement, all of which will be developed as the scheme progresses. The operational carbon, taking

account of the opportunity for energy recovery on discharge, is relatively small compared to other water supply options.

Benefits

12.6 SESRO provides an excellent opportunity for biodiversity net gain and positive contributions to NC value, as shown by the indicative Gate 2 Master Plan. A wide array of other opportunities to deliver shared regional benefits have been identified, including flood risk mitigation, improved traffic and recreational use of the site.

12.7 The opportunities created at SESRO should lead to long-term benefits of a far greater magnitude than the short-term disbenefits. SESRO will provide a wide range of wider socio-economic benefits, including employment creation, economic growth during construction, health and wellbeing and education.

Scheme delivery

12.8 The largest option is considered deliverable by the draft WRMP24 required date of 2040. The project is currently on a pathway to be construction-ready by 2030.

12.9 The commercial assessment completed for Gate 2 concludes that the two leading options for the procurement of SESRO would be either a DPC model or else a SIPR model, with the latter being the preferred route at this stage.

12.10 The single-phase SESRO options all qualify as NSIPs and are therefore would need to be consented through DCO under the Planning Act 2008 (PA2008).

12.11 The programme is on track to deliver the future RAPID gateways as outlined in Section 7, with Gate 3 proposed for January 2025. This represents a proposed change from the initial programme outlined by RAPID in their Final Determination documentation, but we believe reflects a more efficient and effective way to deliver the future scheme promotion and delivery programme.

12.12 The analysis completed for Gate 2 has identified a number of important consenting and delivery risks. The major construction phase risks have been incorporated into the scheme cost and hence options appraisal process. For the major pre-construction risks, appropriate mitigation has identified and applied. This will be retained under proactive management by the Project Management Board as the scheme progresses.

Costs

12.13 The Gate 2 submission has been delivered for a cost of £7.2M, showing an efficiency saving of 73% compared to the RAPID allowance.

12.14 The Gate 3 forecast costs are much higher, as the scheme accelerates towards promotion (based upon the current positioning of this SRO within the draft WRMP24 strategy), but still within the RAPID allowance. We forecast costs of £41.6M at Gate 3.

12.2 Recommendations

12.15 It is recommended that the scheme continue to Gate 3, for the further refinement of options and selection of an initial preferred scheme.