South East Strategic Reservoir Option (SESRO)

Supporting Document A1

Basis of Design Report

J696-DN-A01A-ZZZZ-RP-ZD-100021

Version: 1.0

Standard Gate three submission for SESRO SRO

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 the suite of documents that make up the 'Gate 3 submission.' Gate 3 of the RAPID programme represents a checkpoint on the way to solutions being prepared for consent applications. The intention at this stage is to provide RAPID with an update on activities being undertaken in preparation for consent application submission; activities' progress including programme through to completion; and consideration of specific activities to address particular risks or issues associated with a solution. The regulatory gated process does not form part of the consenting process and will not determine whether an SRO is granted planning consent.
- Given the stage of the SROs in the planning process, the information presented in the Gate 3 submission includes material or data which is still in the course of completion, pending further engagement, consultation, design development and technical / environmental assessment. Final proposals will be presented as part of consent applications in due course.
- The project information captured in this document reflects a design freeze in October 2024 following the non-statutory consultation, to meet the requirements of RAPID's gated process. Since then, the design has continued to evolve which includes further work with Affinity Water and Southern Water partners to form agreed requirements for the development consent application, such as the incorporation of Southern Water's proposed water treatment works into the SESRO consent. You can find the latest information about the design and development of the project at https://thames-sro.co.uk/projects/sesro/.

Disclaimer

Revision history

Version	Date	Submitted at
1.0	23-07-2025	RAPID submission

Table of contents

List of tables:

List of figures:

Glossary

Terms and acronyms	Definition
ADC	Auxiliary Drawdown Channel
AEP	Annual Exceedance Probability
BIM	Building Information Modelling
CCBD	Cow Common Brook Diversion
DCO	Development Control Order
DEFRA	Department of Environment and Rural Affairs
EHDD	East Hanney Ditch Diversion
EIA	Environmental Impact Assessment
FSR	Flood Storage Reservoir
Interim master plan	The interim landscape and environmental master plan issued for consultation in summer 2024
LON	London WRZ
MDD	Mere Dyke Diversion
NSIP	Nationally Strategic Infrastructure Project
PINS	Planning Inspectorate
PS	Pumping Station
RAP	Reservoir Advisory Panel
Reservoir Tunnel	Tunnel between the SESRO PS and the main tower
RFS	Replacement Flood Storage
River Tunnel	Tunnel between the SESRO PS and the inlet/outfall
SCL	Spray Concrete Lining
SESRO	South East Strategic Reservoir Option
SiPR	Water Industry (Specified Infrastructure Projects) (English Undertakers) Regulations 2013
SRO	Strategic Resource Option
STT	Severn Thames Transfer
SWA	Slough, Wycombe and Aylesbury WRZ
SWOX	Swindon and Oxfordshire WRZ
T2AT	Thames to Affinity Transfer SRO

Terms and acronyms	Definition
T2ST	Thames to Southern Transfer SRO
TBM	Tunnel Boring Machine
W&BC	Wilts and Berks Canal
W&BCT	Wilts and Berks Canal Trust
WRMP24	Water Resources Management Plan 20204
WRSE	Water Resources South East
WRZ	Water Resources Zone
WTW	Water Treatment Works

Executive summary

The South East Strategic Reservoir Option (SESRO) would deliver a new fully bunded raw water reservoir near Abingdon, Oxfordshire. This report provides a summary description of the gate three design and highlights changes since the gate two indicative design.

Gate three project development has included optioneering to provide an evidence base for the alternatives that have been considered within the scheme, development of initial design principles for the project, an interim landscape and environmental master plan, and further engineering design development to inform gate three cost and carbon estimating.

Other work has included scoping and starting ground investigations (including a clay compaction trial) and various other surveys, Environmental Impact Assessment (EIA) scoping and a non-statutory public consultation in summer 2024.

Engineering design development continued in parallel with the public consultation and EIA Scoping to inform gate three costing. Any design changes required in response to the consultation or scoping decision will be incorporated after gate three.

A number of changes have been made to the design since gate two and these are summarised in Section 2.5. Two of the most notable are removal of the Auxiliary Drawdown Channel (ADC) in favour of using the River Tunnel for discharge of emergency drawdown flow and a change to the location of the proposed rail siding. These changes were based on option appraisal work and were included in the summer 2024 public consultation. The changes have been incorporated in the gate three design for costing, however review of consultation responses is ongoing and therefore the decisions are not finalised.

A number of next steps are highlighted in Section 5.3, which together indicate that further design work will be undertaken to refine the gate three design in consultation with a range of stakeholders, and to achieve a level of design maturity commensurate with RAPID gate four, Development Consent Order (DCO) submission and the requirements of the procurement process under the Water Industry (Specified Infrastructure Projects) (English Undertakers) Regulations 2013.

Multi-disciplinary design work will continue to create a fully integrated design for SESRO that is aligned to our proposed design principles and delivers our design vision (which may also evolve): *"We will deliver a reservoir for the south-east which will help to protect customers, communities, and the environment from drought. We will provide a safe, sustainable, and resilient water supply for future generations whilst delivering new high-quality spaces for nature and recreation, creating a lasting legacy for communities and the environment."*

1 Introduction and Context

1.1 Introduction

1.1.1 Under the Water Industry Act 1991, every water company must prepare and maintain a Water Resources Management Plan (WRMP). This plan is updated every five years and sets out how companies are required to produce WRMPs every five years. The water-stressed status of south-east England was recognised by Ofwat (the Water Services Regulation Authority) following submission of the WRMP 2019 (Various Water Companies, 2019), and subsequently, funding was provided for water companies to investigate, then develop SROs that will benefit customers and the wider society and help protect and enhance the environment. Thames Water's WRMP 2024 was published on 18 October 2024, following a direction to publish from the Secretary of State in August 2024. The WRMP24 aligns with the revised draft Water Resources South East (WRSE) regional plan and establishes the need for a new 150Mm3 reservoir (the South East Strategic Reservoir Option, or SESRO) that will primarily supply Thames Water, Southern Water and Affinity Water customers.

1.2 SESRO

1.2.1 In 2019, Ofwat provided funding for water companies to investigate and develop new large scale Strategic Resource Options (SROs) which are expected to play a crucial role in meeting long-term water needs, particularly in the south east which is described as "seriously water stressed". SESRO is a strategically important SRO which requires development by multiple partners for wider regional benefit beyond one company's supply boundaries. This type of scheme is lengthy and complex to consent and develop. In accordance with Thames Water's WRMP, SESRO is required to be operational by 2040.

1.3 RAPID

1.3.1 RAPID, a joint team made up of the three water regulators: Ofwat, the Environment Agency (EA) and the Drinking Water Inspectorate (DWI), was set up to support and oversee the progress of SROs. At PR19, Ofwat introduced a new gated process for which RAPID provides advisory oversight. At each gate, RAPID assesses the progress made in the development of each solution and provides recommendations to Ofwat on whether to release the next tranche of funding to continue scheme development. This process allows comparison of the solutions at regular intervals, and has clear checkpoints, or 'gates', to assess progress and determine which solutions should be taken forward for further work.

1.3.2 Each scheme passes through a series of governance 'gates', enabling key information to be presented and an assessment made on whether the scheme should continue for further development. The gates, for a standard SRO, set out by Ofwat in PR19 are as follows:

- Gate 1 – Initial feasibility, design and multi-solution decision making.
- Gate 2 – detailed feasibility, design and multi-solution decision making.
- Gate 3 – finalised feasibility, pre-planning investigations and planning applications
- Gate 4 – Planning application, procurement strategy and land purchase.

1.4 Structure of Report

1.4.1 This report has been prepared to provide technical supporting information for the SESRO SRO gate three submission to RAPID. This report is Supporting Document A1, Basis of Design. An overview of the SESRO project is provided in the gate three main report to RAPID (primarily, in section 2).

1.4.2 The structure of this supporting document is as follows:

- Section 1 – describes background and context
- Section 2 – provides and overview of the project
- Section 3 – describes the gate three conceptual design
- Section 4 – discusses scheme delivery
- Section 5 – considers future work to continue developing the project

1.5 Background

1.5.1 SESRO would deliver a new fully bunded raw water reservoir near Abingdon, Oxfordshire and provides an opportunity to deliver a resilient water supply to the south east for generations to come.

1.5.2 The concept for SESRO is to abstract water from the River Thames near Culham when sufficient flow is available, store it in a non-impounding raw water reservoir (i.e. a reservoir that does not dam a watercourse) and release it to the same river reach to augment flow in the river for downstream abstraction at times of low flow. Reservoir water will also be transferred in a treated water transfer to the Southern Water area and a raw water transfer will supply local Thames Water customers in the Swindon and Oxfordshire (SWOX) water resource zone (utilising existing treatment facilities). The scale of the development provides an opportunity to deliver new spaces for nature and recreation, providing environmental and socioeconomic benefits for the local area and wider region.

1.6 Strategic Resource Option Programme and Water Resources Planning

1.6.1 In the final determination of the 2019 water industry price review (PR19) Ofwat set out a formal gated process and allocated funds to develop integrated SROs during the 2020-2025 planning period (AMP7). The SESRO partners of Thames Water, Affinity Water and Southern Water are developing SESRO through the gated process.

1.6.2 This report provides an update to the concept design of the scheme to support the gate three submission to RAPID.

1.6.3 The feasible option set for the Water Resources South East (WRSE) regional water resources plan and Thames Water WRMP24 (which is the statutory plan under the Water Industry Act 1991) included a range of size variants for SESRO and the WRMP24, which has been approved by the Department of Environment, Food and Rural Affairs (Defra), selects the largest variant of 150Mm^3 for delivery by 2040. On this basis, gate three design development has focussed on a 150Mm^3 reservoir, the associated infrastructure necessary to deliver the project and development of an interim environmental and landscape master plan. This report does not discuss the other size variants.

1.7 Development Consent and Summer 2024 Public Consultation

1.7.1 Some water resource options being developed in the SRO programme, such as SESRO, may automatically qualify as Nationally Significant Infrastructure Projects (NSIPs) under the Planning Act 2008 and would be consented by a DCO. DCO applications are examined by an Examining Authority appointed by the Planning Inspectorate, which will make a recommendation to the Secretary of State who will determine whether to grant consent. Refer to gate three supporting document E1, Planning Strategy for further information.

1.7.2 National planning policy was designated for water resources infrastructure projects in the National Policy Statement (NPS) for Water Resources Infrastructure in September 2023. The NPS sets out the government's policies for development of NSIPs for water resources in England.

1.7.3 A DCO submission must be accompanied by an Environmental Statement based on and EIA. The project must also show a history of consultation including statutory consultation on the proposals.

1.7.4 Gate three project development has included optioneering to provide an evidence base for alternatives that have been considered within the scheme, development of initial design principles for the project, an interim landscape and environmental master plan (hereafter referred to as the interim master plan), an EIA Scoping report, and further engineering design development to inform the gate three cost estimating.

1.7.5 The following reports were published for non-statutory consultation in summer 2024[1]:

- SESRO Draft Design Principles (J696-AA-ZZZZ-RP-ZDP100001)
- SESRO Option Appraisal Context and Methodology Report (J696-DN-A01A-ZZZZ-RP-ZD-100006)

[1] Consultation website: Document library - Thames Water Resources Management Plan (thames-wrmp.co.uk)

- Access and Diversion Roads Options Appraisal Report (J696-DN-A01A-ZZZZ-RP-ZD-100009)
- Rail Siding and Materials Handling Area Options Appraisal Report (J696-DN-A01A-ZZZZ-RP-ZD-100008)
- Connectivity to the River Thames Options Appraisal Report (J696-DN-A01A-ZZZZ-RP-ZD-100010)
- Water Treatment Works Options Appraisal Report (J696-DN-A01A-ZZZZ-RP-ZD-100007)
- Interim Landscape and Environmental Master Plan Report (J696-AJ-ZZZZ-RP-EN-100010) – note that the master plan drawing is reproduced in Appendix A of this report.
- Consultation brochures and factsheets

1.7.6 The EIA Scoping Report (J696-AJ-A02X-ZZZZ-RP-EN-10012) was submitted to PINS on 28 August 2024[2] and a scoping opinion was received on 08 October 2024.

1.7.7 The project design is described in the interim master plan and the EIA Scoping Report through a zoning plan. The Project was subdivided into seven broad zones, along with areas accounting for optionality and future design flexibility, to allow for ongoing consultation and design work on options for associated infrastructure. The interim master plan and EIA Scoping reports provide a description of the proposed scheme design, which should be referred to and is not repeated in this report. It is noted that this gate three Basis of Design report aligns with the reports that were consulted upon in 2024 but is structured around the components required to deliver the project rather than the zoning plan.

1.7.8 It is noted that engineering design development has continued in parallel with the public consultation and EIA Scoping to provide sufficient detail for gate three costing. Design development for the purpose of gate three has been based on preferred options, although it is acknowledged that these could change based on consideration of summer 2024 public consultation responses and/or the scoping opinion from PINS. Any changes required from these processes will be incorporated in the design after this gate three submission.

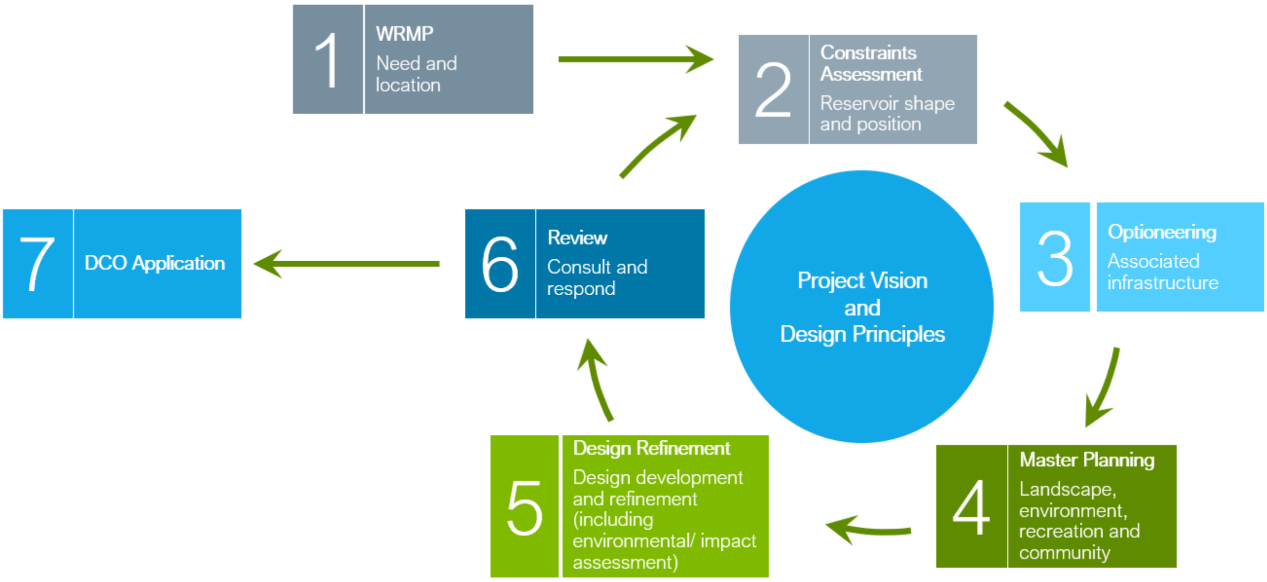
1.8 Summary of Gate 3 Design Process

1.8.1 SESRO is a large project and requires an iterative design development process that considers the core purpose of the reservoir and its potential to deliver environmental gain and social value. Figure 1-1 summarises the design development process as a series of steps that can be repeated as the design

[2] EIA Scoping Report Documents | South East Strategic Reservoir Option (SESRO) (planninginspectorate.gov.uk)

progresses and increasing design data (including survey work and consultation responses) becomes available. The process is underpinned by a Project Vision and Design Principles (see reference above).

Figure 1-1: SESRO Multi-Disciplinary Design Development Process



Source: Thames Water Internal, 2024

1.8.2 The design development stages are summarised as follows:

1. **WRMP – Identification of need and location:** SESRO is included on the WRMP24 Constrained List based on an indicative concept design. The WRMP process includes statutory public consultation and develops a best value plan. A number of capacity variants are included on the Constrained List for selection in the WRMP and the plan identifies the need for a 150Mm^3 reservoir at the SESRO location. See Thames Water WRMP24 documentation for further information[3]
2. **Constraints Assessment – Development of reservoir shape and position:** Identification of the shape, position and footprint of a 150Mm^3 reservoir at the SESRO location through examination of existing environmental and engineering constraints and required storage capacity.
3. **Optioneering – Associated infrastructure:** Identification of preferences for the core infrastructure necessary for construction and operation of the reservoir through multi-disciplinary, multi-criteria option appraisal, including liaison with technical stakeholders such as Network Rail and utility suppliers.
4. **Master Planning – Landscape, environment recreation and community:** Development of a master plan for the whole project, a multi-disciplinary exercise focussing on landscape

[3] Water resources | Regulation | About us | Thames Water

design, space for nature, recreational and community facilities, including liaison with landscape stakeholders and community workshops.

5. **Design Refinement – Design development and refinement (including environmental appraisal/assessment):** Development of outline design for residual issues. May include engineering feasibility to explore different configurations of assets such as pumping station arrangements. Development of sufficient design detail to inform EIA, DCO and procurement. Undertake interim appraisals, and eventually EIA and iterate design to deliver appropriate mitigation, enhancement and compensation.
6. **Review – Consult and respond:** Public consultation, stakeholder and community engagement. Ongoing stakeholder and community engagement for SESRO to inform the design development process, EIA and statutory and non-statutory public consultations. After each consultation, the project will undertake another iteration of design development as set out in Figure 1-1 to develop further detail and/or make alterations in work associated with stages 2 to 5 (including a review and consideration of option appraisal work where additional information is identified that could impact option selection).
7. **DCO Application:** Preparation and submission of the DCO application for SESRO based on iterated outline design.

1.8.3 In parallel and subsequent to the DCO application and examination (should the Secretary of State grant the DCO), design work would continue to tender design and detailed design for construction. This would include work to discharge DCO Requirements.

1.8.4 During Gate three initial information has been developed for steps 2 to 5, building on previous work in WRMP and RAPID Gates 1 and 2. The project is now working through step 6 and will revisit previous steps as appropriate in preparation for step 7.

1.9 Flood Risk

1.9.1 Flood risk is a critical consideration for development, and planning policy requires a Flood Sequential Test and Flood Risk Assessments to be undertaken.

1.9.2 Site Selection for SESRO was undertaken as part of WRMP24 and a Flood Sequential Test report is included in the Thames Water WRMP24 supporting documents as an appendix to the Resource Options – Reservoirs Feasibility Report Addendum[4]. The appendix summarises relevant planning policy and indicates that the 150Mm^3 reservoir option passes the Sequential Test (based on the Gate 2 Conceptual Design) as there are no other locations in the site selection study area that can accommodate a reservoir of this size.

[4] Website link: Water resources | Regulation | About us | Thames Water. Document Link: Feasibility report addendum - Reservoir (thameswater.co.uk), see Appendix C

1.9.3 The reservoir is essential infrastructure and parts of the reservoir (and necessary associated infrastructure) would be located in flood zones, therefore an Exception Test (set out in planning policy) is also required (although it is noted that from a flood risk vulnerability[5] point of view it could be considered water-compatible development). The addendum evaluates how the project performs against the exception test requirements by considering the likelihood that it would:

- provide wider sustainability benefits to the community that outweigh the flood risk
- remain operational and safe for users in times of flood
- result in no net loss of floodplain storage
- not impede water flows and not increase flood risk elsewhere

1.9.4 The appendix concludes that the project passes the exception test.

1.9.5 The gate three design development process described in Section 1.8 above indicates that the need and location of SESRO is identified in the WRMP (Step 1 of the process), which is accompanied by the Sequential Test Report Appendix. Constraints assessment (Step 2) was used to confirm the shape of the reservoir, the general route of watercourse diversions and the location of the area of reservoir footprint flood replacement storage (RFS) within the site. Other option appraisals for essential associated infrastructure were then undertaken (Step 3) on the basis of those elements of the design considered at Step 1 and Step 2

1.9.6 It is noted that work at Step 2 changes the existing flood zones so that they are not necessarily relevant to further optioneering decisions; however, the Step 3 option appraisal methodology considers flood risk in the multicriteria assessment methodology. The preferred options have been included in the Gate three design and the design includes mitigation for loss of floodplain at the project level based on hydraulic modelling. The sequential and exception tests for the overall project have not been revisited in report form in Gate three; however, the updated project design continues to meet the tests by mitigating all forms of flood risk within the SESRO site.

1.9.7 Design development and preparation for DCO submission will continue to Gate 4 and an EIA will be carried out including consideration of alternatives and formal flood risk assessment (see the EIA Scoping report for further information). It is expected that the Flood Sequential Test and Exception Test will be revisited and reported as appropriate in the DCO submission.

1.9.8 Further comments on the treatment of flood risk in option selection are provided in Table 1-1 below.

[5] National Planning Policy Framework - Annex 3: Flood risk vulnerability classification - Guidance - GOV.UK

Table 1-1 – Review of Option Appraisal to Flood Risk

Option Appraisal Report	Approach to Flood Risk
Access and Diversion Roads Options Appraisal Report (J696-DN-A01A-ZZZZ-RP-ZD-100009)	**Main Access Road** – Initial review of constraints concluded that the junction of the access road with the existing road network should be as close to the strategic road network as possible to reduce impact on local roads and people. On this basis all options pass through the River Ock floodplain. Access to the site from the A338 to the east would cross the proposed reservoir RFS and watercourses, access from the west would pass through Steventon village and cross watercourse diversions, there is no road access available from the south due to the mainline railway. On this basis the approach passes the Flood Sequential Test. Design development based on hydraulic modelling using the Environment Agency River Ock model updated as appropriate, has identified areas of RFS in the costed gate three design to mitigate the impact of the access road. It is noted that there have been discussions with the Environment Agency about the opportunity to develop a flood mitigation scheme for Abingdon that utilises the main access road as a flood retention barrier; however this is not currently part of the core scheme at gate three. **Steventon to East Hanney Road Diversion** – This road is constrained by the need to maintain connectivity between the two villages. All available options pass through areas at risk of flooding. Options A and B were developed to minimise interaction with the proposed watercourse diversions and RFS as far as practicable, and any resulting impacts were assessed against the flood risk criteria.
Rail Siding and Materials Handling Area Options Appraisal Report (J696-DN-A01A-ZZZZ-RP-ZD-100008)	As described in the option appraisal report options are constrained to being adjacent to the railway and SESRO. Two locations were appraised in detail with the area between them being ruled out due to existing watercourses / flood zones and environmental designations. The option to the east (which is outside flood zones) is not considered viable due to technical railway constraints. The option at the preferred location was iterated to minimise impact on properties and flood zones and is subject to further design development. It is noted that widening the search area to just west of the A338 would extend the project area and land take, impact a greater number of properties and encounter floodplain associated with the Letcombe Brook. The search area is constrained to the east by urban areas, primarily Steventon. Therefore, the Flood Sequential Test is satisfied.

Option Appraisal Report	Approach to Flood Risk
Connectivity to the River Thames Options Appraisal Report (J696-DN-A01A-ZZZZ-RP-ZD-100010)	Modelling has been carried out in this area using the existing Environment Agency hydraulic model of the River Thames, amended as appropriate. This work has been discussed with the Environment Agency at technical liaison meetings. The model was used to consider options for both studies in this report and inform the criteria assessment. **Emergency Discharge** – as described in the report, flood modelling was used to develop the options and inform option selection. The purpose of this infrastructure is to respond to an emergency at the reservoir and in this situation all options would have the same impact on the River Thames, therefore it is not a differentiator between options. Emergency Discharge impacts will be evaluated further in discussion with the Environment Agency as the project develops towards DCO. The preferred option minimises impact in the River Thames floodplain around Culham compared to other options. **Intake / Outfall** – this infrastructure is required adjacent to the river and is deemed to be water-compatible, however flood risk was included in the option assessment criteria alongside other potential impacts. Hydraulic modelling has been used to identify RFS for the preferred option in the costed gate three design.
Water Treatment Works Options Appraisal Report (J696-DN-A01A-ZZZZ-RP-ZD-100007)	As described above flood risk will change if the reservoir is implemented, and this was taken into account in the option identification process (i.e. the western wetland zone was ruled out with the flood sequential test referenced in the reasoning). The report states that the three assessed options are considered to lie outside the flood zones after construction of SESRO and therefore flood risk is not a differentiator.

1.9.9 Other associated infrastructure locations, notably the pumping station, are based on engineering and operational constraints / requirements. For example, the pumping station aligns with the reservoir borrow pit and tower locations to facilitate tunnelling, and the borrow pit alignment is dependent on geological conditions. The gate three design includes RFS as described above.

1.9.10 It is noted that the EIA Scoping Opinion from PINS indicates that impact of dam failure should be addressed in the Major Accidents and Disasters section of the ES. The potential for failure is very remote and considered in design development through alignment with the Reservoirs Act 1975. It is not considered as normal operation and has not been addressed in the Flood Sequential Test. We will continue to work closely with key consultees on this aspect of the design as we develop the Preliminary Environmental Information Report (PEIR) and undertake the EIA during subsequent project stages.

1.9.11 Further information on flood modelling is provided in Section 3.4.

1.10 Purpose of this Report and Alignment with Gate Three Guidance

1.10.1 This report provides an overview of the current design to support the RAPID gate three submission.

1.10.2 RAPID gate three Guidance[6] lists the expectations for the gate three design in Section 2 Solution Design. Table 1-2 replicates the list and provides commentary on how the expectations are addressed for SESRO.

Table 1-2 – RAPID expectations for Gate Three Design (from Gate Three Guidance Section 2)

RAPID Expectation	Commentary on SESRO submission
Solution design information should be developed to a standard suitable for pre-application planning consultation as per planning policy in England and/or Wales as appropriate.	As described above, SESRO undertook non-statutory public consultation on option appraisals, design principles and an interim master plan in summer 2024 and the project is working towards statutory consultation in summer 2025.
Solution owners should have narrowed down their solution to a firm single, potentially scalable, option including clearly defined locations as included in final regional plans and WRMPs (draft plans for accelerated gate three).	Thames Water and Affinity Water WRMP24 plans require a 150Mm^3 SESRO reservoir by 2040. Southern Water published its revised draft Water Resource Management Plan (dWRMP 2024) in August 2024. Public consultation on the revised dWRMP 2024 was open from 11 September to 4 December 2024. The revised draft plan includes a requirement for 120Ml/d from SESRO to T2ST from 2040. A revised draft regional plan for South East England was submitted to Defra on 31 August 2023 by WRSE, alongside a response to the feedback received during a public consultation held from 14 November 2022 to 20 February 2023. The plan will be finalised after responses to the Southern Water revised dWRMP consultation described above have been considered. As described above, optioneering and master planning has been undertaken to

[6] Strategic regional water resource solutions guidance for gate three (version 3), January 2024, RAPID: Strategic regional water resource solutions guidance for gate three (version 3) - Ofwat

RAPID Expectation	Commentary on SESRO submission
	develop a preferred configuration for the project, which was subject to public consultation in summer 2024. The resulting design is described in this report (sometimes by reference to the published consultation documents). However, changes to the design to respond to the consultation are ongoing and will inform EIA and further public consultation in summer 2025.
Solutions should be developed in line with Stage 3 of the RIBA plan of works, and ACWG Design Principles, approaching but not necessarily reaching the extent of RIBA Stage 3 outline design for a planning or DCO application. The extent of progress made at gate three towards reaching RIBA Stage 3 design should be commensurate with achieving that level of design by the date by which the solution is timetabled to submit its planning/DCO applications. Solutions are not expected at gate three to have made planning applications, which is noted as an outcome of RIBA Stage 3, or to have made applications for DCOs. Solutions should be undertaking the pre-application stage of the NSIP process or sought pre-application planning advice from relevant local planning authorities.	The RIBA Plan of Works describes Stage 3 as Spatial Coordination with core tasks including: design studies, engineering analysis, cost exercises and architectural concept. Resulting in spatially coordinated design aligned to the cost plan, project strategies and outline specification. The overall gate three design meets these requirements with the development of the design since gate two and consultation on option reports, an interim master plan and draft design principles for the project. The project design responds to Sponsors Requirements and SRO strategies developed by the client team within Thames Water (and agreed with Affinity Water and Southern Water). However, it is recognised that the design is not DCO ready and further design development work is required as described in Section 5. The design development process for SESRO is described in Section 1.7.
Solutions should have considered all applicable requirements from The Network and Information Systems (NIS) Regulations 2018 and the Security and Emergency Measures (Water and Sewerage Undertakers and Water Supply Licensees) Direction 2022 (SEMD).	A security review has been undertaken for SESRO and the general approach to security is described in Section 3.2. Detailed information is sensitive and is not included in this public facing gate three submission.

1.10.3 Section 2.2 of the guidance lists design information that should be included in the gate three submission. The list is replicated in Table 1-3 below with signposting to the relevant sections of this report or other relevant documents in the gate three submission for SESRO:

Table 1-3 – RAPID reporting requirements for design (from Gate Three Guidance Section 2.2)

Item	Section	Comments
Solution description, updated from gate two where necessary.	Section 3	The project is also described in the interim master plan and EIA Scoping Report (See Section 1.77)
Rationale and evidence for selection of the preferred solution option, and scalable elements where justifiable, in reference to the range of options considered.	Section 1	See referenced option appraisal reports.
Configuration of the preferred solution option and its elements including a description of how the solution and its elements will be operated and how that operating strategy has influenced design.	Sections 2 and 3	See referenced sections for a description of the preferred solution.
A description of the site selection process, and routing where relevant, for the preferred solution option, how multi-disciplinary input has been integrated into the process and noting any outstanding risks or constraints and how these will be addressed.	Section 1	Site selection for SESRO is part of the WRMP process. Subsequently SESRO option appraisal has focussed on defining a preferred configuration for the project, as described in Section 1.
Site specific vision and design principles.	Section 1	See referenced draft design principles document that was published for public consultation.
A description of the key assets to be constructed as part of the preferred solution including relevant diagrams/schematics and site general arrangement design drawings and maps, consistent with any pre-application submissions. This may include process diagrams, or completing RAPID-issued cost data tables, as requested.	Sections 2 and 3	Also see separate gate three submission documents for cost and carbon.
Evidence of, and any assumptions relating to interactions within the solution, as well as between other proposed water resource solutions, in terms of system connectivity / impacts and mutual inclusivity / exclusivity. This should be described in the context of outcomes of regional groups reconciliation, and any further development on agreements made since.	Section 2.2 and 3.8	SESRO can be delivered independently, however it would provide water to other SRO and WRMP projects (including T2ST and T2AT) and therefore the need for SESRO is interlinked with other WRSE projects. Infrastructure will

Item	Section	Comments
		be needed on the SESRO site for other projects. For further information see the main gate three report and the referenced sections of this report.
Scalability within the preferred solution option, as well as between other proposed water resource solutions, in terms of dependency and phasing.	Section 3.8	Scalability would be achieved through additional transfer projects rather than an increase in reservoir volume. Phased reservoir solutions were included in the WRMP option set but have not been selected in the plans.
Plan and programme of work on how and when you will develop a digital twin, with an explanation of how it will integrate into the company's existing digital twins and how testing through this process will influence design, construction and operation.	Section 3.3	It is acknowledged that this aspect of the project is still developing. Models have been used in design development and will be developed further as the project progresses. See Section 3.6.
Recommendations and output from an independent design review where proportionate, and how these have been taken into account.	Section 5	See also the main gate three report (section 2.2.10).

1.10.4 Gate three guidance also requires information on utilisation and water resource benefit, which is reported in the main gate three report and not covered in this design report.

2 Scheme Overview and Location

2.1 Overview

2.1.1 SESRO would create a large non-impounding raw water reservoir near Abingdon in Oxfordshire for potable water supply to customers the south east of England. The design concept is to abstract water from the River Thames near Culham when sufficient flow is available, store it in a non-impounding raw water reservoir and release it to the same river reach to augment flow in the river for downstream abstraction at times of low flow. Reservoir water will also be transferred in a treated water transfer to the Southern Water area and a raw water transfer will supply local Thames Water customers in the SWOX water resource zone.

2.2 Dependencies and Links with Other Schemes

2.2.1 SESRO is not dependent on any other SROs or other company options. However, in order for SESRO to deliver a benefit to Thames Water and Affinity Water customers, the water that is released into the River Thames would need to be re-abstracted, treated and distributed which may require the provision of additional infrastructure developed through separate projects.

2.2.2 There are other water resource options considered in the WRSE regional planning that would either benefit from, or be dependent on, water supply from SESRO, these are summarised below (for further information see Section 3.8):

- **Thames Water options** to supply the LON (London), SWOX (Swindon and Oxfordshire) or SWA (Slough, Wycombe and Aylesbury) Water Resource Zones (WRZs). Only SWOX would require works at the SESRO site.
- **Thames to Southern Transfer (T2ST):** The reservoir would serve Southern Water customers through a water treatment works (WTW) located at SESRO and a piped treated water transfer to the Southern Water region. This infrastructure would be delivered through the T2ST SRO[7] and is not within the scope of SESRO (although the SESRO design development has considered potential locations for a T2ST WTW and includes the transfer pipeline within the SESRO project boundary). The T2ST water treatment works (WTW) is currently part of Southern Water's scope to consent under the T2ST DCO and construct using their CAP. Discussions are taking place between Thames Water and Southern Water about whether it could be beneficial for the T2ST WTW to be consented early under the SESRO DCO but still remain with Southern Water to construct using their CAP.

---

[7] Water transfer from Thames Water to Southern Water

- **Thames to Affinity Transfer (T2AT) SRO**[8]:The T2AT SRO is considering options to transfer water into the Affinity Water area. Some of these would depend on the development of SESRO for water resource; however, they would not require any works at the SESRO site.
- **Abstraction at South East Water's** existing surface water intake on the River Thames at Bray could potentially benefit from SESRO in the future (being downstream of the SESRO discharge point), but additional abstraction at this point is not currently included as part of the WRMP24 reported pathway.
- **Severn Thames Transfer (STT)**[9]**:** STT is an SRO project that would transfer raw water from the River Severn to the River Thames for onward transfer in the river and use for water supply in the southeast. The project is not selected in the preferred regional and company WRMPs but is included in adaptive planning scenarios. The conceptual design of the STT pipeline passes through the SESRO site and discharges to the River Thames at Culham, close to the SESRO intake / outfall location. In the gate two design of both projects, it was assumed that the pipeline would be laid in the towpath of the SESRO Auxiliary Drawdown Channel (ADC) which is no longer the preferred option for SESRO emergency drawdown facilities. Therefore, further collaborative work between the two projects has been undertaken to establish alternatives for STT resulting in a reserved corridor through the SESRO site and inclusion of a shaft and connecting adit in the SESRO design, to provide flexibility for STT to utilise the SESRO River Tunnel for discharge if this is confirmed as the preferred option for STT in the future. This would also enable STT water to be used for reservoir refill and for the two projects to share an outfall on the River Thames.

2.2.3 The SESRO site has sufficient space to allow water from the reservoir to be treated on site and then transferred either to the south to serve Southern Water (via T2ST) or north to support SWOX. The additional transfer pipelines and associated water treatment facilities are not included within the SESRO core scheme, although a land allocation within the scheme boundary has been identified. As described in the bullet points above there are ongoing discussions about the consenting of the T2ST WTW. The initial transfer for SWOX will be raw water only to Farmoor and only passive provision will be made for a potential future SWOX WTW.

2.2.4 Further information on interaction with other projects is provided in Section 3.8.

[8] Water transfer from Thames Water to Affinity Water

[9] Water transfer from the River Severn to the River Thames

2.3 Project Requirements

2.3.1 SESRO would provide a 150Mm^3 capacity reservoir which could be filled with water abstracted from the River Thames. The water stored in the reservoir could either then be released to water resource projects or back to the River Thames during periods of low flow.

2.3.2 The following provides an overview of the SESRO requirements as set out in Thames Water's preferred WRMP24 plan:

- Capacity for 1,000Ml/d to be abstracted from the River Thames (with a peak abstraction rate of 1,200Ml/d).
- Up to 321Ml/d to be released as raw water to the River Thames, to support Thames Water's downstream WRZs and T2AT.
- Up to 24Ml/d to be released as raw water and pumped via a pipeline to Farmoor Reservoir.
- Up to 120Ml/d to be released to a T2ST WTW on the SESRO site.

2.3.3 The following provides an overview of the SESRO requirements as set out in Thames Water's adaptive plan:

- Capacity for 1,000Ml/d to be abstracted from the River Thames (with a peak abstraction rate of 1,200Ml/d).
- Up to 321Ml/d to be released as raw water to the River Thames, to support Thames Water's WRZs downstream and T2AT.
- Up to 100Ml/d* to be released as raw water and pumped via a pipeline to Farmoor Reservoir.
- Up to 120Ml/d to be released to a T2ST WTW on the SESRO site.
- Potential for up to 72Ml/d to be released to a SWOX WTW on the SESRO site.
- Potential for up to 500Ml/d to be discharged into the reservoir from an STT pipeline.

*The gate three design includes for a potential future Farmoor transfer of 100Ml/d for the adaptive plan; however, the requirement has increased to 150Ml/d and the impact of this change will be reviewed in the next stage of design.

2.3.4 The timing and precise need for the water resource projects outlined above is still uncertain, but they are options that will continue to be explored as the SESRO scheme is developed.

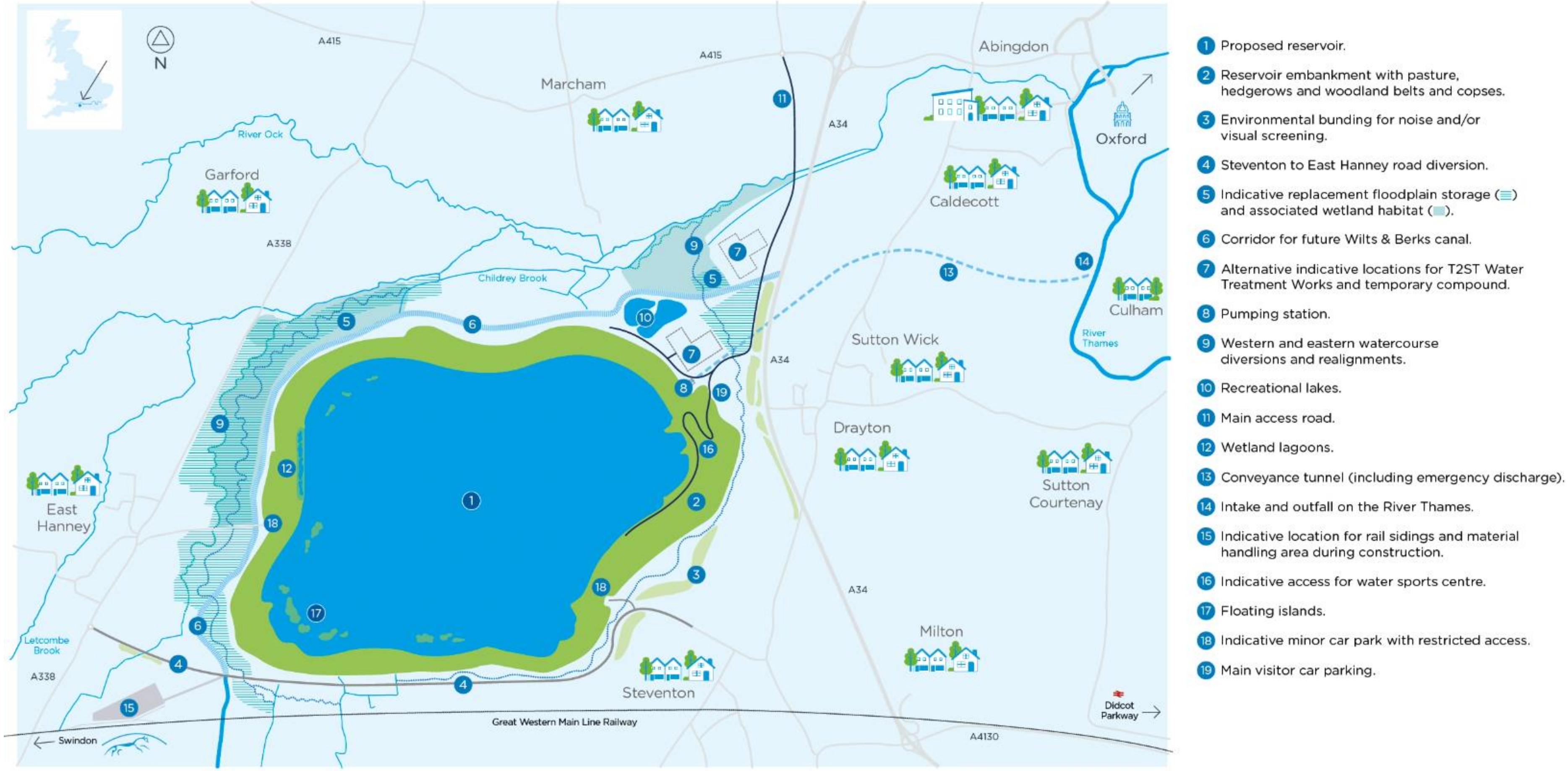
2.4 Project Components

2.4.1 This report sets out the gate three conceptual design for SESRO, the key components of which can be summarised as:

- Provision of a fully bunded reservoir in Oxfordshire, 5km south-west of Abingdon, with a useable storage capacity of 150Mm^3 within the area bounded by the A34 and Steventon to the east; the Great Western Main Line (London to Bristol) to the south; the A338 and East Hanney to the west; and the River Ock to the north.
- Pumping station at the toe of the embankment (on the north-east side of the reservoir) containing pumps for filling the reservoir and turbines for energy recovery during periods when the reservoir releases water to the River Thames.
- An approximately 3.5km long conveyance tunnel to transfer flows via the pumping station to and from an intake / outfall structure on the right bank of the River Thames near Culham.
- Raw water would be abstracted from the river when water levels are high, using pumps to fill the reservoir. The maximum quantity abstracted in any day would not exceed 1,000Ml.
- Flows would be discharged into the river via the energy recovery turbines (maximum release rate of up to 321Ml/d).
- Auxiliary drawdown siphons to allow release of additional water from the reservoir in an emergency scenario. The siphons would connect to the pumping station for discharge to the River Thames through the conveyance tunnel.
- Channel and floodplain construction as required to mitigate the impact of the reservoir on local watercourses and floodplains.
- Main access road (from A415) and diversion of the East Hanney to Steventon Road.
- Temporary rail siding to facilitate delivery of construction materials by freight train.
- Recreation facilities, public education facilities, landscaping and creation of aquatic / terrestrial habitats. Including a corridor to facilitate reconstruction of the Wilts & Berks Canal by others. The Wilts & Berks Canal was taken out of operation ~100 years ago but may be reinstated in the future.

2.4.2 An overview of the proposed SESRO project is provided in Figure 2-1. A more detailed site layout plan taken from the interim master plan is included in Appendix A.

Figure 2-1 Schematic Representation of SESRO



Source: Thames Water, as published in summer 2024 public consultation.

2.5 Design Changes since gate two

2.5.1 There have been a number of changes to the design since gate two based on the following:

- Further confirmation of the project / operational requirements
- Option appraisal studies
- Master planning
- Engineering review and design development

2.5.2 Other work undertaken since gate two to inform the design development process includes:

- A programme of ground investigation
- Watercourse and topographical surveys
- Environmental surveys and investigations
- EIA Scoping
- Stakeholder engagement and public consultation

2.5.3 Key changes to the design since gate two are summarised in Table 2-1. It is noted that the gate three design has not been updated to accommodate the outcome of the summer 2024 public consultation and is subject to change as a result.

Table 2-1 – Summary of Design Changes Since Gate Two

Asset	Changes Since Gate Two	Explanation
Reservoir	Reservoir shape, embankment heights and borrow pit profile remain similar to gate two. Interpretation of the ground has been updated, slightly lowering the foundation elevation of the dam and leading to the inclusion of a 'dig and replace' trench within the dam foundation. It has also led to increased instrumentation within the dam to enhance monitoring during construction. General engineering design development has led to changes in thicknesses and gradings of internal drainage and inner face protection zones, updated (increased) settlement allowance and removal of the wave wall.	1) Reinterpretation of ground model has included re-evaluation of the level of the bottom of periglacially disturbed material – this has the effect of lowering the level of the general dam foundation (therefore increasing fill volumes) and reducing the proportion of borrow pit excavation which can be used as 'structural fill'. 2) Reinterpretation of the ground has lowered the assumed strength of the upper part of the dam foundation, which is to be mitigated through inclusion of a 'dig and replace' trench under the inner shoulder of the embankment.

Asset	Changes Since Gate Two	Explanation
	Following ground investigation during Gate 3 the design of the structural embankment has been developed to include a core. There have been some changes to the landscape scheme that affect the external face of the reservoir embankments and the location of floating islands. The project design continues to achieve a cut and fill balance to minimise import and export of construction material.	3) The reservoir now also includes enhanced instrumentation to enable monitoring of movement and porewater pressures in the dam foundation during construction and operation. 4) An updated assessment of the expected settlement of the embankment has increased the end of construction crest level slightly, increasing fill volumes. 5) The width of the chimney drain has increased, and its alignment changed from vertical to sub-vertical, in response to comments from the independent SESRO Reservoir Advisory Panel, increasing volume of filter sand. 6) Riprap sizes on the inner face have been updated in response to updated climate change allowances on windspeeds and updated fetch lengths. 7) The wave wall has been removed due to updated assessment of wave overtopping. 8) Further discussions with landscape stakeholders, landscape character assessments and development of design principles has informed updates to the landscape design.
Reservoir Air Diffuser Network	Limited design of the reservoir air diffuser network had been carried out prior to the gate two submission. Some initial concept level design has been undertaken as part of gate three.	The design includes an air diffuser network to ensure water quality. The design has had minor updates and will be updated again before gate four / DCO submission.
Conveyance: Operating Requirements	Changes to key operating requirements of the conveyance system.	1) Introduction of the requirement for the reservoir to be able to release flows to WTWs at the same time as filling the reservoir from the River Thames. At gate

Asset	Changes Since Gate Two	Explanation
		two the release was only to the River Thames. 2) Requirement for the conveyance system to be able to pass the full emergency drawdown flow without the need for an Auxiliary Drawdown Channel (ADC). As documented in the Connectivity to the River Thames Options Appraisal report.
Conveyance: River Intake/Outfall Structure and River Tunnel (between SESRO pumping station and the River Thames)	The preferred intake/outfall structure location has moved approximately 240m upstream from the gate two location. The river tunnel alignment has been updated accordingly. The river tunnel internal diameter has increased from 4.2m to 6m. A 1.4km length of secondary lining has been introduced to the river tunnel. Increase to the size of intake / outfall structure. Review and update of the plant / process design. This has included introduction of a method for tunnel dewatering (to replace the need for tunnel sweetening flows when the tunnel is not in use). Update of the alignment and design of the access road to the intake / outfall structure. Introduction of Replacement Floodplain Storage (RFS) to account for raised areas in River Thames floodplain.	1) The change to intake / outfall structure location was informed by option appraisal (see Connectivity to the River Thames Options Appraisal report). 2) To pass the full emergency discharge the internal diameter of the river tunnel increased from 4.2m to 6.0m. Design development of the larger diameter tunnel indicated secondary lining of a 1.4km length is required. 3) To allow for the larger tunnel size the internal diameter of the shaft at the intake / outfall structure has increased. 4) The outfall structure and the associated gates have increased in size to allow for the full emergency discharge flow. 5) Plant / process design has been updated, including: review of number and layout of intake screens; use of pipework to replace intake culverts; addition of control valves / flow meters; introduction of tunnel dewatering pumps; consideration of access requirements; consideration of stoplog requirements; addition of a fuel tank for back-up generation; and update to the proposed control building.

Asset	Changes Since Gate Two	Explanation
		6) The introduction of tunnel dewatering pumps removes the need for a sweetening flow to be passed through the river tunnel when not in operation. Annual emptying of the river tunnel is also considered to reduce the extent of mussel encrustation in the tunnel.
Conveyance: Reservoir Tunnel (between SESRO pumping station and the main tower in the reservoir) and Main Tower	Review and update of the plant / process design given changes to the operating requirements. The internal diameter of the reservoir tunnel has increased from 4.8m to 5.8m to provide space for two 2.2m diameter pipes (whereas in gate two design there was a single bi-directional pipe). Given the inclusion of two 2.2m diameter pipes in the reservoir tunnel, a higher proportion of the emergency drawdown flow now passes through the reservoir tunnel. The main reservoir tower diameter is now 31m. The design of the tower has been revisited to facilitate the larger diameter (including the addition of piles).	1) The requirement for the reservoir to be able to release flows to WTWs at the same time as filling the reservoir from the River Thames results in a need for two separate pipes in the reservoir tunnel. To be able to fit two 2.2m diameter pipes the tunnel diameter has increased. 2) The structural form of the reservoir tunnel has been reconsidered given the larger diameter. 3) Plant / process design in the main tower and reservoir tunnel has been updated to meet updated operational requirements, including (but not limited to): pipework arrangement; addition of control valves / flow meters; introduction of a fast filling mode of operation; consideration of access requirements; consideration of crane requirements; and update to the proposed control building at the top of the main tower. 4) The main tower diameter has been increased to 31m to provide sufficient space for the updated pipework / valve arrangement.
Conveyance: Secondary Towers	Limited design of the secondary towers had been carried out prior to the gate two submission. Design development has been	1) The number of gate openings in the secondary towers has been based on the gate three flows required to be released from the

Asset	Changes Since Gate Two	Explanation
	undertaken as part of gate three. Plant / process design has been carried out based on the latest operating requirements.	reservoir (for the WTWs as well as releases to the River Thames). 2) The design of the towers at Queen Mother reservoir informed the development of the towers with 10 sides and 5 levels of gate openings. 3) The design of fish screening at Farmoor reservoir was used to inform the update to the proposed screening arrangements.
Conveyance: Intake Pumping Station	The pumping station plant / process design has updated to respond to the changes to the operating requirements (discussed above). The civil design has been updated to account for the revised plant / process design. Through these design updates the pumping station plan area has increased.	1) Plant / process design for the pumping station has been updated to meet updated operational requirements, including): intake pumps (larger number of smaller pumps), adjustment of hydropower turbines (for revised proposed releases), inclusion of additional energy dissipation valves (to provide capacity for the full emergency drawdown); inclusion of booster pumps (for providing flow to WTWs); review of pipework arrangement, inclusion of sump pumps; consideration of crane requirements; review of access requirements; and update to the proposed control building. 2) Civil design has changed from a rectangular box to three interlinked cells. This provides the space required for the adjustments to the plant / process design outlined above. 3) An indicative above-ground building has been included in the design to cover two of the three above-mentioned interlinked cells. A second indicative above-ground building has also been included in the design to house control and electrical

Asset	Changes Since Gate Two	Explanation
		components for operation of the pumping station.
Conveyance: Emergency Discharge	The river tunnel diameter has increased from 4.2m to 6.0m. Siphons are retained in the design with discharge into an enlarged pumping station rather than an ADC.	Based on options appraisal, the preferred option for discharge of emergency flow is through the River Tunnel only and for the purposes of gate three the Auxiliary Drawdown Channel (ADC) has been removed from the design (note that this is subject to the outcome of the summer 2024 consultation).
Watercourses and Floodplain	Watercourse alignments and sections have been updated as part of the master planning and design development process. Changes have been made to the main Replacement Floodplain Storage (RFS) area to the west of the reservoir. Smaller RFS areas have been updated or introduced.	Multidisciplinary work has developed the watercourse design informed by stakeholder feedback and technical work. Updates to flood risk modelling to account for design development of roads and watercourse alignments has informed changes to RFS areas.
Associated Infrastructure: Recreational Facilities and Architecture	The number and location of recreational buildings has changed through the master planning process and architectural review.	Discussions with stakeholders and further technical work have informed development of the design. The design will continue to develop based on feedback from the summer 2024 public consultation.
Associated Infrastructure: A415 to SESRO Main Access Road	The road alignment and location of the junction with the A415 have changed. Road drainage design developed.	Changes reflect the preferred arrangement identified in the options appraisal (see the Roads option appraisal report). The appraisal was subject to consultation in summer 2024 and the design will be reviewed against the consultation responses after gate three.
Associated Infrastructure: Steventon to East Hanney Road Diversion	Minimal change to alignment, junction and road design further developed.	Alignment was reviewed as part of options appraisal; however minimal changes were identified.

Asset	Changes Since Gate Two	Explanation
Associated Infrastructure: Temporary Rail Siding and Materials Handling Area	The preferred location of the rail siding has changed and the design has been updated accordingly. The gate three location is approximately 3km to the west of the gate two location. The arrangement of the rail siding and materials handling area has been developed to suit the new location.	Changed to reflect the preferred location in the options appraisal. The appraisal was subject to consultation in summer 2024 and the design will be reviewed against the consultation responses after gate three.
Associated Infrastructure: Utilities	Minimal change in approach since gate two.	Whilst the design changes are minimal discussions have continued and are ongoing with utility providers and statutory undertakers. Existing solar farm decommissioning will require agreements with existing owners and SSE and discussions are ongoing.
Associated Infrastructure: Drainage	Embankment toe drain alignment adapted to suit other changes to embankment slopes. Highway drainage added. Surface water and foul drainage concept developed. Groundwater drainage design reviewed.	Multidisciplinary work has informed updates to drainage alignments within the master plan. A site drainage strategy has been developed.
Landscape Scheme	Development of a comprehensive interim master plan with updates to landscape topography (including noise bunds), planting and habitat creation.	Multidisciplinary work has developed a more comprehensive landscape scheme informed by discussions with landscape and environmental stakeholders, landscape character assessments, environmental requirements and draft design principles.
Facilities for Other Water Resource Projects: T2ST	T2ST pumps confirmed in the SESRO pumping station. The SESRO design also includes pipelines between the SESRO	Since gate two it has been determined that a T2ST WTW is required on the SESRO site. Option appraisal determined two

Asset	Changes Since Gate Two	Explanation
	pumping station and T2ST WTW, a potable pipeline route / corridor through the SESRO site for the T2ST project and a waste drainage pipe from the T2ST WTW.	preferred locations for the WTW. The SESRO team continue to work with T2ST to develop an integrated design for the two projects.
Facilities for Other Water Resource Projects: Local water supply facilities	The SESRO design includes a raw water pipeline route / corridor through the SESRO site for local raw water supply to Farmoor Reservoir.	Since gate two it has been confirmed that SESRO needs to facilitate transfer for potential future local water supply projects (initially raw water to Farmoor, later potential WTW at SESRO with a treated water transfer pipeline).
Facilities for Other Water Resource Projects: Severn to Thames Transfer (STT)	At gate two the concept design allowed 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. The ADC has been removed from the gate three design (i.e. it is not currently the preferred emergency drawdown option) and SESRO does not facilitate this section of pipeline. A reserved corridor has been identified through the SESRO site to facilitate the future delivery of STT should it be required. A shaft and connecting adit are included in the SESRO design to facilitate future connection of STT to the SESRO river tunnel.	In the WRMP24 plan STT is on a post 2040 adaptive pathway and not in the preferred plan, therefore there is greater uncertainty about whether the project will be implemented.

Note: The sizes / volumes / rates in this table (and elsewhere in this report) solely reflect the design position at gate three. They are provided for context to the revised cost estimate at gate three but will be subject to refinement and change as the scheme design progresses towards DCO submission.

3 Conceptual Design

3.1 Operating Philosophy

3.1.1 Normal operation of the scheme would include abstraction of water from the River Thames, storage of water in the reservoir and release of water from the reservoir. Release of water would either be back to the River Thames or to other water resource projects which could include a raw water transfer to a T2ST WTW, a raw water transfer to Farmoor Reservoir and a raw water transfer to a SWOX WTW (potential future project only). Section 2.3 outlines the flow requirements in the preferred and adaptive WRMPs.

3.1.2 The following sub-sections describe the operating scenarios.

Inflow to the Reservoir

3.1.3 The schematic in Figure 3-1 provides an overview of the process for inflow to the reservoir:

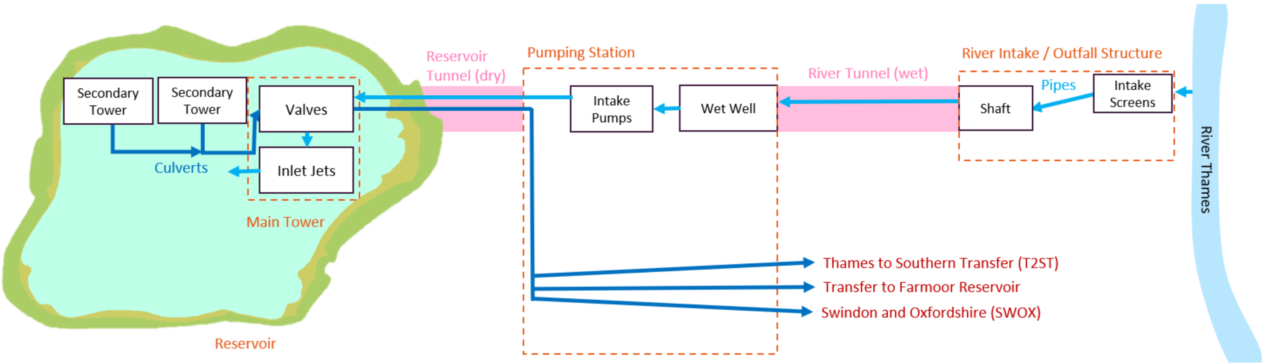
- Water would be abstracted via intake screens at the river intake / outfall structure on the riverbank of the River Thames at Culham. The river intake / outfall structure would connect to the river tunnel via a shaft.
- The river tunnel would be connected to an underground pumping station at the toe of the reservoir embankment.
- Water would be pumped from the pumping station into a pipe passing below the reservoir embankment within a dry reservoir tunnel. This 'reservoir tunnel' would connect to the main intake/outlet tower where water would be jetted into the reservoir to encourage mixing of river water and reservoir water.
- The design would allow a potential future Severn to Thames Transfer (STT) project (which is part of the WRMP adaptive plan) to discharge up to 500Ml/d into the river tunnel. This flow would either be released to the River Thames via the river tunnel, or it would be pumped into the reservoir.

3.1.4 Key assumptions on abstraction and inflow to the reservoir for the gate three design are as follows:

- No abstraction would take place into SESRO when the river flow as measured at Culham is less than 1,450Ml/day on the previous day.
- The maximum pumping capacity would not exceed 1,200Ml/day, either from the River Thames or from a combination of the River Thames and the STT (for WRMP adaptive plan).
- The maximum quantity abstracted in any day would not exceed 1,000Ml (and 150,000Ml/year).
- Abstraction would increase progressively at a rate of no more than 300Ml/d.

- When there is sufficient water available in the River Thames it would be abstracted to maintain or raise reservoir water levels whilst maintaining the outflow from the reservoir to supply the other water resource projects.
- During reservoir filling from the River Thames it would also be necessary to be releasing water from the reservoir to provide up to the maximum flow requirements of the other water resource projects.

Figure 3-1: Schematic for Filling of the Reservoir



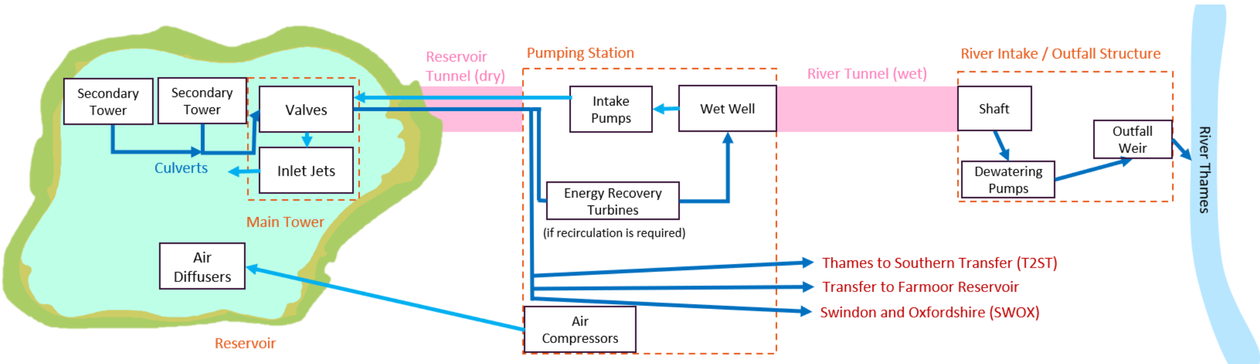
Storage Within the Reservoir

3.1.5 The schematics in Figure 3-1 provides an overview of the requirements for storage of water in the reservoir:

- Total 'live' (usable) storage volume for the reservoir would be 150Mm^3. This would be partially below existing ground level (created by excavation of a borrow pit) and partially above existing ground level (created by construction of the reservoir embankment). In addition to the 'live' (useable) water, a zone of 'dead' (unused) water would be retained at the base of the reservoir to help maintain water quality within the entire live storage zone.
- The entire inner face of the reservoir embankment would be protected against wave erosion. This would largely consist of a layer of rip rap (angular rock armour), which would be underlain by sand and gravel bedding layers placed on the clay reservoir embankment. At locations where access to the reservoir water surface is required for recreation, ramps will be incorporated into the inner face.
- During periods of the year when there is no transfer of water between the reservoir and the River Thames it will still be necessary to be providing at least the minimum flow to the other water resource projects. During these periods it would also be necessary to maintain water quality in the reservoir and river tunnel. The project includes a range of facilities to manage water quality risk:
    - A network of air diffusers (on the bed of the reservoir) would be incorporated into the design to release streams of bubbles into the water, to reduce the risk of stratification forming in the reservoir.

- The project includes two secondary towers in addition to the primary tower (where water is jetted into the reservoir from the river). The secondary towers provide options for abstraction locations and elevations so that the best water quality is abstracted for supply. The number of secondary towers is to be confirmed by future water quality modelling.
- In addition to the air diffusers, warmer water close to the reservoir surface could be released via the secondary towers to the pumping station. From there, this warmer water could then be pumped back into the reservoir at the base of the main tower (where the water will be colder). The need for such recirculation of water is to be informed by future water quality modelling.
- During prolonged periods when it will not be necessary to transfer water between the River Thames and the reservoir, the river tunnel would be dewatered to prevent the water within it from becoming stagnant. Pumps at the bottom of the shaft of the intake / outfall structure would be used to dewater the river tunnel, which could be achieved over approximately four days.

Figure 3-2: Schematic for Storage within the Reservoir (Standby)



Release from the Reservoir

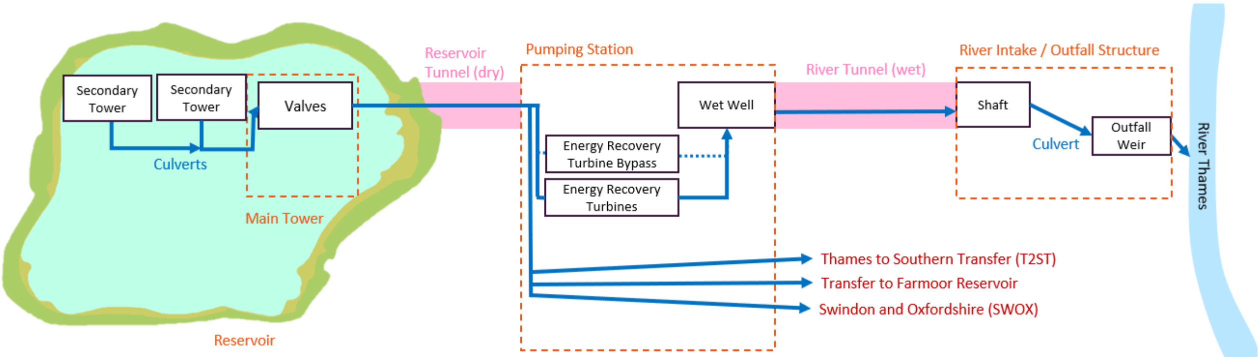
3.1.6 The schematics in Figure 3-3 provides an overview of the process for release of water from the reservoir, either back to the River Thames or to other water resource projects:

- There would be secondary towers in the reservoir connected via a culvert on the bed of the reservoir to the (above mentioned) main tower. Gates within the walls of these secondary towers would be opened to allow water to be released from the reservoir.
- The reservoir tunnel and river tunnel (outlined above) would be used to convey water from the reservoir to the river intake/outfall structure for discharge back to the River Thames. The release from the reservoir back to the river is to be between 50Ml/d to 321Ml/d under normal operation. When the reservoir level is high enough, the transfer of water by gravity back to the

River Thames would provide an opportunity for energy recovery. Two energy recovery hydropower turbines are incorporated into the pumping station to enable this. Energy recovery turbine bypass valves are also included in the pumping station to enable release of water if the turbines are out of operation.

- Additional pipework and valving arrangements within the pumping station are included to allow water to be directed to the other water resource projects that are part of the WRMP preferred plan. This includes a 120Ml/d raw water transfer to a T2ST WTW and a 24Ml/d raw water transfer to Farmoor Reservoir.
- The design also provides space for potential future adjustments that would allow reservoir water to be directed to water resource projects that that are part of the WRMP adaptive plan. This includes increasing the (above mentioned) raw water transfer to Farmoor Reservoir from 24Ml/d to 100Ml/d and an additional 72Ml/d raw water transfer to a SWOX WTW (that would provide a supply into Thames Water's Swindon and Oxford Water Resource Zone)

Figure 3-3: Schematic for Release from the Reservoir



3.1.7 Release of water from the reservoir in an emergency drawdown scenario is discussed at the end of Section 3.2.

3.2 Reservoir Design

3.2.1 The reservoir would have an embankment all the way around the perimeter which would be highest along the northern side where the ground is lowest, and lowest along the southern side. The perimeter embankment height would be between 15 and 25m above ground level, with a minimum crest elevation of 80.2-80.4m above sea level. The embankment would have a crest length of around 10km, enclosing a reservoir with a surface area of around 6.5km^2 (similar to Grafham Water in Cambridgeshire, and around half the area of Rutland Water).

3.2.2 The SESRO Reservoir design consists of:

- Earth embankment
- Borrow Pit

- Erosion protection
- Internal filters and drainage
- Reservoir mixing

3.2.3 The concept design of the reservoir has been developed since gate two. The reservoir shape, embankment heights and borrow pit profile remain similar to gate two, and the project design continues to achieve a cut and fill balance to minimise import and export of construction material. However, the design has been changed in the following ways: interpretation of the ground has been updated, slightly lowering the foundation elevation of the dam and leading to the inclusion of a ‘dig and replace’ trench within the dam foundation. It has also led to increased instrumentation within the dam to enhance monitoring during construction and operation. General engineering design development has led to changes in thicknesses and gradings of internal drainage and inner face protection zones, updated fill zoning, updated (increased) settlement allowance and removal of the wave wall.

3.2.4 There have been some changes to the landscape scheme that affect the external face of the reservoir embankments and the location of floating islands.

3.2.5 The following subsections describe each of the above components of the reservoir design as well as reservoir safety and the balance of excavation and fill associated with the design.

Reservoir Safety

3.2.6 The reservoir would be designed and constructed in compliance with the applicable reservoir safety legislation (the Reservoirs Act 1975, as amended). In accordance with this Act, the design and construction of the reservoir would be supervised by a Construction Engineer, namely a competent and highly experienced dam engineer already appointed to the ‘All Reservoirs Panel’ by the Secretary of State. It would also be overseen by an independent expert engineering panel for additional scrutiny appropriate for a large reservoir such as SESRO.

3.2.7 The design of SESRO will continue to follow United Kingdom and international best practice for the design of embankment dams, to ensure the highest possible standard of dam safety is met. Some of the key design features are:

- Internal filtering and drainage – to safely manage dam seepage flows whilst preventing these eroding the dam internally.
- No buried engineered fill / structure interfaces. Instead, all water conveyance would be via a tunnel excavated through the foundation clay, or via siphon pipes over the dam crest.
- Provision of pipework to enable an emergency drawdown at an initial rate of 1m/day – this is the maximum recommended installed rate within current UK

guidance for reservoirs and matches that adopted at all other major Thames Water reservoirs.
- A wide embankment crest and measures to prevent unauthorised vehicular access to limit the risks of damage by persons.
- Provision of a comprehensive control system to prevent overfilling of the reservoir.
- Wave erosion protection – the inner face of the embankment would be protected from wave erosion capable of protecting against extreme storm winds.
- Sufficient freeboard (difference in level between maximum operating level and the dam crest) to take account of long-term settlement of the dam, and the risk of large waves breaking over the dam.
- Monitoring and surveillance – a comprehensive, automated system of instruments would be installed within the dam and its foundation, primarily measuring the response of the foundation during construction. Further instrumentation will also be installed to enable surveillance during operation Such readings would supplement on-site monitoring by operatives trained in reservoir safety surveillance.

3.2.8 The Health and Safety at Work Act including statutory instruments such as the Construction (Design and Management) Regulations 2015 and other safety legislation would also apply to the entire SESRO scheme.

Reservoir Embankment

3.2.9 The reservoir embankment would be constructed primarily using clay materials excavated from the site (from the reservoir borrow pit and the stripping of the dam foundation). Most of the material used for the structural part of the dam will be from the thick Kimmeridge and Gault clay strata which are present at the site and will be excavated from the borrow pit.

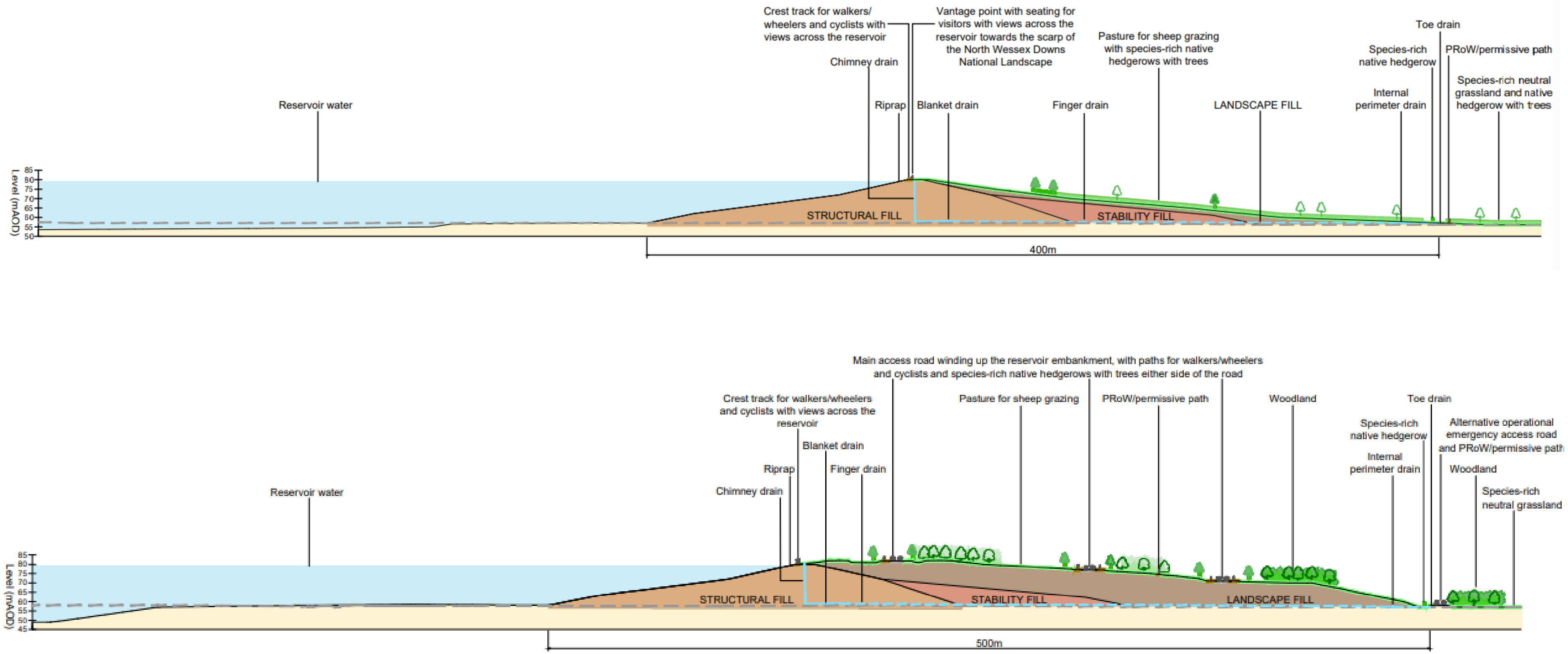
3.2.10 Figure 3-4 provides an indicative cross section of the reservoir embankment and shows that:

- The embankment would be formed of zones of structural fill and landscape fill, all won from excavations at the site. The dam will be split into zones, as is common in large modern dam design, reflecting differing watertightness and strength requirements depending on location within the embankment, and the properties of the available material.
- In an update from the gate two design, the design now includes a ‘dig and replace’ trench into the foundation, under the inner shoulder of the dam. This is to strengthen the dam foundation at this location through digging out and re-compacting the material within the trench volume, thereby breaking up any geological features which may be present and which may otherwise adversely affect the foundation strength.

- The dam would also include sand and gravel filter and drainage zones which are typical for embankment dams and help manage seepage through the embankment.
- The inner face of the embankment would be protected with riprap, i.e., a layer of angular natural quarried rock armour, which dissipate energy from waves which form on the reservoir surface.
- The dam crest will carry a road along its entire length, however vehicular access will be controlled, and the road will primarily be used by non-motorised recreational users alongside light operational and surveillance vehicles.
- The outer toe of the dam will be surrounded by a toe ditch, which will receive discharges from the internal drainage system at discrete locations. This ditch will also be shaped to prevent unauthorised vehicular access onto the dam.
- The outer shoulder of the dam will be shaped with variable depths of landscape fill to naturalise the form of the reservoir in accordance with the landscaping plan.

Figure 3-4: Indicative Cross Sections of the Reservoir Embankment

Taken from the interim master plan (see Section 1.7 for full reference)



Reservoir Borrow Pit

3.2.11 The Kimmeridge and Gault clay present as bedrock at the site would be used to form the dam embankment, excavated from a borrow pit forming the 'bowl' of the SESRO reservoir. To access this clay, other materials would also need to be excavated, namely the overlying subsoil above the bedrock clay, and a thin layer of Lower Greensand, a sandy stratum which lies between the Kimmeridge and Gault Clays. The watertight core of the dam is to be formed only of Kimmeridge and Gault Clays. The Lower Greensand and some of the subsoils are expected to be of reliable strength so can be used as structural fill forming the dam shoulder, alongside fill formed of Kimmeridge and Gault Clays. Other materials are unsuitable for inclusion within the structural zones of the embankment and would therefore be placed as landscape fill to create a coherent landscape design and avoid their haulage from site.

3.2.12 The reservoir borrow pit shape has been selected to suit geological constraints whilst maintaining good water quality and providing sufficient material to form the structural embankment. Features include:

- Provision of a 100m wide trench at the base of the borrow pit, running south-west to north-east. The secondary towers would be constructed on the base of the trench, and the primary tower and reservoir tunnel portal align with the north-eastern end of the trench.
- Provision of a 100m wide 'buffer' between the inner toe of the embankment and the upper edge of the borrow pit excavation. This enables a temporary haul road to run between the two and ensures the excavation does not affect the stability of the dam.
- The borrow pit has a 'V' shape profile when viewed from NW to SE, which aligns with the dip of the geological strata whilst also being suitable for maintaining water quality.

3.2.13 The borrow pit design would continue to be assessed in response to the findings of future ground investigations and water quality modelling.

Borrow Pit Excavation to Embankment Fill Balance

3.2.14 The concept design maintains a balance of the volume of material excavated from the borrow pit and the volume of material required to form the embankment, to avoid the need to import material to site (other than materials that are not available on the site such as aggregates for rip rap, filter, and drainage zones) or to export bulk excavated material from site.

3.2.15 It is necessary to balance the total volume from excavation and fill, but also important to excavate sufficient clay which is suitable to use in the structural zones within the embankment. The gate three borrow pit design gives sufficient material to form the structural embankment fill to construct the reservoir, whilst also leading to the production of enough landscape fill to form the current proposed landscaping design. During further design development, further study of the ground variability (including the findings of the 2024 Ground Investigations and Clay Compaction Trial) and modelling of the embankment design will allow the shape of both borrow pit and embankment to be optimised to reduce the earthworks as much as possible.

Erosion Protection

3.2.16 For the design of any embankment dam, it is essential to protect the dam from the potential erosive impact of waves which would break against the inner face of the embankment. SESRO would include a layer of riprap stone to protect the inner face, and sufficient freeboard to prevent wave spray and slop from eroding the dam crest and downstream shoulder during storms.

3.2.17 The riprap would consist of large, angular blocks of natural rock, which would interlock and dissipate the wave energy. The riprap would be laid on sand and gravel bedding layers and a geotextile to provide support and prevent washout of the embankment clay from between the riprap stones.

3.2.18 This solution is a common type of wave protection for embankment dams in the UK, with many established precedents. The rock sizes and the thickness of the gravel / sand layers have been selected based on established methods relating to maximum wave heights. As the design develops more detailed modelling would be undertaken to enable the riprap rock size to be optimised. These materials are not available at the site and would therefore need to be imported. Studies have been undertaken to investigate how import of this material could be achieved by freight trains and at gate three this is considered feasible based on current timetables. The gate three design of the project includes the construction of temporary rail sidings to facilitate the import of these materials.

Internal Filters and Drainage

3.2.19 The embankment includes internal drainage layers formed with sand and gravel. There is a ‘chimney drain’ under the outer crest edge, a drainage ‘blanket’ at the base of this, and a series of internal drains connecting this to the downstream toe of the embankment. These internal drains then connect to an external toe drainage ditch, at discrete locations where the drainage flow would be measured. This drainage ditch would continue around the entire outer perimeter of the reservoir embankment.

3.2.20 This type of drainage network is typical for embankment dams. It is required to safely intercept and manage seepage which may pass through the dam and/or foundation, whilst also preventing the migration of clay particles. The arrangement also has the effect of draining the outer shoulder of the embankment (enhancing stability) and allows for monitoring of seepage.

3.2.21 The filter and drainage material (clean sands and gravels) are not available at the SESRO site in the quantities and gradings required and would therefore need to be imported. Studies have been undertaken to investigate how import of this material could be achieved by freight trains and at gate three this is considered feasible. The gate three design of the project includes the construction of temporary rail sidings to facilitate the import of these materials.

Reservoir Water Quality

3.2.22 The temperature of water within a reservoir naturally varies with depth. Water at the reservoir surface tends to be warm and oxygenated, while water at greater depths (which receives less sunlight) is likely to remain colder and de-oxygenated. These conditions can encourage algae growth at the reservoir surface which can adversely affect water quality and make temperature differences worse by blocking sunlight. It is therefore important to ensure there are systems in place to encourage sufficient re-circulation and mixing of reservoir water.

3.2.23 Some natural circulation of reservoir water would be caused by the effects of wind shear and the Coriolis force. Furthermore, the jetting of water into the reservoir at the base of the main tower would help augment this natural circulation. However, to account for periods of the year when water is not being jetted into the reservoir there is a need for a separate system for reservoir mixing.

3.2.24 To maintain water quality during storage in the reservoir, the scheme consists of:

- A network of air diffusers on the bed of the reservoir, which would release bubbles of air into the reservoir. This air would be fed to the diffusers from air compressors in the pumping station using a network of pipes buried in the perimeter embankment and reservoir bed. The stream of bubbles from each diffuser would encourage cold water at the base of the reservoir to rise to the surface, allowing warmer water at the surface to move to lower levels. It is expected that diffuser operation would be required during the six-month period between April and September when higher temperatures would increase the risk of stratification.
- An ability to recirculate reservoir water, which could be achieved by abstracting warm water from the top of the reservoir waterbody at the secondary towers into the pumping station wet well (via connecting culverts and outflow pipe in the reservoir tunnel). Pumping the warm water out of the pumping station wet well back into the reservoir (via the inflow pipe in the reservoir tunnel and main tower in the reservoir). The warm water would be jetted back into the reservoir at the bottom of the reservoir waterbody, thereby displacing colder reservoir water.

3.2.25 The requirements for the above will be revisited at the next design stage, once water quality modelling has been further progressed.

Emergency Drawdown

3.2.26 Guidance from the Environment Agency / Defra advises that reservoirs should incorporate facilities to enable a sufficiently rapid drawdown of the reservoir water level in the unlikely event of an emergency. For SESRO a maximum installed drawdown capacity of 1m depth per day at the full supply level is currently proposed. With a reservoir surface area of approximately 6.5 km^2, this requires an emergency drawdown capacity of 75.5m^3/s.

3.2.27 The indicative design for gate two included a drawdown strategy to convey an emergency discharge flow of ~75.5m^3/s to the River Thames with water being discharged through the following two routes:

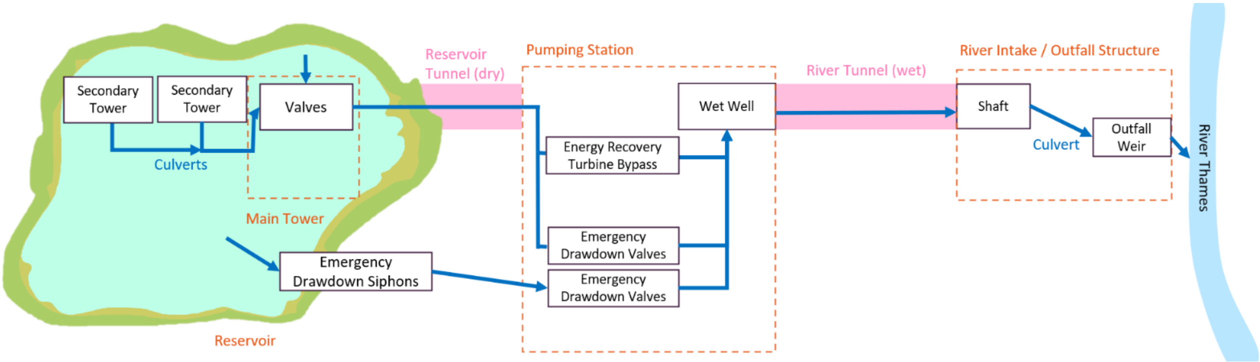
- Discharge of ~30.5m^3/s via the reservoir towers, reservoir tunnel, pumping station, river tunnel and outfall structure.
- Discharge of ~45m^3/s via four siphons over the reservoir embankment, discharging to a surface channel to the River Thames (an Auxiliary Drawdown Channel (ADC))

3.2.28 Option appraisal (which was published as part of the summer 2024 public consultation) identified that the preferred option was to remove the ADC from the design and instead include a larger diameter river tunnel to allow the full emergency discharge to pass to the River Thames via the pumping station and river tunnel. Therefore, the ADC is not incorporated in the current design (which does not include response to the summer consultation and is therefore subject to change).

3.2.29 The current design would allow an emergency drawdown flow of ~75.5m^3/s to the River Thames as shown in the schematic in Figure 3-5. Further details of the different components are provided in Section 3.3.

- Gates in the secondary towers would be opened to allow ~33.5m^3/s of water to pass, via the connecting culverts, into pipework in the main tower.
- A gate in the main tower would also be opened to allow ~23m^3/s of water to pass, via a culvert, into pipework in the main tower.
- A number of valves within the main tower would be opened in order to divert the combined ~56.5m^3/s of water into both of the pipes within the reservoir tunnel. The pipework would take this flow to the pumping station.
- Two siphons (passing over the reservoir embankment) would also be activated in order to provide the additional ~19m^3/s capacity needed to achieve the full 1m/day drawdown requirement. These siphon pipes would take this flow to the pumping station too.
- Within the pumping station, eight emergency discharge valves and the energy recovery turbine bypass valves would allow the full 75.5m^3/s flow to be passed to the pumping station wet well and into the river tunnel for release to the River Thames at the outfall weir. Testing of the valves would be carried out sequentially to reduce the discharge during each test.

Figure 3-5: Schematic for Emergency Drawdown from the Reservoir



3.2.30 Further details of the various components of the emergency drawdown strategy are provided in Section 3.3.

3.3 Conveyance System Design

3.3.1 The SESRO Conveyance system consists of:

- An intake / outfall structure on the riverbank of the River Thames.
- Conveyance tunnel from the intake / outfall structure to the pumping station (hereafter referred to as the river tunnel).
- A pumping station near the toe of the reservoir embankment.
- Conveyance tunnel from the pumping station to the main tower in the reservoir (hereafter referred to as the reservoir tunnel).
- A main tower in the reservoir.
- Two secondary towers in the reservoir (connected via a culvert on the bed of the reservoir).
- Emergency drawdown siphons over the reservoir embankment.

3.3.2 The following subsections describe each of the components of the conveyance design.

Intake / Outfall Structure

3.3.3 The combined river intake / outfall structure would be located on the right bank of the River Thames near Culham. The intake arrangement would allow water to be abstracted from the river through an array of screens sited on a slab submerged on the bed of the river. The length of the intake structure would be approximately 42m along the riverbank. Pipes would link the intake screens / manifold to a vertical shaft (approximately 25m deep with an internal diameter of 14m) to form the connection with the conveyance tunnel (the portal of which would pass through the wall of the shaft at its base). Valves would be included on the connecting pipework to enable isolation of the shaft from the River Thames and to facilitate maintenance activities.

3.3.4 Discharge of water from the reservoir to the River Thames would be via the same conveyance tunnel and shaft as would be used for abstraction. From the shaft the water would be passed back to the River Thames, via a connecting culvert and an open, stepped cascade structure. Gates would be included within the connecting culvert to isolate the shaft from the River Thames and to facilitate maintenance activities.

3.3.5 The intake / outfall structure would be secure, preventing unauthorised access into the tunnel and minimising risk to river users posed by the abstraction and discharge flows.

Tunnels

3.3.6 Water will be transferred between the intake / outfall structure and the reservoir via two tunnels:

- River tunnel – For connecting the shaft at the river intake/outfall structure with the wet well of the pumping station. This would be an approximately 3.5km long segmentally lined tunnel with an outer diameter of 6.6m and an internal diameter of 6.0m. The tunnel would have an additional secondary cast in-situ lining for approximately 1.4km at the eastern end (where there is less cover above the tunnel); thereby reducing the internal diameter of the tunnel over this section to 5.5m.
- Reservoir tunnel – For connecting the pumping station to the main tower in the reservoir. The tunnel would be approximately 450m long with a sprayed concrete primary lining (7.5m outer diameter, 7.1m internal diameter). The tunnel would have a secondary cast in-situ lining throughout; thereby reducing the internal diameter of the tunnel to 5.8m. From the portal used to construct the sprayed concrete lining tunnel there would be an approximately 25m long cut and cover section of tunnel to form the connection with the main tower.

3.3.7 The river tunnel is designed as a wet tunnel where the tunnel lining contains internal water flows without internal pipework. The river tunnel, pumping station wet well and shaft at the intake / outfall structure will be filled with water during abstraction of water from the River Thames and release of water back to the River Thames. The river tunnel can be dewatered during periods where there is no need to pass flow between the reservoir and the River Thames.

3.3.8 The reservoir tunnel is designed as a dry tunnel where the water flows are contained within two 2.2m diameter pipes (one to be used for inflow to the reservoir and one to be used for outflow from the reservoir, except in emergency drawdown conditions when both pipes will operate as outflow conduits). This reservoir tunnel can therefore be used for: access from the pumping station to the main tower; inspection and maintenance of the internal pipework; and routing of cabling for power / communications.

Pumping Station

3.3.9 The pumping station structure is to house the pumps, turbines, valves and associated pipework necessary for the requirements of the conveyance system. The structure is located near the base of the reservoir embankment to the north-east of the site, accessed via internal roads with connection to the public highway. The structure will interface with both the reservoir tunnel and the river tunnel.

3.3.10 There will be a requirement for above-ground structures to provide space for ancillary equipment, electrical transformers/switchgear, and operation / maintenance facilities.

Pumping Station – Plant and Process Design

Intake Pumps

3.3.11 The normal operating capacity requirement for the intake pumps is 1000Ml/d, equivalent to an instantaneous flow rate 11.6m^3/s, however, to provide flexibility of operation a maximum pumping rate equivalent to 1200Ml/d, or 13.9m^3/s instantaneous flow rate has been selected. This provides 20% margin of standby capacity during normal operation and gives the operator flexibility in selecting operating hours or providing catch-up flows.

3.3.12 Ten pumps have been included in the design to allow pumping across the full range of levels within the reservoir (from a full supply level of 79mAOD to a bottom operating level of 51mAOD). The pumping arrangement provides the ability to abstract the required maximum instantaneous flow of 1200Ml/d to a minimum flow of approximately 70Ml/d.

3.3.13 The typical water level at the River Thames is approximately 49.5mAOD, while the maximum water level in the reservoir is 79mAOD, therefore a level difference of approximately 29.5m.

3.3.14 The ten intake pumps receive water from the wet well of the pumping station via a suction manifold. A certain depth of water above the suction manifold is required in the pumping station wet well during abstraction to reduce the risk of vortices forming and air being drawn into the system. This has informed the necessary level of the suction manifold, and therefore the necessary level of the floor of the underground pumping station structure.

Energy Recovery Turbines and Bypass Valves

3.3.15 Water stored in the reservoir would be at a higher elevation than the water in the River Thames when the reservoir is full. This means there is a potential for energy recovery when water is released from the reservoir back to the River Thames. The design therefore includes energy recovery turbines.

3.3.16 The latest Water Resources modelling proposes that the release rates from the reservoir to the River Thames would start at 50Ml/d in 2040 (when SESRO is first commissioned) and rise over time up to 193Ml/d by 2065. Two energy recovery turbines have been included in the concept design, each with a rated discharge of approximately 100Ml/d. Therefore, when the scheme is first commissioned one turbine would operate at half capacity to achieve the 50Ml/d release rate. Later in the life of the project, two turbines would operate at close to their rated discharge to achieve the 193Ml/d release rate. It is noted that it may be possible to introduce further energy recovery turbines for the outlet to T2ST and the Farmoor transfer, subject to further design work, but these are not included in the gate three design of SESRO.

3.3.17 There may be situations where the energy recovery turbines are not operational (e.g. for maintenance) during periods where water needs to be released from the reservoir to the River Thames. The concept design therefore allows for water to be released instead via energy recovery turbine bypass valves.

Emergency Drawdown

3.3.18 To be able to draw the reservoir down by 1m per day in an emergency scenario it would be necessary to release 75.5m^3/s when the reservoir is at the full supply level. To be able to pass this flow from the reservoir to the pumping station there are two components:

- Approximately 56.5m^3/s passed from the reservoir to the pumping station via the reservoir towers and pipework within the dry reservoir tunnel. From the pipework in the reservoir tunnel, the flow would be discharged into the pumping station wet well via six of the emergency discharge valves (submerged sleeve valves) and the four energy recovery turbine bypass valves (needle valves).
- Approximately 19m^3/s passed from the reservoir to the pumping station via two siphons and pipework buried in the downstream face of the reservoir embankment. From the pipework associated with the siphons, flow would be discharged into the pumping station wet well via two emergency discharge valves (submerged sleeve valves).

3.3.19 To pass the required 75.5m^3/s from the pumping station wet well to the River Thames in the event of an emergency drawdown it would pass via the wet river tunnel to the intake / outfall shaft. From the intake / outfall shaft the flow would be discharged to the river via the outfall weir.

Water Resource Projects

3.3.20 As noted in Section 2.3, the water stored in the reservoir could either be released back to the River Thames, or to other water resource projects that are part of preferred and adaptive WRMPs. Therefore, the SESRO plant and process design allows for the following:

- T2ST WTW – 120Ml/d flow to be delivered either via gravity or pumped, depending on the water level in the reservoir. Five pumps would be provided to facilitate the flow required (for lower reservoir water levels). Valves would be provided on the pumps, which would be closed to allow gravity flow. Discharge would be to a header tank at the inlet to the T2ST WTW.
- Raw water transfer to Farmoor Reservoir – 24Ml/d flow to be delivered (preferred plan), 100Ml/d to be delivered (adaptive plan). Given the elevation difference and distance between SESRO and Farmoor, the flow would always need to be pumped. Two pumps would be provided to facilitate the 24Ml/d flow. Space for a further three pumps would be provided, which could be installed should the flow requirement increase to 100Ml/d.
- SWOX WTW – 72Ml/d flow to be delivered (adaptive plan) either via gravity or pumped, depending on the water level in the reservoir. Space would be provided for four pumps that could be installed to facilitate the flow required (for lower reservoir water levels). Valves would be provided on the pumps, which would be closed to allow gravity flow. Discharge would be to a header tank at the inlet to the SWOX WTW.
- Simultaneous releases from the reservoir to all three of the above water resource projects, as well as a release from the reservoir to the River Thames.

3.3.21 As noted in Section 2.3, the SESRO concept design has considered a potential future need to integrate with the Severn to Thames Transfer (STT) if this were to be constructed as part of the adaptive WRMP. The STT could deliver a maximum flow of 500Ml/d and a minimum flow (for pipeline sweetening) of 18Ml/d. The SESRO pumping station includes a pipe connection for the STT sweetening flow, which is gravity-fed to the pumping station and then into the reservoir. Higher flows from STT, up to the peak of 500Ml/d, would be discharged into the SESRO river tunnel (via a separate shaft and adit). From here, the STT flow would either be released by gravity to the River Thames via the SESRO river tunnel, or it would be pumped into the reservoir.

Pumping Station – Civil Design

Underground Structure

3.3.22 The plan area of the underground structure of the pumping station has been determined by the pumps, turbines, valves and their associated pipework (which are described in the above section of the report). This has resulted in an underground structure that is approximately 120m long and 50m wide.

3.3.23 The depth of the underground pumping station has been determined by the need to interface with the reservoir tunnel and river tunnel. This has resulted in an underground structure that is approximately 17m deep to floor level.

3.3.24 To provide an underground structure of the required dimensions it is proposed to use three 50m diameter interlocked cells formed by 1.2m thick diaphragm walls. At the locations where the cells interlock, it is proposed to include approximately 37m long horizontal reinforced concrete props (2m x 2m) at top and intermediate levels.

Above Ground Structures

3.3.25 All large plant would be situated in the underground structure described above. However, the pumping station design also incorporates two above ground buildings:

- An approximately 56m x 88m building with an approximate height 10-12m above existing ground level. This building would be above two of the cells of the underground pumping station structure and would primarily house a gantry crane to be able to lift the plant outlined in the section above.
- An approximately 27m x 56m building with an approximate height 5-6m above existing ground level. This building would house the electrical equipment and operation / control rooms.

Reservoir Towers

Main Tower

3.3.26 Water would be discharged into the reservoir via pipework situated at the base of a main tower (which would be internally dry). This would be located in the north-east corner of the reservoir to allow for connection to the dry reservoir tunnel. The tower would be circular with an internal diameter of approximately 28m to allow for the pipework and valving required for different modes of operation. The base slab of the main tower would be at approximately 38mAOD. The top of the main tower walls would be at approximately 82mAOD, above which a building (approximately 5-10m high) would be included to house electrical equipment and a gantry crane to allow for lifting of the service and isolation valves. Access to the top of the main tower would be via an internal staircase.

3.3.27 There would be a cut and cover section of tunnel to form the connection between the dry main tower and the portal for the dry reservoir tunnel. This connection would provide a way of accessing the main tower from the pumping station and would also allow for the inlet and outlet pipes to extend from the pumping station into the base of the main tower. The inlet pipe connection would allow water abstracted from the river to be pumped, via the pumping station, to the base of the main tower where it would be jetted into the reservoir through two jet nozzles. The motion caused by jetting of the water in this way would augment the natural circulation of reservoir water driven by the effect of the prevailing wind and the Coriolis force, thereby contributing to efforts to prevent stratification.

3.3.28 At the base of the main tower there would be connections to three concrete culverts to facilitate release of water from the reservoir:

- Two culverts would be associated with receiving flows from the secondary towers (see section below). The culverts would connect to the pipework and valving arrangement in the main tower to allow flows from the secondary tower culverts to be passed to the pumping station, via the outlet pipe in the reservoir tunnel.
- One culvert would be associated with receiving flows from the reservoir if there was a need for an emergency drawdown. The culvert would connect to the pipework and valving arrangement in the main tower to allow flows from the reservoir to be passed to the pumping station, via both the inlet and outlet pipes in the reservoir tunnel.

Secondary Towers

3.3.29 To provide flexibility in the locations within the reservoir where water can be abstracted, the concept design incorporates two secondary towers, which would be located away from the dam crest and towards the centre of the reservoir. These towers are only provided for abstraction from the reservoir and therefore do not contain pipework and nozzles for jetting water into the reservoir.

3.3.30 The secondary towers would be located within the central trench of the borrow pit. The base slabs of the secondary towers would be at approximately 43.5mAOD, with the top of the tower walls being at approximately 80.5mAOD. The towers would have an internal diameter of approximately 11m and would be internally wet (i.e., water level inside equals that of the reservoir outside).

3.3.31 The secondary towers would allow water to be released from the reservoir at five different levels. Across the five levels there would be nine openings controlled by wall-mounted penstocks on the wet-well side of the tower walls. Each of the openings would also have combined trash racks and fish screens on the reservoir side of the tower walls; these would help reduce the risk of debris and fish from entering the conveyance system. For release of water from the reservoir typically between two and four of the 18 penstock gates across the two secondary towers would be opened at a time. The number and selection of penstock gates that would be opened would depend on the water quality at the each of the secondary towers and the amount of flow that is to be released from the reservoir. Should there be a need for emergency drawdown of the reservoir all 18 penstock gates would be opened. A gantry crane would be included on top of each of the secondary towers, which would be used for lifting of the combined trash racks / fish screens and installation of stoplogs to allow for cleaning and maintenance. If required, the crane could also be used for lifting of the penstock gates.

3.3.32 Each secondary tower would be individually connected to the main tower via culverts running along the central trench of the borrow pit. These culverts would convey flows from each of the secondary towers to the main tower.

3.3.33 Access to the secondary towers for local operation, regular inspection and maintenance would be by boat. Therefore, each tower would include an external staircase to allow access to the top of the secondary tower from any reservoir water level.

3.4 Associated Infrastructure Design

Watercourses

3.4.1 The reservoir footprint would cut across existing watercourses and surface drainage channels, therefore watercourse diversions are required to maintain waterway connectivity. These are the Cow Common Brook Diversion (CCBD) and East Hanney Ditch Diversion (EHDD), located on the west side of the reservoir, and the Mere Dyke Diversion (MDD), located on the east side of the reservoir.

3.4.2 The indicative alignment of the watercourses was developed through engagement between the engineering team and aquatic environment specialists, and the system of watercourses and wetland ditches has been refined and further integrated with the Replacement Flood Storage (RFS) areas during gate three.

3.4.3 The landscape and biodiversity habitat design to the west of the reservoir is centred around the Cow Common Brook and East Hanney Ditch Diversions. It comprises a large area of wetland habitat mosaic which includes reeds, species rich wet grassland and floodplain marsh, as well as localised areas of wet woodland and a series of ponds and scrapes. Connectivity between the wetland areas and watercourse diversions is provided by a series of ditches. Three types of ditches make up the wetland system – conveyance ditches, ecological ditches and washland ditches.

3.4.4 The western wetland area has been developed, and updated, following feedback from the Environment Agency at gate two. For further information about landscape design refer to the interim master plan issued for public consultation (See Section 1.7 for reference).

3.4.5 The CCBD would be fed by Cow Common Brook and Portobello Ditch on the southwest side of the reservoir. The CCBD would flow northwards around the western edge of the reservoir, eventually discharging into the existing Landmead Ditch which would convey flows to the River Ock. The EHDD would be fed by the existing East Hanney Ditch and would flow parallel to the CCBD for much of its length, before discharging into Childrey Brook, which is a tributary of the River Ock, to the northwest of the reservoir.

3.4.6 The western RFS area is situated on either side of these two diversion channels, with additional RFS alongside Landmead Ditch.

3.4.7 The Mere Dyke Diversion commences to the south of the reservoir and runs in an easterly direction between the Steventon to East Hanney road diversion and the reservoir toe. In the upper reach, the watercourse picks up flow from the local catchment, as well as from new culverts installed beneath the road diversion, including the existing Orchard Farm Ditch and Goose Willow Ditches. The watercourse then flows north, where it is fed by the existing Mere Dyke and by smaller watercourses including North Drayton Ditch, Steventon Ditch West, Steventon Ditch East and Mere Dyke West. The MDD discharges into the River Ock to the northeast of the reservoir.

Watercourse Channel Design

3.4.8 The design of the diversion channels typically incorporates a low flow channel set within the main channel. The low flow channel is typically designed for the 50% Annual Exceedance Probability (AEP) event and provides a depth of flow for aquatic species during dryer periods. The low flow channel meanders within the main channel, which provides higher depths and better represents a natural watercourse.

3.4.9 The main channel is typically sized for the 20% AEP event. In larger events, the main channel will overtop, either to the RFS areas or to a third stage channel in the cases where RFS areas are not present. Where a third stage channel is present, it has been designed to carry the 1% AEP plus the higher climate change allowance of 84%.

Replacement Flood Storage

3.4.10 A hydraulic model was developed in gate two to understand how the construction of SESRO may impact fluvial flooding in the River Ock catchment and to investigate the volume of floodplain that may be displaced and therefore need to be replaced within the project design. During gate three work the model has been further refined, particularly in its representation of the proposed design.

3.4.11 A second model has been developed to understand the impact of the project on the River Thames floodplain. This was used during the Connectivity to the River Thames Option Appraisal (see Section 1.7) and has since informed RFS design.

3.4.12 The Environment Agency has been consulted about both models and they are both based on pre-existing models that were originally developed for the Environment Agency.

3.4.13 The models have been developed to represent a base case scenario that reflects the existing situation and future scenarios with and without SESRO. The models will continue to be refined based on emerging survey data and changes in the interim master plan as the design is refined for DCO submission.

3.4.14 The hydraulic models have informed an RFS design for both catchments.

3.4.15 The River Ock RFS is largely located to the west of the reservoir, although some smaller areas are located elsewhere, and it replaces floodplain lost below the reservoir footprint and some other associated infrastructure such as the main access road. Indicative areas are shown on the Interim Master Plan (see

Appendix A).

3.4.16 River Thames RFS will cover a smaller area and is required to accommodate the intake / outfall structure. This is not shown on the interim master plan, however modelling has been undertaken and allowance made in the cost for this need.

Groundwater Drainage

3.4.17 The construction of the reservoir would block groundwater flows that currently occur within the superficial deposits which reside above the (largely impermeable) Kimmeridge and Gault clay formations. The groundwater has been assessed to flow generally from south to north in the layer of superficial deposits, and the gate three design includes groundwater drainage to ensure that groundwater flows are intercepted and drained around the reservoir. The conceptual design has changed since gate two based on further groundwater modelling; however, the final design remains dependent on additional validation of the model using emerging survey data.

3.4.18 In gate two it was anticipated that a groundwater drain would be required on a similar alignment to the toe drain around the southern side of the embankment, whereas the new conceptual arrangement proposes a network of drainage similar to typical agricultural land drainage. This would allow interception and diversion of flows over a wider area but still drain flows into the watercourse diversions that flow north into the River Ock, thus maintaining the existing direction of flow.

3.4.19 An indicative eastern and western quadrant ‘herringbone’ drainage system has been adopted, in which drainage pipes/channels are oriented perpendicular to groundwater flow. This will allow for the maximum capture of groundwater and allow the water to be routed into the east and west watercourse diversions or other surface water channels.

3.4.20 The project team recognise that this is an area of concern for the public and the groundwater drainage design continues to be developed by technical specialists, in consultation with the Environment Agency. Flood risk will be addressed in the Preliminary Environmental Impact Report for the project and a Flood Risk Assessment will be submitted with the DCO submission.

Wilts and Berks Canal Corridor

3.4.21 The Wilts & Berks Canal (W&BC) connected the Kennet and Avon Canal to the River Thames at Abingdon in 1810 but was abandoned in 1914. However, the Wilts & Berks Canal Trust (W&BCT) aim to achieve full restoration of the canal with a primary aim for recreational use. The design of SESRO therefore allows for a safeguarded corridor around the west and north side of the reservoir which could be used for construction of the W&BC in the future by the W&BCT. The alignment of the corridor has been reviewed during the gate three master planning and minor amendments made to ensure integration with other aspects of the design.

3.4.22 The gate two indicative design included an ADC to convey emergency discharge flow to the River Thames. This channel was also envisaged to become part of the restored canal. Gate three option appraisal removed the ADC from the design in favour of an underground transfer of emergency flows (see Section 1.7 and consultation documents for more information), therefore the gate three design does not facilitate reconstruction of the canal from the main SESRO site to the river. This decision and design are subject to further review based on responses to the summer 2024 public consultation.

3.4.23 The SESRO project team have had discussions with the W&BCT throughout all phases of development of the SESRO design and engagement is continuing, particularly in relation to whether the canal corridor could include some elements of canal earthworks to facilitate future restoration and better integrate the canal with the landscape design of SESRO. The corridor for W&BC is proposed to facilitate a 5.3 m wide, 1.5 m deep canal cross-section which would allow for traditional canal narrow boats.

Recreational Facilities

3.4.24 A range of recreational buildings and activities have been proposed for SESRO, as described in the interim master plan, see Appendix A and the associated report issued for consultation.

3.4.25 The recreational activities included in the core scheme, as shown on the layout plan in Appendix A, include:

- Visitor facilities mainly focussed on the north east area of the site. The gate two indicative design included an education centre near the main RFS and wetlands (in the north west corner) however this has been moved to reduce impact on the wetlands and the nearby crematorium.
- Various potential locations for a visitor centre.
- A water sports centre on the embankment which would likely have internal / external boat storage, a clubhouse, and access to the reservoir for controlled water-based activity.
- Potential locations for a café, including one on the embankment.
- An education centre, either integrated with other one of the other facilities above or a separate building.
- An extensive network of walking, cycling, and riding routes around the site.
- A dedicated nature conservation zone, along the western side of the reservoir, combining the replacement flood storage area, diverted watercourses and wetland creation. It is envisaged that walking routes in this area would be more limited to reduce footfall.
- Car parking.

3.4.26 Work is continuing on the legacy and recreational strategy for SESRO and this will be informed by analysis of responses from the summer 2024 public consultation and ongoing dialogue with local environmental and recreational groups.

3.4.27 The interim master plan (Appendix A) shows the proposed footpath and cycle paths that would connect into existing public rights of way (PROW) that surround and cross the SESRO site. These changes are designed to maximise the amenity value of the retained, diverted and proposed new routes, enable access for all and to encourage a wide range of non-vehicular routes into and around the SESRO site.

3.4.28 The PROW routes have been updated since gate two; however, the choice of final scheme PROW routes and access will be further refined and adjusted to reflect ongoing liaison with Oxfordshire County Council and other local stakeholders, analysis of responses to the summer 2024 public consultation, engagement with local recreational groups, further feedback from future public consultation events and further technical analysis.

Roads and Access

3.4.29 There are a number of roads in the SESRO project including:

- Main Access Road
- Steventon to East Hanney road diversion
- Internal site roads
- Car parking

3.4.30 The first two roads were subject to option appraisal and the preferred options have been taken forward into the gate three design, although the final DCO design is subject to feedback from the Summer 2024 consultation which included the option appraisal work.

Main Access Road

3.4.31 As shown on the interim master plan in Appendix A, the main access route into site for both construction and operation would be from the A415 (Marcham Road). The alignment was updated from the gate two design during the option appraisal process and the resulting preferred option has been developed to inform gate three costing. The design now includes a roundabout on the A415 that is closer to the junction with the A34 than the gate two design, and at the location of the existing access to Dalton Barracks, so that it could also serve this site if it is develop for housing in the future (as designated in the local plan). The roundabout would be constructed offline from the A415 to the south of the existing road to minimise disruption during construction. The road alignment avoids existing allotments and routes south into the site from the roundabout, following the line of the A34 and staying fairly close to it, to minimise landscape visual impacts.

3.4.32 Junction modelling of the new access road junction and the A415 / A34 junction has been updated to inform gate three design.

3.4.33 It is envisaged that the access road would be a two-lane carriageway with a shared cycle / footpath on both the east and west sides of the road. Road drainage has been added to the gate three design with swales and attenuation ditches. It is anticipated that the road would meet an internal site roundabout (not shown on the interim master plan) to the south of the River Ock floodplain and the internal roads would split at this point towards the recreational lakes, the SESRO pumping station, the main car park and the embankment road. The access road would also serve the T2ST WTW in either of the provisional locations identified.

3.4.34 The access road would be raised above the River Ock floodplain on an embankment and would cross over the River Ock, the canal corridor, and the western watercourse diversion on bridges. Bridges or culverts would also be required for the road to pass over smaller watercourses. There is an opportunity for the design of SESRO access road embankment to be adapted so that it would act as a part of a flood alleviation scheme that has previously been investigated by the Environment Agency (Abingdon FAS). See Section 3.9 for further information.

Steventon to East Hanney Road Diversion

3.4.35 The reservoir will sever the road that currently connects East Hanney to Steventon and therefore it requires diversion. The road diversion route was subject to option appraisal and the preferred option (which is very similar to the gate two solution) is included in the gate three design, subject to analysis of the summer 2024 public consultation feedback.

3.4.36 Outside of Steventon the road would be diverted to the south from its current alignment and then route west along the southern extent of the reservoir embankment. A new roundabout would be created at the junction with the A338 to the south of East Hanney (constructed offline to minimise construction impact). This alignment would reduce the impact on traffic within East Hanney and could also help better serve a proposed new Wantage and Grove Railway station if this were also to be constructed in the future.

3.4.37 The total length of the realigned East Hanney to Steventon Road would be ~5km. It is envisaged that the road would consist of a rural two-lane carriageway with a with a footway on the north side of the road and a shared cycle / footway would on the south side of the road.

3.4.38 The Steventon to East Hanney road would be slightly raised above existing ground level but would require a higher embankment on the approaches to its crossing of the West Watercourse Diversion and the potential future Wilts and Berks Canal.

Internal Site Roads and Car Parking

3.4.39 It is envisaged that an operational road will run around the entire crest of the embankment, and another will run around the toe of the embankment to allow for operational access and inspections. These will be dual purpose for walking and cycling. Spurs from these roads will serve the various operational and recreational facilities as indicated on the interim master plan drawing in Appendix A.

3.4.40 It is anticipated that there will be two main car parking areas:

- Main visitor car park – located at the end of the A415 to SESRO Access Road.
- Lakeside car park – located near the Recreational Lakes (not shown on the interim master plan)

3.4.41 Smaller car parking areas are included in the gate three design, these are representative of the likely design but still subject to further design development based on analysis of the summer 2024 consultation feedback and further work with stakeholders. Parking is provided at the following locations:

- Reservoir crest café car park – located on the reservoir crest with limited spaces to be used for staff, deliveries and disabled access to café; with controlled access at toe of the reservoir embankment.
- Water sports centre boat store and temporary parking – located on the reservoir crest with controlled access at toe of the reservoir embankment.
- Pumping station car park – for operational and maintenance vehicles only.
- East Hanney and Steventon car parks – provision of limited spaces at the 'stub' roads would be left following construction of the Steventon to East Hanney road diversion; intended to be for local use only to enable parking and pedestrian access to the site.

Service Diversions

3.4.42 A number of existing services have been identified which require diversion in advance of any construction works at the site. The gate three design includes for this work; however, engagement with the appropriate statutory undertakers and service providers is ongoing to reach agreed positions for DCO submission.

3.4.43 Services that have interfaces with the proposed works include:

- Electricity cables
- Fibre optic cables
- Gas networks
- Water mains
- Sewerage
- Telecoms

3.4.44 The most significant diversions will be high voltage overhead electricity cables that currently cross the site. These diversions can have a long lead time to organise and implement and will need to integrate with other aspects of the SESRO design and construction.

New Services

3.4.45 New utility supplies will be required to facilitate the construction and operation phases of SESRO. The following gives a summary of the requirements, it should be noted that these only consider SESRO, and not the requirements for the other water resource projects that will require facilities on the SESRO site.

Table 3-1 – Summary of Required Services

Service	Commentary
Construction Power Supply	Power will be required for: • Tunnel Boring Machine (TBM) • Rail siding and materials handling area • Staff cabins • On site parking and security Total power requirement at peak of construction is estimated at approximately 5,600kVA
Permanent Power Supply	Power will be required for: • Pumping Station • River Intake/Outfall structure • Recreational buildings • On-site parking and security The T2ST WTW will also require power and the two projects are working together to assess the overall power needs.
Water	Permanent water supply will be required to operational and recreational buildings. Water supply will also be required during construction.
Surface Water Drainage	The gate three design for costing includes road drainage, the toe drain will capture surface water run-off from the embankments. Hard standing areas around buildings will be drained appropriately to the watercourses crossing the site, further design detail will be developed prior to DCO (alongside development of architectural concepts and designs), and the remaining areas of the site will be drained by the watercourse diversions and groundwater drainage as appropriate. As discussed earlier the project is subject to flood modelling and surface water will be included in the Flood Risk Assessment.
Foul Drainage	Permanent foul drainage would be required for operational and recreational buildings. The currently preferred solution would deliver a gravity sewer network within the site, draining to a foul pumping station possibly shared with the T2ST WTW. From that point, a rising main would be used to carry the foul water flows from SESRO and T2ST to an appropriate point on the Thames water sewer network.
Telecommunications	Connections will be required for operational and recreational facilities. Operational needs will include communication, remote equipment control and links to the wider water resources network. The specific requirements, mode of control and final connections will be further developed at the next stage of design.

Rail Siding and Materials Handling Area

3.4.46 As outlined above, the reservoir embankment and borrow pit would be designed to ensure volumes of cut and fill are balanced, to avoid the need to import or export clay from the site. There are, however, some significant quantities of sands, gravels, and rip rap required for the embankment inner slope protection and for filter and drainage layers within the embankment. To avoid having to transport this material by road haulage the SESRO scheme would include a new rail siding, so this material could be transported to the site via rail.

3.4.47 The location of the rail siding was subject to option appraisal and the preferred option has moved west since the gate two design. The new preferred location is shown in the option appraisal report (see Section 1.4). There is more confidence in this solution in terms of interaction with the very busy and strategic Great Western Main Line Railway, and the design that is being developed avoids the nearby local wildlife site; however, it does impact a small number of existing residential properties. The design is subject to the outcome of the summer 2024 consultation, further design development and agreement with Network Rail.

3.4.48 The rail siding would be temporary, constructed on the existing Great Western Main Line (London to Bristol) along with an adjacent materials handling / stockpiling area. Trains would be routed off the main line, which is on embankment, and into a siding at a lower level adjacent to the materials handling area and then back up to the main line.

3.5 Security

3.5.1 A security review of SESRO has been undertaken to understand SEMD[10] requirements for the operational water infrastructure and other security measures that would be appropriate to manage the safety of visitors to the site. The site will be protected by appropriate security measures (not shown on the interim master plan in Appendix A) such as fencing to operational infrastructure and controlled barriers to site roads etc.

3.5.2 The design will meet all statutory requirements in relation to security.

[10] The Security and Emergency Measures (Water and Sewerage Undertakers and Water Supply Licensees) Direction 2022 (SEMD) is the principal general direction issued by the Secretary of State and Welsh Ministers under Section 208 of the Water Industry Act 1991 (the Act). Undertakers and licensees are required to maintain a water supply and/or sewerage system in the interests of national security or to mitigate the effects of any civil emergency which may occur.

3.6 Digital Representation of the Project

3.6.1 Building and Information Modelling (BIM) of the emerging SESRO design (i.e. the interim master plan and underlying gate three engineering design) informed visualisations (including a virtual reality representation of the design) presented at the summer 2024 public consultation. These models will continue to be developed in gate four and will ultimately inform a digital twin for the site that will be developed for use in construction and operation.

3.6.2 Alongside models of the site that provide information for onsite operation it is recognised that SESRO will form part of the larger south east water resources system and provide water to multiple water companies. High level consideration of how the system could operate has informed thinking for the SESRO Stage 2 commercial submission to RAPID, which is not published publicly, and will be subject to further work ahead of DCO and tender of the project.

3.7 Scheme Operation Energy Estimates

Pumping Energy Required and Renewable Energy Generation

3.7.1 The energy that is required to refill the reservoir and the energy that can be generated when releasing water from the reservoir would vary from year to year, depending on utilisation of the scheme. Outputs from Deployable Output (DO) modelling (daily inflows, outflows, and reservoir storage volumes) have been used to estimate the average annual energy requirements for:

- Energy generated by the energy recovery turbines during periods when water is released from the reservoir back to the River Thames.
- Energy required to pump water from the River Thames to the reservoir via the intake pumps.
- Additional energy required to pump water from SESRO to T2ST and Farmoor. It should be noted that the requirements for pumping to T2ST and Farmoor will need to be revisited once their designs, and their anticipated utilisation, has been further developed.

Average Energy Estimate

3.7.2 The estimates demonstrate that the pumping energy required, and turbine energy generated vary across the modelled years. Where the modelled year is representing a drought the DO model draws more water out of the reservoir, resulting in higher energy generation. Then in the subsequent modelled year, the DO model shows longer periods of reservoir refilling and therefore higher pumping energy requirements. Taking an average across all the modelled years shows that (on average):

- Generate 885 MWh from release to the River Thames.
- Require 5,915 MWh for pumping to refill the reservoir.

- Require approximately 813 MWh for additional pumping from the reservoir to Farmoor and T2ST.

Theoretical High Utilisation Energy Estimate

3.7.3 A theoretical high utilisation scenario is also considered to estimate an associated pumping energy requirement and turbine energy generation. The theoretical high utilisation scenario considers:

- A release of 237Ml/d to River Thames for 266 days
- Pumping (where gravity discharge is not possible) of 74Ml/d from the reservoir to T2ST for 365 days.
- Pumping of 24Ml/d for raw water transfer from the reservoir to Farmoor for 365 days.
- Pumping of 1000Ml/d to refill the reservoir from River Thames for 99 days.

3.7.4 It is estimated that this theoretical high utilisation scenario would:

- Generate 2,650 MWh from the release to the River Thames.
- Require 8,200 MWh for pumping to refill the reservoir.
- Require approximately 3,678 MWh for pumping from the reservoir to Farmoor and T2ST.

Theoretical Low Utilisation Energy Estimate

3.7.5 A theoretical low utilisation scenario is also considered to estimate an associated pumping energy requirement. The theoretical low utilisation scenario considers:

- A release of 3.6Ml/d as a sweetening flow to Farmoor for 365 days.
- A release of 18Ml/d as a sweetening flow to T2ST for 365 days.
- Pumping of 1000Ml/d to refill the reservoir from the River Thames for a combined eight days across the year.
- Tunnel dewatering required on eight occasions throughout the year.

3.7.6 It is estimated that this theoretical low utilisation scenario would:

- Generate no energy, as no water would be released to the River Thames.
- Require 904 MWh for pumping to refill the reservoir.
- Require approximately 408 MWh for pumping from the reservoir to Farmoor and T2ST.
- Require approximately 54MWh for tunnel dewatering.

Air Diffuser Network

3.7.7 As discussed in Section 3.2, to reduce the risk of deteriorating water quality, the concept design includes for a network of air diffusers connected to two 200 kW air compressors in the pumping station.

3.7.8 Computational Fluid Dynamics modelling indicates that these would need to operate during the six-month period between April and September when higher temperatures would increase the risk of stratification. The modelling outputs indicate that 1.92 MWh/day would be required during this period. Assuming an efficiency of 60% the daily energy requirement is therefore 3.2 MWh, corresponding to an annual energy requirement of ~585 MWh.

3.8 Interaction with Other Schemes

3.8.1 As indicated in Section 2.2 SESRO interacts with a number of other water resources projects, as follows:

- Thames Water options to supply the LON (London), SWOX (Swindon and Oxfordshire) or SWA (Slough, Wycombe and Aylesbury) Water Resource Zones (WRZs). Only SWOX requires works at the SESRO site.
- T2ST SRO: The reservoir would serve Southern Water customers through a water treatment works (WTW) located at SESRO and a piped treated water transfer to the Southern Water region.
- T2AT SRO: This project is dependent on SESRO for water resource; however it would not require any works at the SESRO site.
- Abstraction at South East Water's existing surface water intake on the River Thames at Bray and not dependent on works at the SESRO site.
- Severn Thames Transfer (STT): Not currently selected in the preferred regional and company WRMPs but is included in adaptive planning scenarios. The conceptual design of the STT pipeline passes through the SESRO site and discharges to the River Thames at Culham, close to the SESRO intake / outfall location. STT requires a reserved corridor through the SESRO site and a connection point on the SESRO tunnel.

SWOX Infrastructure

3.8.2 There are two scenarios for SWOX transfer. Initially the WRMP calls for a raw water transfer to Farmoor Reservoir, which would be delivered at the same time as SESRO. Later there is a potential need for a treated water transfer including a water treatment works at SESRO. The gate three design provides for both these scenarios.

3.8.3 Scenario 1 – The SESRO design includes for pumps within the main SESRO pumping station for the raw transfer and a pipeline to the edge of the SESRO site. The pipeline from there to Farmoor would be provided under a separate Thames Water project.

3.8.4 Scenario 2 – the SESRO design includes space within the SESRO pumping station for installation of additional pumps in the future to transfer reservoir water to the treatment works. Space is reserved on the SESRO site for a potential future WTW. Currently this is anticipated to be at the T2ST Option 4 location alongside the main access road.

T2ST Infrastructure

3.8.5 The T2ST SRO project has established a need for a WTW at the SESRO site, however the SESRO project has undertaken an option appraisal to establish the location of the treatment within the site (see Section 1.4). Two locations were identified, and the final location will be established in the next stage of project work (prior to gate four and DCO submission). Water would transfer to the WTW by gravity when the reservoir is full but when the reservoir is down pumped transfer would be required; therefore, the SESRO pumping station includes pumps for T2ST. The SESRO design also includes pipelines between the pumping station and the WTW, and the treated water pipeline to the southern edge of the SESRO site (at the main line railway). The T2ST project would design and deliver all works from that point including the railway crossing.

STT Infrastructure

3.8.6 As discussed in Section 2.2, STT is a potential future project and may not go ahead; however, the SESRO project has sought to ensure that it does not prevent STT from being developed if required.

3.8.7 To achieve this SESRO includes a reserved corridor through the SESRO site for STT and a shaft and connecting adit to the SESRO Reservoir Tunnel. This would provide flexibility for STT to utilise the SESRO River Tunnel for discharge (without disruption to SESRO operation during STT construction) if this is confirmed as the preferred option for STT in the future. This would also enable STT water to be used for reservoir refill and for the two projects to share an outfall on the River Thames.

3.9 Opportunities / Future Benefits

3.9.1 Three opportunities for SESRO to deliver shared benefits are listed in the main gate three report: flood defence for Abingdon, support to Wilts and Berks Canal restoration, and use of the reservoir for buffer storage to the wider water resources system.

3.9.2 The potential to support flood defence for Abingdon is discussed below. A corridor for the Wilts and Berks Canal has been embedded in the gate three design and is discussed in Section 3.4. The wider water resources system is not covered in this engineering design report.

3.9.3 In addition to these opportunities, a scoping exercise has been undertaken on behalf of local stakeholders, considering options for how the local flood risk issues in Steventon and East Hanney, associated with the Letcombe Brook and Ginge Brook which are both unchanged by the current SESRO proposals, might be alleviated, potentially using the SESRO site. These discussions are ongoing and will continue as the design for DCO submission is progressed.

3.9.4 Flood alleviation opportunities for Abingdon and the local villages could only be realised through of a multi-agency delivery vehicle with shared funding and additional off-site development.

Flood Storage Reservoir for Abingdon

3.9.5 The Environment Agency has previously carried out a feasibility study for construction of a flood alleviation scheme for Abingdon. This included a flood embankment constructed across the River Ock upstream (east) of the A34, to impound a Flood Storage Reservoir (FSR) which would fill during floods by holding back a proportion of the flood flow and thereby reduce flooding in Abingdon.

3.9.6 The SESRO main access road is proposed to be built on an embankment along a similar alignment to the flood embankment considered in the Environment Agency study. Therefore, there is potentially an opportunity for one embankment to provide both access to the SESRO site and flood storage. This dual-purpose functionality has not been incorporated into the SESRO design at gate three, however flood modelling was undertaken (during gate two) to investigate the opportunity, with further engineering feasibility work undertaken in gate three to help inform discussions with the Environment Agency

3.9.7 The gate three work concluded that it would be technically feasible to adapt the access road embankment to a dual-purpose structure combining the access road with an FSR; however, a combined design would result in additional engineering complexity and has environmental implications that require further investigation.

- The FSR would be an impounding reservoir (i.e, it would form a dam across the River Ock) and it would therefore require a spillway to control the water level of the reservoir. The spillway would release water from the reservoir when the storage capacity is reached, and flood waters continue to flow in from the River Ock catchment. There is potential for vehicular access along the SESRO access road to be restricted when the spillway is active which requires further consideration.
- Combining the two schemes would require alignment and structural changes (to those proposed in Gate 3) to the access road to allow retrofitting of a control structure to limit flows. Such an approach would change the environmental impact of SESRO with regards to the Water Framework Directive (WFD), flood risk, habitat creation and other environmental issues.
- The space taken up by the FSR would not be fully within the current SESRO site and therefore it would also have land and planning implications. The environmental and planning impacts have not been assessed at this stage.

3.9.8 Beyond gate three, the SESRO partners and the Environment Agency will continue to discuss this opportunity, to better understand the issues and benefits. If agreed further exploration of the engineering, cost and environmental implications and the associated integrated consenting strategy will be undertaken.

4 Scheme Delivery

4.1 Construction Activities

4.1.1 The main construction activities required for SESRO are summarised below:

- Mobilisation and enabling works (including service diversions)
- Creation of a railway siding
- Creation of watercourses, floodplain and drainage
- Earth moving to create the borrow pit and embankments, RFS, other components of the landscape scheme and road embankments
- Tunnelling
- Road construction (including road bridges over watercourses etc)
- Concrete works for the operational structures, such as the pumping station
- Mechanical and electrical fit-out
- Building construction and fit-out

4.1.2 The project design is predicated on achieving a balance of cut and fill for the main earthworks to minimise imports for embankment construction (or exports of excavated material); however, imports of construction materials will be required. The following sub-sections describe the main construction materials and material deliveries. Later sub-sections describe the construction process.

4.1.3 Construction activities will require a significant amount of plant and equipment such as dumper trucks, excavators, and cranes of various sizes.

4.1.4 Refer to SESRO gate three supporting document D, Project Management Plan for the expected delivery timeline, including high level construction programme.

4.2 Main Construction Materials

4.2.1 The main construction materials are discussed in the following sections and are summarised in Table 4-1 below. Other materials will be required for mechanical and electrical fit-out and to construct the recreational facilities and landscape scheme.

Table 4-1 – Summary of the Main Construction Materials

Asset	Use	Material	Proposed Transport
Reservoir embankment	Main body of reservoir embankment (structural and landscape fill zones)	Kimmeridge and Gault clay. Lower Greensand, superficial soils, topsoil.	Excavated and transported on site
Reservoir embankment	Filtering and drainage layers	Clean filter sand and drainage gravel	Rail

Reservoir embankment	Embankment inner face erosion protection	Hard, durable graded rock (riprap) overlaying a gravel bedding layer, and a sand filter layer	Rail
Conveyance tunnel	Tunnel and shaft lining	Pre-cast concrete segments	Road
Buildings and structures	Foundations, structures, and contents	In-situ poured concrete, steel reinforcement, other building materials and plant	Road
Roads, cycleways, and footpaths	Road layers	Sub-base / capping layers and asphalt surface	Road
All construction	Operation of construction vehicles	Fuel	Road

Reservoir Earthworks and Internal Filters / Drainage

4.2.2 The vast majority of material excavated on site would be from the reservoir borrow pit and dam foundation stripping, with other volumes associated with the tunnel, pumping station and the RFS areas. All excavated material would be used on site to avoid the need for export and disposal off site.

4.2.3 The excavated fill would be placed in either 'structural' or 'landscape' zones within the reservoir embankment (see Section 3.2, Figure 3-4 for indicative embankments sections), depending on their engineering characteristics. Excavation and placement would be planned so as to minimise haulage distances and avoid double handling (i.e. use of temporary stockpiles).

4.2.4 The reservoir embankments also include filtering and drainage layers consisting of clean filter sand and drainage gravel. These materials are not available for excavation at the site and would be imported to the site by freight train.

Reservoir Embankment Erosion Protection – Riprap and Bedding Layer

4.2.5 Due to the need for the inner face of the embankment to be protected against erosion by waves the design includes a layer of hard, durable graded rock (riprap) overlaying a gravel bedding layer, and a sand filter layer. These materials are not present at the site or in its vicinity in the quantities required. Preliminary investigations have concluded that these materials could be sourced in the UK and brought to the SESRO site by rail in the quantities required.

Concrete

4.2.6 Most of the concrete that would be required for construction of SESRO would need to be poured in-situ. However, some (particularly tunnel lining and shaft segments) could be precast off site and imported.

4.2.7 In-situ concrete constituents (primarily cement, fine aggregate, coarse aggregate, and water) could be imported to the site separately and mixed at an on-site batching plant. Alternatively, concrete would be batched off-site at existing batching plant facilities and delivered by road in standard mixer trucks.

Road Sub-Base / Capping Layers and Asphalt

4.2.8 All new permanent roads and cycle paths would require materials to be imported to the site. Temporary haul roads around the site could be constructed of the same materials or alternatively from roller compacted concrete.

4.2.9 Most road construction would need to be completed during the initial stages of construction before the rail siding and associated materials handling area would be operational. Therefore, most of the materials for road construction would need to be imported by road rather than by rail.

Fuel

4.2.10 Significant imports of fuel would be required for construction of the reservoir, if using diesel-fuelled earthmoving plant. It is anticipated that fuel would be delivered to site in tankers. However, there may be opportunities to use alternatives to diesel powered earthmoving plant, such as electric or hydrogen and the project is continuing to explore this with construction advisors and carbon reduction experts.

4.3 Construction Process

4.3.1 Construction will be a phased process working through mobilisation and enabling works, construction of the main elements of the works and finally filling and commissioning.

4.3.2 The following sections provide a summary of the work required for the key components of the operational reservoir.

Enabling Works and Construction Compounds

4.3.3 At the start of construction enabling works will be undertaken to provide access to the site from the A415 and set up a temporary contractors compound to facilitate construction of the main access road, initial haul roads and establishment of the main construction compound further into the site.

4.3.4 Other enabling works will include environmental and archaeological surveys, service diversions, utility connections, securing the site boundary, site clearance and various other activities.

4.3.5 It is envisaged that construction on the main SESRO site will be accessed from the A415 and haul roads within the site, although temporary access may be required for short periods from other roads and to works outside the main site such as road junction upgrades and new services. The intake / outfall location will have separate construction access.

4.3.6 Additional satellite compounds will be required during the construction works focussed on specific activities such as the rail sidings and intake / outfall structure.

Reservoir Earthworks

4.3.7 The excavation of the borrow pit and subsequent placement of the excavated material to form the reservoir embankments is the most considerable construction activity and would require a large fleet of dumper trucks as well as numerous large excavators, dozers and compaction rollers.

4.3.8 The construction of the reservoir embankment would be undertaken over a number of summer working seasons to avoid the risk of poor winter weather affecting clay handling. It is currently planned to undertake main embankment construction in four earthworks seasons, however this is to be confirmed on completion of further ground investigation, the clay compaction trial and subsequent design development.

Borrow Pit Excavation

4.3.9 The stripping of topsoil and vegetation from the borrow pit would be carried out alongside requirements for archaeological investigations.

4.3.10 The superficial deposits (overburden) encountered within the top of the borrow pit excavation are expected to only be suitable as landscaping fill, whilst the clay strata below would be used for structural fill. A deep working face would be established to allow both to be excavated concurrently as required to suit the embankment construction and reduce the need for double handling.

4.3.11 The borrow pit excavation would need extensive temporary works to control water (keeping it away from working faces and haulage routes) and store it in lagoons for settlement of fines prior to discharge into adjacent watercourses (or use as dust suppressant during construction and if necessary, for earthworks compaction). The settlement ponds would be constructed at the northeast corner of the reservoir and be retained after construction as permanent water features for landscape and biodiversity improvement, and recreation (shown on interim master plan drawing in Appendix A as Recreational Lakes).

Embankment Construction

4.3.12 It is envisaged that the embankment would be constructed with multiple work faces on either side of the start point progressing towards each other. The embankments would typically be constructed from the outside face towards the inside face. This enables the outer landscape fill to be placed first (thereby providing visual and noise barrier benefits, as well as reducing the amount of double handling of superficial deposits).

4.3.13 All fill forming the embankment would be laid in horizontal layers and compacted by appropriate roller plant.

4.3.14 There are two aspects of the embankment which must be constructed of imported material. One of these is the drainage / filter layer against the outer face of the highly impermeable ‘core’ and underneath the downstream shoulder. This must be constructed of suitable sand and gravel, which is not available on site. The other is rip-rap, which consists of angular rock armour placed on the upstream face of the dam to prevent wave erosion (placed on a bed of smaller aggregate, which must also be imported).

4.3.15 It is envisaged that these materials would be imported to site by rail and then transported to the embankment working face via dumper trucks on haul roads. Stockpiling of these materials at the rail siding materials handling area would be necessary given expected difference between delivery timing (all year) and placement timing (summer only). Most drainage material would be required towards the start of the embankment construction, with more rip rap needed towards the end.

Reservoir Towers

4.3.16 The gate three design includes three towers, a larger diameter main tower and two smaller diameter towers. The main tower will include a superstructure at the top to house equipment.

4.3.17 The towers would be formed of reinforced concrete, cast in-situ using either slip forming or jump forming techniques. The volume of concrete and steel in the tower is the same irrespective of construction method. It is likely that the two smaller towers would be constructed in sequence, so formwork can be re-used, and peak batching rates minimised.

River Intake/Outfall Structure

4.3.18 The river intake/outfall structure would primarily be a reinforced concrete structure on the right bank of the River Thames with a below ground shaft, an above-ground building for control equipment and plant, and screens in the river for the intake.

4.3.19 Construction works would be within the floodplain and measures would therefore be required to protect against fluvial flooding inundation of the site. Cofferdams and dewatering would be required along the river front surrounding the in situ concrete works and around the shaft so that the works could be constructed safely. The cofferdams would likely be constructed from sheet piles.

4.3.20 The buried circular shaft behind the river intake / outfall structure which connects to the conveyance tunnel would either be formed of a precast concrete segmental wall or in-situ spray concrete lined (SCL) shaft, both methods would require an in-situ concrete base. The TBM would drive from the pumping station to the river and be lifted out of the shaft on completion of the conveyance tunnel. At least one crane will be required at the intake / outfall site to support construction and facilitate lifting out of the TBM, at times there may be a need for two. It is likely that lifting the TBM will be a special lift requiring laydown area for a larger crane that the one for day to day use.

River Tunnel

4.3.21 This section of tunnel would be excavated by a TBM, which would be installed within the SESRO pumping station and driven towards the shaft at the river intake / outfall structure. The excavated clay material from the tunnel would be from the same formation as that encountered in the reservoir's borrow pit and would be used in the embankments as landscape fill.

4.3.22 As is normal for tunnelling operations, the underground work would be expected to progress on a 24-hour, seven day working pattern. As the TBM advances, pre-cast concrete tunnel lining segments would be installed around the tunnel perimeter and bolted together. The tunnel would have an additional secondary cast in-situ lining for approximately 1.4km at the eastern end to enhance durability. This would be poured in-situ in rings after the tunnelling is complete.

Reservoir Tunnel

4.3.23 This section of the tunnel would link the pumping station that sits just outside the toe of the embankment to the tower within the footprint of the reservoir. The tunnel would be constructed by excavation of the clay and a sprayed concrete primary lining rather than use of a TBM. A secondary lining would be cast in-situ throughout. From the portal used to construct the SCL tunnel there would be a cut and cover section of tunnel to form the connection with the main tower.

4.3.24 The tunnel could be driven in either direction, with the excavated clay placed within the reservoir embankment.

4.3.25 When tunnelling is complete pipework will be installed to connect the pumping station to the towers. The intended installation method is an entirely welded pipeline, with pipe segments welded within the pumping station basement then pushed forward via hydraulic jack into the tunnel. Within the tunnel the pipes will be mounted on roller type supports, to facilitate the original push type installation.

Pumping Station

4.3.26 As described in Section 3.3 the pumping station is proposed to be constructed as three 50m diameter interlocked cells or shafts formed by 1.2m thick diaphragm walls. Diaphragm walls are an efficient way to create large open excavation supports such as the pumping station without the need for interlocking or contiguous piling. During wall construction continual access for concrete deliveries will be required.

4.3.27 At the locations where the cells interlock, it is proposed to include approximately 37m long horizontal reinforced concrete props at top and intermediate levels. Construction will be top-down, installing the permanent props as the cells are excavated to approximately 19-20m depth. From this level a reinforced concrete base slab would be cast, which would require 25m deep barrettes to help resist uplift pressures.

4.3.28 Once the main pumping station structure is constructed it will be used as the starting point for the TBM drive. The excavated material from pumping station and tunnel construction would be used on site as embankment or landscape fill.

4.3.29 When tunnelling is complete any further work needed to the civil structure would be undertaken (some elements may be prefabricated or precast) followed by installation of pumps, valves, and pipework.

Rail Siding

4.3.30 Construction of rail siding will require modifications to the existing mainline railway systems such as signalling, embankment construction, construction of new track to extend the existing four track section of mainline railway and deliver the SESRO railway siding, and construction of a materials handling area.

4.3.31 This requires close working with Network Rail and temporary possessions of the existing track during construction. The project is working with Network Rail to develop the approach to this element of the design and construction.

5 Future Scheme Development

5.1 Design Review and Assurance

5.1.1 Reservoir and tunnel engineering has been overseen throughout gate three development by an independent panel of accredited engineers, the Reservoir Advisory Panel (RAP). The panel has met regularly with the design team to discuss the design approach and solutions. In August 2024 this was supplemented by appointment of a Construction Engineer for the project under the Reservoirs Act 1975. The designers have sought consensus with the RAP and Construction Engineer on key engineering design decisions.

5.1.2 Further design oversight has been provided through technical reviews during 2024 and through assurance activities for this gate three submission. External technical assurance has been undertaken on the gate three design. Comments arising from the assurance process have either been taken into account in the design or included in the next steps identified later in this section.

5.2 Conclusion

5.2.1 This basis of design report describes the status of SESRO design development at gate three. One further gate was described by Ofwat in the PR19 determination (gate four – planning applications, procurement, and land purchase), and the project will continue to progress towards gate four, DCO submission and preparation for procurement, pending feedback from RAPID on the gate three submission.

5.2.2 The DCO process (and other associated requirements such as those under the EIA regulations, rules relating to the compulsory acquisition of land etc.) has specific requirements around consultation and documentation for submission to DCO Examination.

5.2.3 The scheme is also progressing towards procurement through the Water Industry (Specified Infrastructure Projects) (English Undertakers) Regulations 2013 (SiPR) route, which requires regular submissions to Ofwat describing progress and the status of market engagement activities. Further design development will support this process.

5.2.4 The SRO gates, DCO process and preparation for procurement are progressing in parallel and further design development needs to: provide an appropriate level of detail to satisfy RAPID that the project should progress through the gates; deliver data to the wider project team for planning and environmental assessment; and create sufficient project definition to inform tender documentation. There will be a continued drive to reduce uncertainty and understand risk in cost estimates, and to ensure that safety (during the lifecycle of the scheme) is considered at every stage of design development.

5.2.5 The following sections outline key activities for future scheme development. Refer to the main gate three report and supporting document D, Project Management Plan for further information about the timeline for future activities. The next public facing iteration of the design is expected to be published for public consultation in 2025.

5.3 Next Steps

5.3.1 The project will progress towards DCO, RAPID gate four and procurement, and design development activities will continue commensurate with the requirements of these processes. Specific design activities include but are not limited to the following:

- Ground investigations and a clay compaction trial are ongoing and the engineering design will be updated in response to the interpretation of this work.
- Other ongoing survey work will inform updates to fluvial and groundwater modelling to increase certainty in the design for flood mitigation.
- Ongoing environmental survey work will inform updates to design of environmental mitigation such as noise bunding and habitat creation.
- Discussions will continue with the Environment Agency about various aspects of the project including intake screens, flooding, WFD watercourses and the design will be updated as appropriate.
- Public consultation was undertaken in summer 2024 and the feedback from the consultation will inform updates to the design, particularly in relation to the master plan.
- An EIA Scoping Opinion has been provided by PINS and the impact on design is currently being assessed.
- Further design work will be undertaken in relation to active travel and public rights of way connectivity.
- The recreational strategy will be further developed to confirm the approach to recreational buildings and facilities.
- A coherent site wide architectural concept will be developed.
- Further work is being undertaken on potential for renewable energy generation that will inform design development.
- Continued engagement with highway authorities and development of junction upgrade designs.
- Continued work with Network Rail to develop the rail siding design.
- Continued work with utility suppliers in relation to utility diversions and new services for construction and operation.
- Continued working with other related projects, particularly T2ST, to ensure that the project designs are aligned and integrated.
- Continued multi-disciplinary design work to create a fully integrated design for SESRO that is aligned to our design principles and delivers our design vision (which may also evolve): *"We will deliver a reservoir for the south-east*

which will help to protect customers, communities, and the environment from drought. We will provide a safe, sustainable, and resilient water supply for future generations whilst delivering new high-quality spaces for nature and recreation, creating a lasting legacy for communities and the environment."

Appendix A – Interim Master Plan Drawing

Legend
Existing:
Public rights of way
Woodland in the wider landscape
Woodland to be retained as far as practicable
Scrub to be retained as far as practicable
Hedgerow to be retained as far as practicable
Hedgerow with trees to be retained as far as practicable
Tree belt to be retained as far as practicable
Watercourse to be retained
Water body to be retained
Proposed:
Reservoir water extent
Indicative replacement floodplain storage
Inner toe of reservoir embankment and borrow pit contours
Indicative embankment and bund contours
Corridor for potential future canal diversion
Indicative vantage point with seating area for views towards North Wessex Downs National Landscape and/or limestone ridge
Public rights of way or permissive paths
Car park with hardstanding
Car park with reinforced grass
Visitor centre
Cafe
Education centre
Water sports centre
Recreational facility
Operational facility
Proposed:
Watercourse diversion
Watercourse realignment
Wetland ditch
Embankment toe-drain/perimeter ditch
Wetland habitat mosaic with reeds, species rich wet grassland and floodplain marsh
Floating island
Wildlife ponds, scrapes and pools
Great crested newt habitat pond
Recreational lakes
Marginal habitat
Species-rich native hedgerow
Species-rich native hedgerow with trees
Existing hedgerow to be retained as far as practicable and enhanced
Existing hedgerow with trees to be retained as far as practicable and enhanced
Existing tree belt to be retained as far as practicable and enhanced
Pasture for sheep grazing
Species-rich neutral grassland
Scrub
Intermittent trees and shrubs
Woodland and copse
Wet woodland
Land to be reinstated and returned to agriculture
Land to be reinstated to existing use
MAIN SHEET
Caldecott
INTAKE/OUTFALL STRUCTURE
Abingdon Sewage Treatment Works
CONVEYANCE TUNNEL (INCLUDING EMERGENCY DISCHARGE)
Drayton
B4017
ALTERNATIVE INDICATIVE LOCATIONS FOR THAMES TO SOUTHERN TRANSFER WATER TREATMENT WORKS AND TEMPORARY COMPOUND
Marcham
ALTERNATIVE EDUCATION CENTRE LOCATION
CAFE NEXT TO RECREATIONAL LAKES
Bird hides may be incorporated within the wetland area.
PUMPING STATION
RECREATIONAL FACILITIES ASSOCIATED WITH LAKES
Marcham Road
A34
Abingdon
River Ock
SESRO MAIN ACCESS ROAD
Characteristic pattern of wide verges with ditches for road drainage and hedgerows with standard trees to be included along the access road.
INSET A
CONVEYANCE TUNNEL (INCLUDING EMERGENCY DISCHARGE)
A338
Series of linked ponds, scrapes and backwaters to be created within existing floodplain, to include an informal network of footpaths and platforms for pond dipping (catching and studying pondlife) to provide biodiversity enhancements and an educational and recreational resource.
Wet woodland proposed adjacent to existing watercourse and tree belt with an ancient and several veteran trees (as shown on the Woodland Trust Ancient Tree Inventory). To be established through strategic tree planting and natural regeneration.
Childrey Brook
Disclaimer
The indicative proposals illustrated on this drawing, including potential locations of operational and recreational facilities, is subject to consultation, stakeholder engagement and further design development.
Green infrastructure proposals along the northern fringe to align with the Ock Valley Blue Corridor ambitions, set out in the South & Vale Green Infrastructure Strategy. Key opportunities for strategic green infrastructure enhancement, linkage and creation to be explored.
Enhancements to public rights of way network with proposed public rights of way or permissive path links, including along the alignment of the corridor for potential future canal diversion. This would improve accessibility within this strategic green infrastructure corridor.
Bird hides may be incorporated within the wetland area.
Existing hedgerow along A338 to be retained and enhanced.
Wetland lagoons with marginal habitat and wet woodland for biodiversity and visual amenity enhancement.
INDICATIVE MINOR CAR PARK WITH RESTRICTED ACCESS
Steventon Road
East Hanney
Hedgerows, small woodlands and woodland copses proposed on reservoir embankments for habitat connectivity and to help to integrate the embankments into the surrounding landscape.
STEVENTON TO EAST HANNEY ROAD DIVERSION
Letcombe Brook
RESERVOIR TOWERS WITH CONNECTING PIPE LAID ON RESERVOIR FLOOR
SIPHON PIPES BURIED UNDER SURFACE OF DAM
CAFE NEXT TO RESERVOIR
MAIN VISITOR CAR PARK
Bridleway access across A34 retained for walkers/wheelers, cyclists and horse-riders. (No public vehicular access).
ALTERNATIVE VISITOR CENTRE LOCATION
ALTERNATIVE VISITOR AND EDUCATION CENTRE LOCATION
ALTERNATIVE OPERATIONAL ACCESS ROAD (No public vehicular access).
ALTERNATIVE WATER SPORTS CENTRE LOCATIONS. Limited associated secured and monitored car parking accessed via controlled barrier.
POTENTIAL EXTENSION OF ACCESS ROAD TO ALTERNATIVE WATER SPORTS CENTRE
Steventon Substation
Natural play features to be incorporated along trails.
Hanney Road
Steventon
INDICATIVE MINOR CAR PARK WITH RESTRICTED ACCESS
Great Western Main Line Railway
Notes
1. Key infrastructure and recreational facilities are labelled in capitals.
2. Refer to J696-AJ-A02X-ZZZZ-DR-EN-100034, J696-AJ-A02X-ZZZZ-DR-EN-100035 and J696-AJ-A02X-ZZZZ-DR-EN-100036 Interim Landscape and Environmental Master Plan Indicative Embankment Cross Sections (Sheet 1 to 3).
Copyrights
Based on the Ordnance Survey Map with the Sanction of the Controller of H.M. Stationary Office License Number - 100019345. Unauthorised reproduction prohibited. Crown Copyright Reserved.
Do not scale - if in doubt ask
NOT TO SCALE
CURRENT REVISION INFORMATION
This drawing is based on the preferred project configuration with a below ground emergency discharge through the reservoir conveyance tunnel.
C01 A1 Authorised and accepted for consultation DR LD DS 10/05/24
Affinity Water
WATER for LIFE
Southern Water
N/A
Public
Abingdon
South East Strategic Reservoir Option (SESRO)
INTERIM LANDSCAPE AND ENVIRONMENTAL MASTER PLAN WITH BELOW GROUND EMERGENCY DISCHARGE TUNNEL
A1 - 1:10,000 A3 - 1:20,000 A1
A1
J696-AJ-A02X-ZZZZ-DR-EN-100020
C01

It's everyone's water

Taking care of your water