Annex A1: Teddington DRA Gate 3 Conceptual Design Report

J698-AJ-C01X-TEDD-RP-ZD-100001

Standard Gate three submission for London Water Recycling SRO

Notice – Position Statement

This report has been produced as 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 a 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.

Disclaimer

This document has been written in line with the requirements of the RAPID Gate 3 Guidance and to comply with the regulatory process pursuant to Thames Water's statutory duties. The information presented relates to material or data which is still in the course of completion. Should the solutions presented in this document be taken forward, Thames Water will be subject to the statutory duties pursuant to the necessary consenting process, including environmental assessment and consultation as required. This document should be read with those duties in mind.

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1 Executive Summary

1.1.1 This report sets out the conceptual design for the Teddington Direct River Abstraction (DRA) (the Project). The Project has been identified as the best value option in Water Resources South East (WRSE) revised draft regional plan (August 2023) and Thames Water Utilities Ltd (Thames Water)'s Water Resources Management Plan 2024 (WRMP24) issued in October 2024.

1.1.2 The Project has been developed as a part of the London Water Recycling Strategic Resource Option (SRO) and have been assessed through the gated process by the Regulators' Alliance for Progressing Infrastructure Development (RAPID). The SRO gated process by RAPID, working alongside the regional planning stakeholder groups, is providing regulatory oversight of a set of regional water resource management plans that adopts consistent assumptions to form a nationally coherent view.

1.1.3 The Project currently forms a preferred solution option in Thames Water's adopted Water Resource Management Plan 2024 and an application for a Development Consent Order (DCO) is being prepared in accordance with Planning Act 2008.

1.1.4 Design elements in this report are listed below:

- 75 Ml/d Tertiary Treatment Plant at Mogden STW (WRSE Ref. TWU_KGV_HI-RAB_teddington dra 75)
- Recycled Water Transfer Tunnel from Mogden STW to the River Thames upstream of Teddington Weir and discharge (WRSE Ref. TWU_WLJ_HI-TFR_teddingtondramog/ted)
- Abstracted Raw Water Transfer from the River Thames to Thames Lee Tunnel (WRSE Ref. TWU_KGV_HI-TFR_teddingtondrated/tlt)

Table 1.1 Project Summary

Name	Teddington DRA
Gate-3/ WRSE Reference	TWU_KGV_HI-RAB_teddington dra 75 TWU_KGV_HI-TFR_teddingtondrated/tlt TWU_WLJ_HI-TFR_teddingtondramog/ted
Project Type	Resource and Conveyance
WRZ	London. Potentially, Affinity Water's WRZ if Teddington DRA supplies water to Thames to Affinity Transfer (T2AT) SRO.
Engineering Scope	A portion of final effluent from Mogden STW would undergo treatment at a new Tertiary Treatment Plant (TTP) within the Mogden STW boundary, sufficient to allow discharge into the river. The recycled water would then be transferred to a new outfall location on the River Thames, upstream of Teddington Weir. The new River Thames Direct River Abstraction would be located upstream of the recycled water discharge location and would connect into the Thames Lee Tunnel

Name	Teddington DRA
	(TLT) which will convey the raw water to the Lee Valley reservoirs in East London.
Benefit	67Ml/d Dry Year Annual Average (DYAA) and Dry Year Critical Period (DYCP) Deployable Output for the capacities of 75Ml/d
Mutual exclusivities	The cumulative sum of final effluent abstraction for Teddington DRA and Mogden Water Recycling scheme cannot exceed the available final effluent flow at Mogden STW as both schemes use Mogden STW final effluent as a water source (Mogden Water Recycling is not selected as a part of the preferred options).

2 Introduction

2.1 Background

2.1.1 Thames Water Utilities Limited (Thames Water) is engaged in the development of Strategic Regional Water Resource Options (SROs) under the guidance of the Regulators' Alliance for Progressing Infrastructure Development (RAPID). RAPID was formed to help accelerate the development of new water infrastructure and design future regulatory frameworks, with collaboration between Ofwat, the Environment Agency (EA) and the Drinking Water Inspectorate (DWI).

2.1.2 London Water Recycling has been identified as an SRO in the Price Review 2019 (PR19) Final Determination (London Water Recycling SRO – formerly, London Effluent Reuse SRO). At PR19, Ofwat announced a development fund for strategic water resource solutions linked to "Gates" to ensure efficient delivery and to protect customers. Thames Water has been allocated funds to investigate and develop integrated strategic regional water resource solutions, including London Water Recycling SRO to support long-term resilience. The London Water Recycling SRO solution was submitted for the standard Gate 1 and Gate 2 assessment by RAPID, and it has been funded to Gate 3 for further design development.

2.1.3 London Water Recycling SRO incorporates three schemes in Gate 3: a direct river abstraction scheme (Teddington DRA) and two schemes for water recycling of final effluent from Mogden STW and Beckton STW (Mogden Water Recycling scheme and Beckton Water Recycling scheme, respectively). Teddington DRA (the Project) will treat final effluent from Mogden STW in a new tertiary treatment plant (TTP), while, in the case of Mogden Water Recycling or Beckton Water Recycling, final effluent from Mogden STW or Beckton STW is to be treated in each case through an Advanced Water Recycling Plant (AWRP) and discharged to the River Thames or the River Lee Diversion to augment flow in the rivers for abstraction.

2.1.4 Teddington DRA has been identified as the best value option in Water Resources South East (WRSE) revised draft regional plan (August 2023) and Thames Water's Water Resources Management Plan 2024 (WRMP24) issued (as final and accepted by DEFRA) in October 2024. The Project was selected as one of the new water resource options to supply water by the early 2030s to meet the region's resilience to 1-in-200year drought level. WRMP24 identified Beckton Water Recycling scheme as an alternative in the adaptive plans, should Teddington DRA be found to be not feasible.

2.1.5 Teddington DRA is therefore the preferred solution option of the London Water Recycling SRO. In Gate 3, the Project has been further developed to prepare for its Development Consent Order (DCO) application required in accordance with the Planning Act 2008.

2.1.6 This report sets out the evolution of design for Teddington DRA. The proposal for the Project can be summarised as:

- A portion of final effluent from Mogden STW would be subject to treatment at a new Tertiary Treatment Plant (TTP) located at Mogden STW. The recycled water would be transferred to a new outfall on the River Thames upstream of Teddington Weir.
- A new abstraction from the River Thames, upstream of the recycled water discharge location, would transfer water into the Thames Lee Tunnel (TLT) for transfer to the Lee Valley Reservoirs in East London.

2.1.7 Definitions of glossary and abbreviations in this report can be found in section “Acronyms and Glossary

2.2 Project Overview and Location

2.2.1 Figure 2.1 shows overview of Teddington DRA. The Project will abstract a proportion of final effluent at Mogden STW. The abstracted final effluent would be treated in a new Tertiary Treatment Plant (TTP) within Mogden STW boundary, and recycled water from the TTP would be conveyed and discharged into the River Thames just upstream of Teddington Weir which marks the river's tidal limit. The same quantity of water will be abstracted from the River Thames immediately upstream of the discharge location, and abstracted water would be transferred into a shaft connecting into the Thames Lee Tunnel (TLT) which crosses the River Thames. The TLT will convey flows to the Lee Valley Reservoirs, including Lockwood Reservoir.

2.2.2 Tertiary treatment is required to improve the effluent quality prior to discharge to the non-tidal section of the River Thames, upstream of the Teddington Weir. The discharge location of the recycled water will be in the furthest downstream reach of the non-tidal river, as well as being downstream of all the other existing Water Treatment Works (WTW) intake points. The tertiary treatment process would focus on achieving water quality consent parameters suited to ‘receiving water’ environmental quality requirements for discharge to the freshwater River Thames and not Drinking Water Standards. The addition of ferric sulphate for phosphorus removal, Moving Bed Biofilm Reactor (MBBR) for further ammonia reduction and mechanical filters for Biological Oxygen Demand (BOD) and solid removal is proposed for the tertiary treatment. Wastewater from the TTP process would be returned to the Mogden STW inlet works.

2.2.3 There is minimal vacant land available within the Mogden STW site for the proposed development. It is currently proposed that a new platform would be built above some of the existing storm tanks to facilitate the new processes for the TTP and a section of existing embankment near the storm tanks would be cut back and stabilised with retaining walls to create space for ancillary infrastructure.

2.2.4 The Project will supply the London Water Resource Zone (WRZ). The Project would directly benefit East London raw water storage through the transfer of supplementary flows through the TLT. This reduces the abstraction rates at Hampton and therefore allowing abstractions to West London reservoirs to be maintained. Consequently, the Project benefits the whole London WRZ.

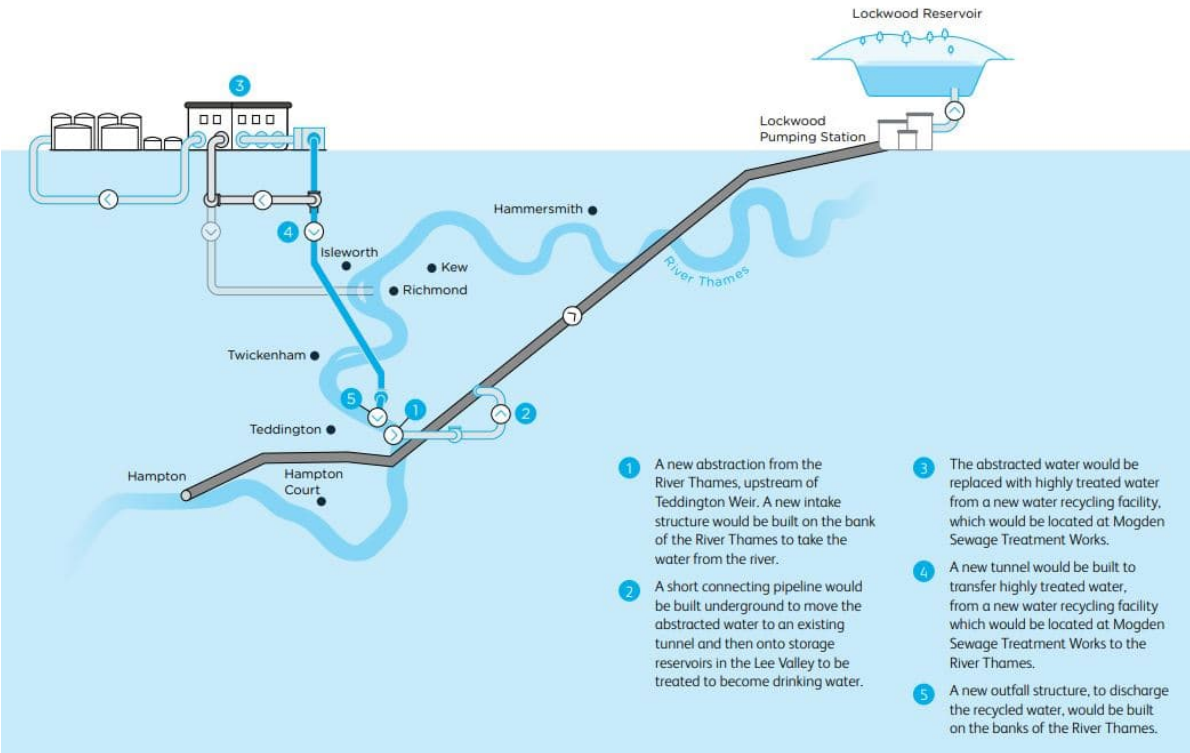


Figure 2.1 Teddington DRA Project Overview

2.3 Gate 3 Design Development

2.3.1 The key design changes from Gate 2 to Gate 3 are described in the following section and summarised in Table 2.1.

Table 2.1 Key Design Changes from Gate 2 to Gate 3

Gate 2 Conceptual Design	Gate 3 Conceptual Design
Environmental studies during Gate 2 showed impacts on river temperature would be acceptable up to the size of 100Ml/d. Maximum size of 100Ml/d was recommended.	The maximum size of Teddington DRA is proposed to be 75Ml/d in agreement with the EA to minimise potential detriment to the river.
TTP assumed two sub-options for different capacities (i.e. 50Ml/d and 75Ml/d). A project greater than 75Ml/d was assumed to be a combination of these sub-options.	A single-phased project with a capacity of 75Ml/d was selected as the best value option. Multi-phased development is no longer considered.
A 1.8m-diameter tunnel with 8 shafts was proposed for recycled water transfer from	A 3.5m-diameter tunnel with 4 shafts is proposed for recycled water transfer from

Gate 2 Conceptual Design	Gate 3 Conceptual Design
Tertiary Treatment Plant in Mogden STW to the discharge upstream of Teddington Weir.	Mogden STW to the discharge upstream of Teddington Weir.
Ferric dosing, Nitrifying Sand Filters (NSF) and Mechanical Filters (MF) were proposed for treatment of final effluent to generate recycled water.	Moving Bed Biofilm Reactor (MBBR) is proposed instead of NSF.
Recycled water generated in TTP during non-drought period (no more than 25% of full treatment capacity) was assumed to be discharged through the new outfall upstream of Teddington Weir.	Recycled water generated in TTP during non-drought period (approximately 15Ml/d) would be discharged through the existing Mogden STW outfall at Isleworth Ait, which is in the tidal reach of River Thames.

Project Size

2.3.2 Following consultation on the draft Water Resources Management Plan 2019 (dWRMP19), a Statement of Common Understanding between Thames Water and the Environment Agency was published stating that Water Framework Directive (WFD) compliance of a 300Ml/d Teddington DRA scheme was uncertain primarily due to potential temperature impacts and therefore the scheme was not environmentally promotable at that time. In the Statement, Thames Water committed to undertake further research into the sensitivity of the Lower Thames ecosystem to smaller DRA discharges and viable mitigation approaches.

2.3.3 As part of the RAPID SRO Gate 1 work and taking account of the dWRMP19 findings and the Statement of Common Understanding, the London Water Recycling SRO has assessed a Teddington DRA scheme in size increments of 50Ml/d and 75Ml/d up to a largest size of 150Ml/d. Based on further work completed and reported at Gate 2 in November 2022, Thames Water investigated and rejected options greater than 100Ml/d due to the continued potential risk of not complying with WFD objectives and Environment Agency guidance.

2.3.4 At the end of 2022, Thames Water issued its dWRMP24 for consultation which included Teddington DRA at 75Ml/d.

2.3.5 Thames Water's WRMP24 was approved on the 4 September 2024 by the Secretary of State for the Environment, Food and Rural Affairs. On reaching the decision to approve Thames Water's plan, the Secretary of State concluded that there is a strategic need for major projects including this Project.

Design Refinement

2.3.6 Feedback from stakeholders and the non-statutory public consultation (on the conveyance route and site options held in Autumn 2023) are reflected where feasible in the Gate 3 refined design. Some of the design opportunities identified in Gate 2 were also incorporated into the design.

2.3.7 For example, a smaller-diameter conveyance option (i.e. 1.8m internal diameter tunnel with eight shafts) for recycled water transfer had been considered in Gate 2. Assessments of alternative tunnel diameters and construction techniques have been undertaken to address key concerns from the communities during non-statutory public consultation in Autumn 2023. The refined designs propose a 3.5m internal diameter tunnel with four shafts for recycled water transfer. These changes enable a reduction of shaft sites and construction activities along the route.

2.3.8 In Gate 3, a process technologies optioneering study for the TTP was undertaken. The use of Moving Bed Biofilm Reactors (MBBR) technology was proposed instead of NSF to provide more robust treatment. MBBR would provide better performance when ammonia levels are very low or high. Bench and pilot plant testing using Mogden STW final effluent is currently being undertaken to confirm performance of the proposed technologies.

2.3.9 The Gate 2 design assumed deepening some of the existing storm tanks in Mogden STW, which would allow the storage capacity of the storm tanks to be maintained on a smaller footprint, thereby freeing up land for the new construction of the TTP. To reduce the impacts on the existing storm tanks the Gate 3 design proposes that the TTP would be constructed on a new platform built above the existing storm tanks. It is also proposed that the existing embankment to the east of the storm tanks would be cut back from the site road and stabilised by retaining walls to create space for some of the ancillary infrastructure.

2.3.10 The Gate 2 Conceptual Design considered that the TTP would be operated at 25% of full treatment capacity during non-drought period to enable timely re-commissioning at the beginning of drought periods. This flow was proposed to be discharged through the new outfall upstream of Teddington Weir. However, in Gate 3, it is proposed that the recycled water would be discharged through the existing Mogden STW outfall to the tidal reach of the River Thames approximately at 15Ml/d during non-drought period. This will improve water quality in Mogden STW final effluent discharged to the river.

Sizing and Phasing

2.3.11 In Gate 3, it is proposed that the maximum size of Teddington DRA will be 75Ml/d and the Project will be developed in a single phase.

2.3.12 Gate 2 environmental investigations concluded that the size of up to 100Ml/d would comply with Water Framework Directive (WFD) objectives and Environment Agency guidance and that impacts on river temperature would be acceptable.

2.3.13 The further studies and modelling have shown only marginal increased environmental risks associated with the 100Ml/d option compared to the 75Ml/d option. However, Thames Water and the Environment Agency settled on a maximum size of Teddington DRA would be 75Ml/d to further minimise the impact to the river at this location.

2.3.14 A 50Ml/d and a 75Ml/d TTP had been considered in the WRSE best value assessment, and a 75Ml/d project was selected to supply water to the region by early 2030s. Therefore, a 50Ml/d sub-option is not being developed further. In addition, multi-phased future development is not expected as the maximum project size is limited to 75Ml/d.

2.3.15 The size of the 3.5m internal diameter recycled water transfer tunnel is required to minimise the number of tunnel shafts and to mitigate impacts on the communities from the construction work.

Constraints Impacting Solution Sizing and Phasing

2.3.16 The key constraints impacting the solution sizing or phasing are:

- **Increases to receiving water body temperature:** Gate 2 environmental assessment identified that temperature increases to the receiving water body during periods of operation constrained the size to 100Ml/d or below, while discharge velocity does not appear to be a constraining factor. In Gate 3, Thames Water and the EA jointly agreed that the maximum size of Teddington DRA would be 75Ml/d to minimise any environmental impacts on the River Thames at this location.
- **Availability of land at Mogden STW for development:** The site is very developed with little available land. A multi-phased development of TTP is challenging due limited space in the STW.
- **Availability of land for conveyance and tunnel shafts:** The nature of the urban, sub-urban environment, and designated sites limits open-cut trenching pipeline options and constraints the potential shaft locations. The diameter of Recycled Water Transfer Tunnel is dictated by the requirements to minimise the number of shafts and health and safety requirements rather than flow capacity of the tunnel.

2.4 Links with Other Options and Elements

Dependencies

2.4.1 Gate 2 investigation suggested potential benefits from a combination of Teddington DRA and TLT extension (i.e. a 3.5m internal diameter tunnel from Lockwood Reservoir Pumping Station to King George V Reservoir (KGV) proposed in the Beckton Water Recycling scheme). However, a Gate 3 modelling study showed no significant drought resilience benefit from this combination, although there may be a wider service resilience benefit. Therefore, these two options are considered to be independent.

Mutual Exclusivities

2.4.2 Teddington DRA and Mogden Water Recycling both propose final effluent of Mogden STW as a water source. Therefore, a sum of final effluent abstraction for the two schemes cannot exceed the available Mogden STW final effluent flow. Assessment of final effluent availability can be found in “Assessment of Source Flow Availability” in section 3.2. Mogden Water Recycling scheme is currently not selected as the preferred option.

3 Conceptual Design

3.1 Site Specific Design Vision and Design Principles

3.1.1 The conceptual design of Teddington DRA has been developed and refined since Gate 2 and following non-statutory public consultation and engagement through Gate 3. The latest design has been developed in accordance with the All Company Working Group (ACWG) publication on Design Principles and Thames Water are following a staged design process through the consenting, procurement, construction and operational stages of the Project.

3.1.2 The approach to design to Gate 3 has been to undertake site optioneering (Stage A), identify a preferred suite of infrastructure sites, test these and the conceptual design through consultation (Stage B), update the design and seek a Scoping Opinion on a single preferred design (Stage C) that is considered likely to achieve consent. Table 3.1 summarises the key activities undertaken against the five ACWG design principles themes.

3.1.3 Table A.1 (Appendix A) attached to the end of this report lists the “ACWG Design Principles”, “Targets” and “ACWG Gate 2 indicators” set out by ACWG, as well as details of activities taken in Gate 3. The ACWG Gate 2 indicators have flexibilities and some of the activities are expected to be completed either during Gate 2 or Gate 3.

3.1.4 Through Gate 3 Thames Water have appointed a project level design champion and embedded ‘good design’ within the activities undertaken which has included maximising opportunities within site layout, landscaping, landform, and integrating biodiversity and conservation interests within the design whilst ensuring safety and function.

3.1.5 Thames Water have developed a Project design vision which captures the ambitions for the Project as follows:

“Teddington DRA aims to create a sustainable and forward-thinking approach to water resilience for customers in London. The Project addresses London supply challenges by providing a new source of water using innovations in water treatment technology, integrating with existing infrastructure and leaving a positive legacy that offers environmental protection and enhancement”.

3.1.6 Design evolution is an iterative process and Thames Water will develop Project specific principles as the design matures and in response to feedback from stakeholders. Early in 2025 Thames Water intend to appoint an independent design panel to review our approach to design and ensure Thames Water maximise design opportunities while developing the design for DCO planning (Stage D).

Table 3.1 Teddington DRA, Gate 3 design principles key activities

ACWG Design Principles	Teddington DRA Gate 3 Design Principles Activities
Cross Cutting Design Principles 1. Be specific: Develop project-specific design vision and principles based on an understanding of the objectives of each project and the people and places it will affect.	Design vision for the Teddington DRA has been developed reflecting Thames Water's ambition for the Project, aligned to the ACWG and National Infrastructure Commission design principles. The development of the Project in Gate 3 has been undertaken in accordance with the principles of: Climate, People, Place and Value, further details of which are provided below.
Cross Cutting Design Principles 2. Safe and well: Actively and collectively develop designs that can be built, used, and maintained without unacceptable risks to the health and safety of workers - particularly during hazardous construction and operational activity. Manage risks to members of the public thoughtfully with an approach that balances maximising wellbeing benefits with protection from risks that could cause significant harm.	During Gate 3 further assessments and investigations have been undertaken to inform design development that will help manage risks to workers and the public during the construction and operation of the scheme. This has included intrusive ground investigation, process pilot plant testing, obtaining utility and unexploded ordnance (UXO) information. CDM Principal Designers have been appointed in Gate 3 in accordance with the CDM Regulations 2015. Design development during Gate 3 including amending the tunnelling technique from Gate 2, which proposed pipejacking, to the use of a tunnel boring machine (TBM). This change has reduced the need for intermediate shafts to a single shaft, reducing interactions and associated risks, in the public realm from construction of the Project. Drinking Water Safety Plans have been updated to ensure the customer's and environment's safety is paramount for the design vision.
Climate 1. Nature knows no boundaries: Water is essential to all life and managing our response to climate change is a collective and urgent activity. Projects must be developed to work across companies and/or legislative boundaries to develop sustainable solutions and environmental enhancement for the wider benefit of society. 2. Resource and carbon efficient throughout: Projects shall seek to reuse existing assets, eliminate waste (including waste of water) and make efficient use of materials and transport across the whole of the project lifecycle.	During Gate 3 discussions and workshops have been held with the Local Planning Authorities and the Environment Agency which have considered the baseline environment and potential mitigation and habitat enhancement measures. Thames Water is committed to meet 10% Biodiversity Net Gain (BNG), in accordance with the requirements of the Environment Act 2021. A key design principle of the Project involves the co-location of the TTP with existing facilities at Mogden STW. In addition, design development in Gate 3 proposes the further use of infrastructure assets with the TTP maintenance flow being confirmed as utilising

ACWG Design Principles	Teddington DRA Gate 3 Design Principles Activities
3. Resilient and adaptable: Design for anticipated future demand at the appropriate scale. Build in the resilience to absorb and recover from the impacts of the extreme events and incremental stresses likely to arise from climate change.	the existing final effluent discharge pipeline and outfall at Isleworth Ait. An updated cost and carbon report is provided in Annex A2 of the Gate 3 submission. This report includes analysis of the design change in the construction of the tunnel and includes a whole-life carbon mitigation assessment carried out based on the PAS 2080:2023 guidance and principles. The capacity of the Project has been determined based on drought conditions/ scenario with the need for the Project accepted by the Secretary of State via the adoption of Thames Water's Water Resources Management Plan 2024. The scheme would provide a secure flow in drought conditions. Both carbon and climate resilience are matters considered within the EIA Scoping Report and proposed to be scoped into the full environmental assessment
People 1. Understand and respond to your Community's needs: Develop a full understanding of the social context that will be impacted by the project over its lifecycle. Design for how local communities will encounter the infrastructure in their everyday lives during both construction and operation. 2. Engage widely, early and meaningfully: Work with stakeholders and local communities to develop their understanding of the importance of nature and water conservation. Develop co-design approaches to aspects of the design of infrastructure and associated landscape where practicable. 3. Improve access and inclusion: Consider how people move around your works. Maximise opportunities to support active travel and improve recreational access to waterside and green spaces that can improve outcomes for wellbeing, health, local economy, social inclusion and education.	During Gate 3 assessments of the baseline environment have been undertaken, which has involved desk-based analysis and surveys. This assessment work is reported in the EIA Scoping Report. Continuous and open communication with stakeholders has been carried out through Gate 3 with a range of stakeholder including local communities. Engagement and consultation with stakeholders including analysis of feedback from stakeholders and local communities impacted by the Project, has influenced the design. Design changes made during Gate 3, which have been influenced by stakeholder and local community feedback includes a change in the tunnelling technique to reduce the number of intermediate shafts, as well as consideration of an in-river discharge for the recycled water to help minimise potential effects on the aquatic marginal habitat. Engagement with stakeholders and local communities has been varied to help maximise access and inclusion. The consultation and engagement undertaken in Gate 3 has included face to face meetings, on-line meetings, production of newsletters, use of social media and the press and public events.

ACWG Design Principles	Teddington DRA Gate 3 Design Principles Activities
Place 1. Take care: Develop proposals in the spirit of stewardship looking to both the past and future of each context to understand and develop its landscape, cultural heritage, health and sustainability. Work with partners to secure the long-term success of all measures. 2. Protect and promote the recovery of nature: Focus on the role of landscape, its capacity to accommodate infrastructure and shape places. Work collaboratively and employ holistic, landscape-scale approaches that support and deliver biodiversity net gain as well as multiple other benefits. 3. Design all features beautifully, with honesty and creativity: Our utility infrastructure can be a source of pride and a positive contribution to its context. Develop proposals that reveal and celebrate its importance, provide visual delight and leave a positive legacy.	The majority of permanent land requirements for Teddington DRA is on land currently owned by Thames Water, with minor land acquisition required for activities such as provision of conveyance shafts, which would be entirely below-ground post-construction. The design developments made during Gate 3 have reduced the number of intermediate shafts and sites requiring development in the public realm and that would require land acquisition. During Gate 3, discussions and workshops have been held with the Local Planning Authorities and the Environment Agency which have considered the baseline environment and potential mitigation and habitat enhancement measures. Thames Water is committed to meet 10% BNG, in accordance with the requirements of the Environment Act 2021. During Gate 3 assessments of the baseline environment have been undertaken, which has involved desk-based analysis and surveys. This assessment work is reported in the EIA Scoping Report, which also proposes additional studies including heritage, townscape and visual surveys to help inform further design development including enhancement opportunities to facilitate a positive legacy for the Project.
Value 1. Maximise embedded value: Work collaboratively across specialisms and with stakeholders to maximise the benefits of the scheme by being smart with the location and arrangement of elements and design of mitigation within the project scope and budget. 2. Understand how you could provide additional value: Identify opportunities to contribute wider regional benefits outside of the project scope. In particular look for synergies with relevant catchment management plans and proposals that support the delivery and enjoyment of a healthy water environment. 3. Capture and measure embedded and additional value: Have clear narratives about how you are contributing to society beyond the core scope of your project. Quantify these benefits so they can be considered meaningfully in conversations on value,	Non- statutory consultation on the site appraisals and selection processes was undertaken during Gate 3. A statement of response to this consultation has been published. Ongoing engagement helped shape design changes made in Gate 3 including changes to the location of Project elements such as the intermediate shaft requirements. An updated cost and carbon report is provided in Annex A2 of the Gate 3 submission. As part of the Gate 3 engagement process customer research across Greater London was undertaken by Thames Water. The results of this research has identified a majority view in acceptance of the Project. As part of the Gate 3 design development we are exploring environmental enhancement opportunities and quantifying how the Project can contribute to

ACWG Design Principles	Teddington DRA Gate 3 Design Principles Activities
financing and risk. Share your experience and knowledge widely.	improving water quality. This work will continue into Gate 4.

3.2 Project Components and Operating Philosophy

3.2.1 The conceptual design for each of following option components are developed in this report as follows:

- Mogden STW final effluent abstraction
- 75Ml/d Tertiary Treatment Plant (TTP) at Mogden STW
- Waste Stream Collection and Discharge at Tertiary Treatment Plant in Mogden STW
- Recycled Water Transfer Tunnel from Mogden STW to Discharge upstream of Teddington Weir on the River Thames
- Recycled Water Discharge (outfall) to the River Thames, upstream of Teddington Weir
- River Abstraction (Intake) from the River Thames, upstream of Teddington Weir
- Abstracted Raw Water Transfer
- Thames Lee Tunnel connection

Assessment of Source Flow Availability

3.2.2 The latest estimates of projected flows to be received by the Mogden STW are presented in Strategic Overview of Long-term Assets and Resources (SOLAR) analysis (SOLAR, AMP6 ver. 4.2 updated on 10 July 2019). SOLAR estimates STW influent in the future, utilising predicted population growth. All flows into Mogden STW essentially leave the site as final effluent though there is a small amount of volume loss during treatment which account for sludge and evaporation.

3.2.3 According to SOLAR the projected domestic flow to be received by Mogden STW in 2031 would be 305Ml/d. Domestic flow does not include infiltration or trade flows, and it is assumed that domestic flow would not reduce significantly during periods of drought. Therefore, this value would provide a conservative estimate of available effluent from Mogden STW during drought conditions as available flows are likely to be higher.

3.2.4 As the estimated abstraction of final effluent for the 75Ml/d Teddington DRA would be approximately 78Ml/d, it is considered that there will be adequate flow for the Project. The 3Ml/d difference between the abstraction of final effluent and recycled water production is due to losses through the TTP process which are returned to treatment.

Source Water (Mogden STW Final Effluent) Abstraction Design Elements

3.2.5 The existing 3m wide final effluent culvert runs along the South edge of the Mogden STW from West to East, and to the North alongside the existing storm tanks on the East side of the STW. This culvert is 3m wide in the east-west section and 4.6m wide in the north-south section. Overflows from the existing storm tanks directly discharge into the final effluent channel along the north-south section. Therefore, final effluent would be abstracted upstream of the storm overflow along the southern edge of the existing storm tank to prevent untreated storm overflows being transferred to the treatment facilities. Abstracted final effluent will be treated in the new TTP within Mogden STW.

Treatment Design Elements

3.2.6 The recycled water discharge would provide compensation flow upstream of the Teddington Weir following raw water abstraction a little further upstream. The discharge location will be in the most downstream reach of the non-tidal section of the River Thames and downstream of all existing raw water abstraction points. Recycled water is not required to conform to Drinking Water Standards, therefore the tertiary treatment design is focused on achieving environmental quality consent parameters for the discharge to the freshwater River Thames.

3.2.7 At this stage of design, conditions for the discharge of recycled water to the River Thames are based on that of the Hogsmill STW discharge permit which is for the same reach of the river as this proposed discharge. The Hogsmill STW Discharge Permit has tighter Emission Limit Values (ELVs) for suspended solids, BOD, ammonia and phosphorus discharge than Mogden STW and the selected tertiary treatment processes will reduce these parameters contained within the Mogden STW final effluent. The proposed process comprises tertiary nitrification to reduce 95%ile ammonia compliance and chemical dosing and tertiary filtration for 95%ile phosphate compliance and Biochemical Oxygen Demand (BOD) compliance.

3.2.8 There are opportunities to consider alternative treatment trains and development of the conceptual design as the Project progresses and this level of tertiary treatment may not be required depending on the performance of Mogden STW in the future and the Environmental Permit for the Project. Therefore, the treatment design described in this report is indicative.

Water Quality

Mogden STW Secondary Effluent Quality

3.2.9 A summary of the key water parameters is presented in Table 3.2. The key Hogsmill STW discharge consent values are also included for reference when considering these basis of design parameters. The Hogsmill STW also currently discharges into the same reach of the river as is the proposed TTP, therefore, it provides a reasonable basis for establishing the recycled water design envelope.

Table 3.2 Key TTP Feed Water Quality Parameters

Parameter	Unit	Mogden STW Final Effluent		Hogsmill STW Discharge Permit	
		Average	95%ile	Limit (maximum of 3 permitted exceedances)*	Maximum limit (no exceedances permitted)
BOD	mg/l	5.4	12.2	7	50
Total Phosphorus as P	mg/l	3.5	5.4	1 (annual average)	N/A
Ammoniacal nitrogen (expressed as N)	mg/l	0.4	1.7	1	12
Suspended Solids	mg/l	15.7	36.0	25	N/A
pH	ph Unit	7.4	7.6	6.5-9.5	N/A
Alkalinity (as $CaCO_3$)	mg/l	201.2	230.4	N/A	N/A

*Based on normal frequency of 24 samples per 12-month period for Sanitary parameters as stated in the Hogsmill Permit

BOD

3.2.10 The existing Mogden STW provides full carbonaceous and nitrification activated sludge treatment. The Mogden STW final effluent has a 95%ile BOD concentration of 12.2mg/l. Treatment to reduce BOD concentrations in the discharging water is required to achieve the discharge consent of 7mg/l (with a maximum number of permitted exceedances depending on sampling frequency). This requires a high degree of solids reduction. This is proposed via mechanical cloth filters.

Phosphorus

3.2.11 The existing Mogden STW does not include chemical dosing for phosphorus removal. Phosphorus reduction is required to achieve the existing Hogsmill STW consent level of 1mg/l total phosphorus (annual average). Chemical phosphorus removal via ferric sulphate dosing and tertiary filtration has been designed to achieve a discharge concentration 50% of the Hogsmill STW phosphorus consent of 1mg/l, equating to a target of 0.5mg/l.

Ammonia

3.2.12 The Mogden STW final effluent has a 95%ile ammonia concentration of 1.7mg/l which is higher than the 1mg/l Hogsmill consent (with a maximum number of permitted exceedances depending on sampling frequency), indicating that tertiary ammonia removal may be required if a similar consent was determined by the EA for the Teddington recycled water discharge. At this stage a Moving Bed Biofilm Reactor (MBBR) process has been included on the basis that ammonia reduction may be required.

Suspended Solids

3.2.13 The existing Mogden STW comprises conventional activated sludge and final settlement tank treatment trains to produce a secondary clarified effluent. The secondary effluent has a 95%ile suspended solids concentration of 36mg/l which will need to be significantly reduced to meet compliance with the Hogsmill STW discharge consent of 25mg/l. Solids reduction via mechanical cloth filtration has been proposed in this conceptual design. Design development will further consider the risk of fluctuation in solids loading, recognising the upgrade works ongoing at Mogden STW and future likely process performance. The final effluent ratio of total suspended solid (TSS) to BOD appears high and existing process performance will be further considered as design progresses.

Recycled Water Quality

3.2.14 The Hogsmill STW currently discharges into the same reach of river and therefore this discharge consent has been used as a proxy for the recycled water quality target and used as the basis of design. Appropriate water quality targets are currently being discussed with the EA with the engagement of the National Permitting Service (NPS).

3.2.15 The TTP recycled water quality has been projected as shown in the table below, assuming indicative tertiary treatment process, including ferric sulphate dosing, Moving Bed Biofilm Reactor (MBBR) and mechanical cloth filters (Mechanical Filters).

3.2.16 As shown in Table 3.3, the projection shows that the proposed TTP treatment process will achieve the discharge consent targets of the Hogsmill STW based on 95%ile Mogden STW final effluent quality. Frequent final effluent quality monitoring is being carried out as part of the pilot trials in order to gather a robust dataset which reflects recent final effluent discharge quality. More information about the pilot trials can be found in the “Pilot Plant and Bench Scale Testing” in section 3.2.

Table 3.3 Proposed TTP Projected Recycled Water Quality

Parameter	Unit	Mogden STW Final Effluent (95%ile of data 2004 - 2020)	Projected Water Quality of TTP Recycled Water (95%ile)	Hogsmill STW Discharge Permit	
				Limit (maximum of 3 permitted exceedances)*	Maximum limit (no exceedances permitted)
BOD	mg/l	12.2	6.2	7	50
Total Phosphorus as P	mg/l	5.4	0.5	1 (annual average)	N/A
Ammoniacal nitrogen (expressed as N)	mg/l	1.7	0.1	1	12
Suspended Solids	mg/l	36.0	20	25	N/A
pH	pH Unit	7.6	6.8	6.5-9.5	N/A
Alkalinity (as $CaCO_3$)	mg/l	230.4	174	N/A	N/A

*Based on normal frequency of 24 samples per 12-month period for Sanitary parameters as stated in the Hogsmill Permit

Proposed Treatment

3.2.17 As described above, suspended solids, BOD, ammonia and phosphorus would be the main parameters of concern for this TTP design. A two-stage tertiary treatment process consisting of Moving Bed Biofilm Reactor (MBBR) and mechanical cloth filters (Mechanical Filters) would address the high suspended solids concentration fed to the plant. The MBBR allows for nitrification and TSS/BOD removal, with upstream ferric sulphate dosing for chemical phosphorus removal. Secondary ferric sulphate dosing could be upstream of final mechanical cloth filters (Mechanical Filters) to achieve the assumed total phosphorus compliance requirements if required.

3.2.18 The indicative treatment process for the Project, as shown in Figure 3.1, would be:

- Ferric sulphate dosing (for chemical phosphorus reduction)
- Moving Bed Biofilm Reactor (for ammonia and BOD reduction)
- Mechanical Cloth Filters (for final solids reduction)
- Associated backwash and desludging equipment for filter units

3.2.19 The process facilities required will be reviewed once the bench and pilot testing have been completed, and following discussions with the Environment Agency.

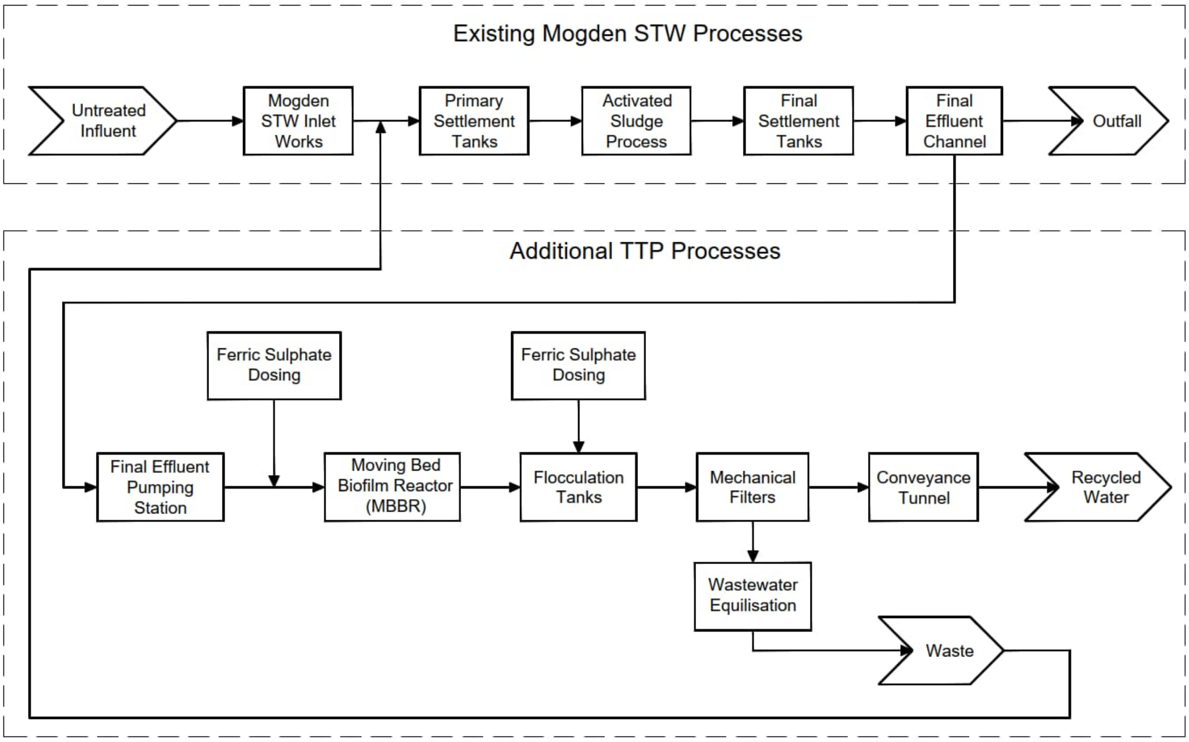


Figure 3.1 High-level process flow diagram of the proposed TTP in Mogden STW

Ferric Sulphate Dosing

3.2.20 Ferric sulphate would be dosed directly into the incoming final effluent stream. Flocculation tanks for effective mixing and contact time for phosphorus precipitation have been included upstream of the mechanical filters should secondary dosing be necessary to achieve desired phosphorus levels. A dedicated ferric sulphate storage tank and dosing skid would be supplied. Ferric dosing requirements have been estimated based on average final effluent phosphorus concentrations to achieve a recycled water output concentration of 1mg/l.

3.2.21 The TTP feed stream has a high phosphorus content and large quantities of chemical sludge can be generated upon addition of ferric. Chemical sludges generated through desludging and backwash of the mechanical filters would be returned to the Mogden STW.

Moving Bed Biofilm Reactor (MBBR)

3.2.22 Moving Bed Biofilm Reactor (MBBR) are proposed to provide biological treatment for BOD, and ammonia reduction. The reactor achieves ammonia removal through an attached biofilm which grows on suspended media. Process air supply is required for the MBBR units to keep the biofilm alive. The MBBR can adapt to low levels of ammonia in the feed making it an ideal model for this TTP design while NSF, which had been proposed in Gate 2, does not provide effective treatment at very low or high ammonia levels. It is proposed to use two MBBRs which can be configured either in series or parallel configuration to handle variable flows and loads. Air supply for nitrification is supplied using blowers. The plastic biofilm carriers need very infrequent replacement.

Mechanical Cloth Filters

3.2.23 Mechanical cloth filters would provide a final solids removal barrier. These units comprise filter discs with cloth type filter pile used to capture suspended solids particles all installed in tanks.

3.2.24 As water flows into a tank, suspended solids and other contaminants accumulate on the outside of the filter, causing the water level in the filter to rise. Backwashing would occur sequentially such that not all discs are backwashed at the same time to allow for full flow operation. Suction pumps would be used for backwashing which are supplied with the package unit, with dirty backwash being discharged through a solids collection system.

3.2.25 During the operation of the filter unit, accumulated solids build-up results in sludge layer formation on the bottom of the tank. Sludge pumps would be used and included within the unit to de-sludge the tank, using the same solids collection system. As with backwashing the de-sludging process would occur sequentially, allowing for the continuous operation of the filter to provide a filtered effluent.

3.2.26 Dirty wash water and sludge could be transferred to the wastewater return pumping station for return to the head of the Mogden STW.

Chemical Storage

3.2.27 The units for the TTP would not require chemical cleaning or chemicals for enhanced backwashing. The only chemical usage could be ferric sulphate dosing for phosphorus removal.

3.2.28 Chemical deliveries to the TTP would be via a common hard standing area which would drain to a dedicated chemical spill tank so that any accidental spills could be contained, treated and disposed of in an appropriate manner. It is anticipated that Chemical Storage will be located on the ground next to the existing site road. An emergency shower and an eye wash stand are also required near the Chemical Storage facility.

Process Unit Summary

3.2.29 Process units and ancillary facilities required for TTP would include:

- Chemical storage and dosing facility
- Moving bed biofilm reactors (MBBR)
- MBBR blowers
- Flocculation tanks
- Mechanical cloth filter (Mechanical Filter)
- Final effluent pumping station (for transfer of effluent to TTP)
- Electrical building

3.2.30 Most of process units and ancillary facilities would be placed on a new platform built above some of the existing storm tanks in Mogden STW. In addition, the existing embankment near the storm tanks would be cut back and stabilised with new retaining walls to create space for the other process and ancillary facilities. Sizes and configurations of facilities for TTP with MBBR process are being investigated. Total footprint required for TTP is estimated at approximately 6,600 m^2.

Waste Streams Management

3.2.31 Sludge produced in the MBBR would be captured by the mechanical cloth filters. The operation of mechanical cloth filters produce backwashing and desludging waste streams which would be returned to the inlet of the Mogden STW. Exact location of the returns is yet to be confirmed, however is required to be upstream of primary treatment and downstream of storm overflow points. Further investigation is required to determine the exact discharge location.

3.2.32 Projected quality parameters of the waste stream are shown in Table 3.4.

3.2.33 In Gate 3, it was assumed that Mogden STW would have sufficient capacity to accept the return of the TTP backwash waste streams, however further assessment is required to confirm this at future stage.

Table 3.4 Projected TTP Waste Stream Flow and Composition

Parameter	Units	75Ml/d Plant Design
Waste Stream Flow	Ml/d	3.4
pH	pH Unit	6.8
Alkalinity (as CaCO3)	mg/l	174
Suspended Solids	mg/l	1044
Suspended Solids (Load)	kg/d	3,518
BOD	mg/l	60
BOD (Load)	kg/d	200
Ammonia	mg/l	0.12
Ammonia (Load)	kg/d	0.41
Phosphorus	mg/l	0.5
Phosphorus (Load)	kg/d	1.7

Pilot Plant and Bench Scale Testing

3.2.34 Pilot and Bench testing with Mogden STW final effluent is undertaken to provide additional data to allow refinement of the TTP design criteria and demonstrate successful treatment to support permitting. Bench testing allows design parameters such as dose rates and contact times to be optimised while pilot testing is used to investigate the efficacy of the proposed treatment process using actual final effluent from Mogden STW.

3.2.35 An MBBR and mechanical filtration pilot plant for TTP is currently being undertaken at Mogden STW. Daily samples will be taken at varying times to ensure data is representative over this period. Upon completion of this phase, the pilot plant will be operated for a further 12 months, with regular sampling and online monitoring taking place during this period. This long-term operation and analysis of the pilot plant performance is required to determine the robustness of the process under different seasons.

Conveyance Design Components

Conveyance Design General Considerations

3.2.36 The general assumptions used to develop the conceptual design of the recycled water conveyance are listed below:

- The proposed tunnel would have an Internal Diameter (ID) of 3.5m and construction would be with a Tunnel Boring Machine (TBM) to minimise required shaft construction outside of Thames Water's premises.
- The spacing of intermediate shafts is limited by operational, health and safety considerations governed by the diameter and construction techniques. The 3.5m tunnel diameter allows the provision of refuge chambers to manage construction-related risks.
- The tunnel would be driven from a drive shaft in Mogden STW to a reception shaft at the discharge site on River Thames upstream of Teddington Weir (Burnell Avenue). All excavated materials from tunnel boring would be hauled from the drive shaft site in Mogden STW to reduce impacts on the local communities. Spoil associated with shaft construction will be removed from the respective shaft sites.
- Based on TBM manufacturer recommendations, a 15.0m ID drive shaft would be required for construction of a 3.5m ID tunnel. It is anticipated that approximately 12,000m^2 would be required for the drive shaft site to accommodate required facilities and areas to store and handle excavated materials. The reception shaft was recommended to be 12.5m ID while interception/ intermediate shafts will be 10.5m ID.

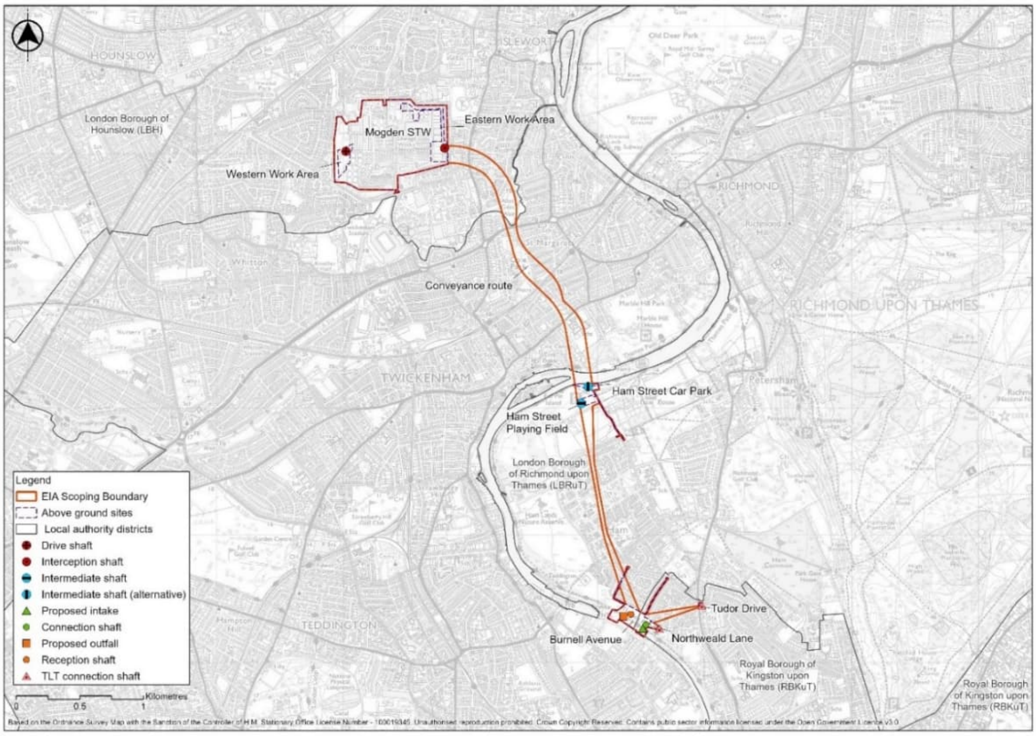
3.2.37 The conveyance design has been refined through stakeholder engagement and feedback from the non-statutory public consultation. It will be refined further and the design will develop with supplementary information including route geology and liaison with key stakeholders.

Conveyance Route

3.2.38 A new approximately 4km long tunnelled conveyance route for recycled water transfer would be constructed to connect the new TTP in Mogden STW to the proposed outfall on the River Thames. The tunnel would be bored at a depth of around 20-30m for the majority of the route from Mogden STW to the site near Burnell Avenue. The final alignment and profile are to be determined following further surveys and detailed design but it is expected this can be accommodated within the proposed alignment. The tunnel route would be designed to sit within the mostly homogenous London Clay Formation geology. The tunnel route would have an internal diameter of approximately 3.5m and would be driven using a Tunnel Boring Machine (TBM) at a constant positive grade from the drive shaft at Mogden STW to the reception shaft to the south of Burnell Avenue.

3.2.39 The general locations of the conveyance route are shown in Figure 3.2. The drive shaft would be in the Western Work Area in Mogden STW. The tunnel would have an intermediate shaft located in the Eastern Work Area close to the proposed TTP to provide a connection to convey recycled water from the TTP, and there would be an additional intermediate shaft located either at Ham Street Playing Field or Ham Street Car Park. The reception shaft will be located in close proximity to the new outfall upstream of Teddington Weir on the River Thames (Burnell Avenue site).

3.2.40 The exact conveyance route will be determined through further design work and investigations, such as environmental surveys and ground investigation.



Note: This figure shows EIA Scoping Boundary at this site. It should be noted that the EIA Scoping Boundary is larger than what may ultimately be required. Works to utilities, diversions and upgrades considering our current understanding of these locations in relation to the Project are included within the EIA Scoping Boundary. As the design and EIA process progresses, the locations of compounds and temporary access routes would be refined. The EIA Scoping Boundary is considered sufficiently large enough to accommodate these refinements and allow flexibility as the design and assessment progresses.

Figure 3.2 Project Area Plan

Tunnel Shafts

3.2.41 A summary of proposed shafts for the recycled water transfer tunnel is in

3.2.42 Table 3.5 below. Descriptions of each shaft site are in the following sections.

Table 3.5 Recycled water transfer tunnel shafts

Name	Internal diameter (m)	Location	Description
Drive shaft	15.0	Mogden STW Western Work Area	The TBM would be launched here, and all of the 3.5m ID conveyance route tunnelling excavated material would be removed from this shaft.
Interception shaft	10.5	Mogden STW Eastern Work Area	Provide the connection to convey recycled water from the new TTP to the new conveyance tunnel.
Intermediate shaft	10.5	Ham Street Playing Field or Ham Street Car Park	An access shaft for health and safety, maintenance and ventilation during construction, and for inspection during operation for the recycled water conveyance tunnel.
Reception shaft	12.5	Burnell Avenue	The TBM would be removed from this shaft and it will connect to the discharge outfall via a pipe.

Drive Shaft Site - Mogden STW Western Work Area

3.2.43 The Western Work Area is located on undeveloped land on the western side of Mogden STW (Figure 3.3). This area is proposed to site the drive shaft (c. 15.0m ID) for the TBM launch, and to provide the storage and laydown area for the construction work. The TBM would be launched here, and the area would also be used for storing tunnel excavated material and materials required for the construction of some of the works proposed for the Eastern Work Area, including the TTP, recycled water interception shaft and associated ancillary infrastructure.

3.2.44 The only permanent development that would be left in situ will be the drive shaft and below ground connection conveyance tunnel between the drive shaft and the recycled water interception shaft.

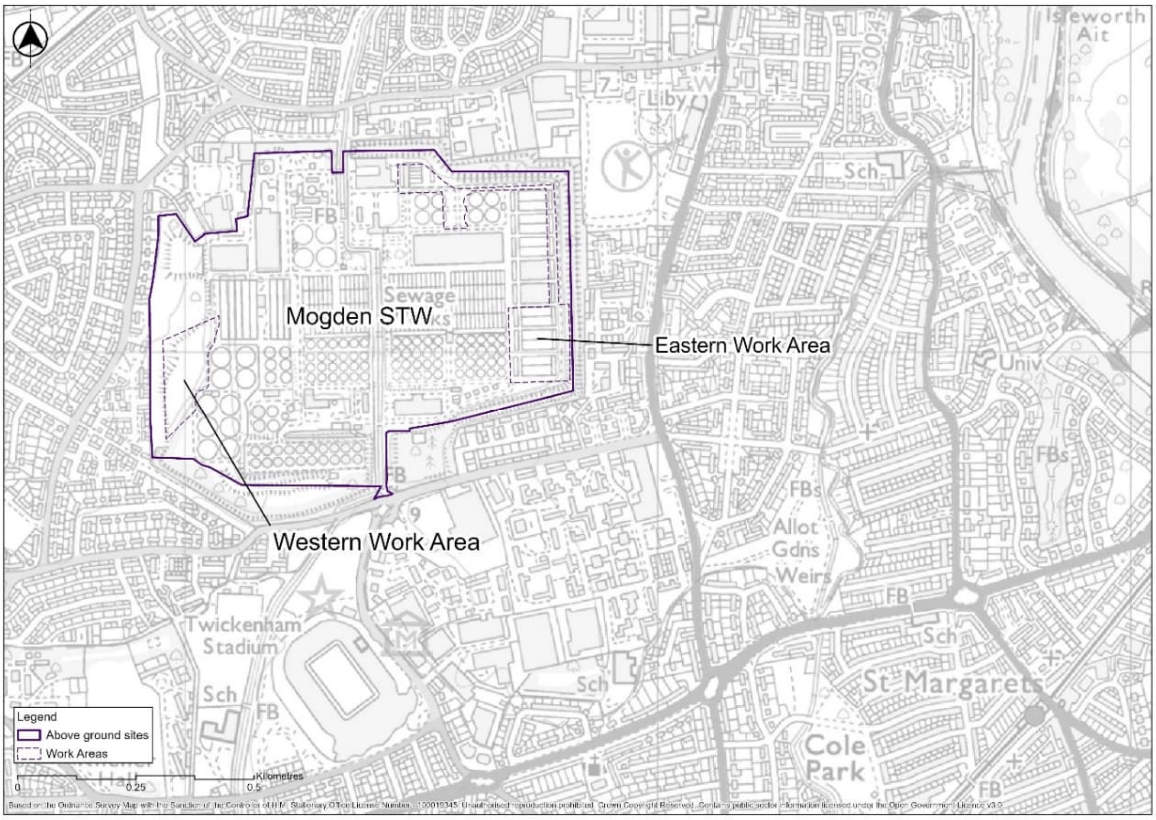


Figure 3.3 Drive shaft site (Western Work Area) and Interception shaft site (Eastern Work Area) in Mogden STW

Interception Shaft Site - Mogden STW Eastern Work Area

3.2.45 The Eastern Work Area in Mogden STW (Figure 3.3) will house the 10.5m ID interception shaft which will be used to connect the TTP to the conveyance tunnel, for the transfer of recycled water. In order to accommodate the shaft, a section of the existing embankment at the southeast corner of STW would be cut back with retaining walls for stabilisation.

Intermediate Shaft Site - Ham Street Playing Field or Ham Street Car Park

3.2.46 There are currently two options for the intermediate shaft near Ham Lands, one at Ham Playing Field and the other at Ham Street Car Park (Figure 3.4). The intermediate shaft would be located at only one of these two sites.

3.2.47 The intermediate shaft would serve as an access shaft during construction and a future inspection point for the conveyance tunnel during operation. The shaft is necessary to provide acceptable access spacing between Mogden STW and the reception shaft when undertaking future inspections and maintenance to ensure the health and safety of operatives.

3.2.48 Once construction of the recycled water tunnel is complete the shafts would be capped with a concrete cover with access hatches for future maintenance (Figure 3.5).

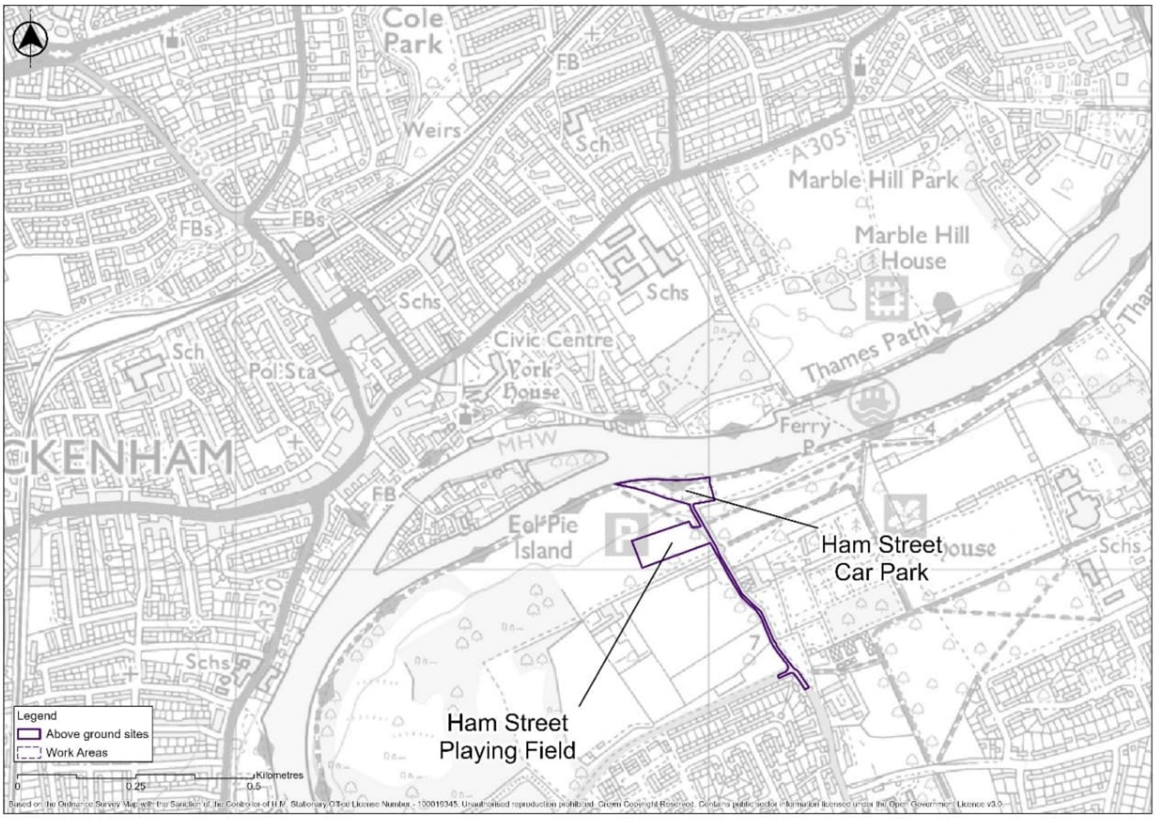


Figure 3.4 Intermediate Shaft Site in Ham Street Playing Field or Ham Street Car Park

Figure 3.5 Typical Shaft Access Hatch after Completion

Reception Shaft Site - Burnell Avenue Site

3.2.49 A 12.5m ID shaft will be located at Burnell Avenue for the reception of the TBM (Figure 3.6). The TBM would be removed from the reception shaft once tunnel excavation has been completed. In addition to facilitating the construction of the conveyance tunnel, the shaft will be used to transfer recycled water to the new River Thames outfall.

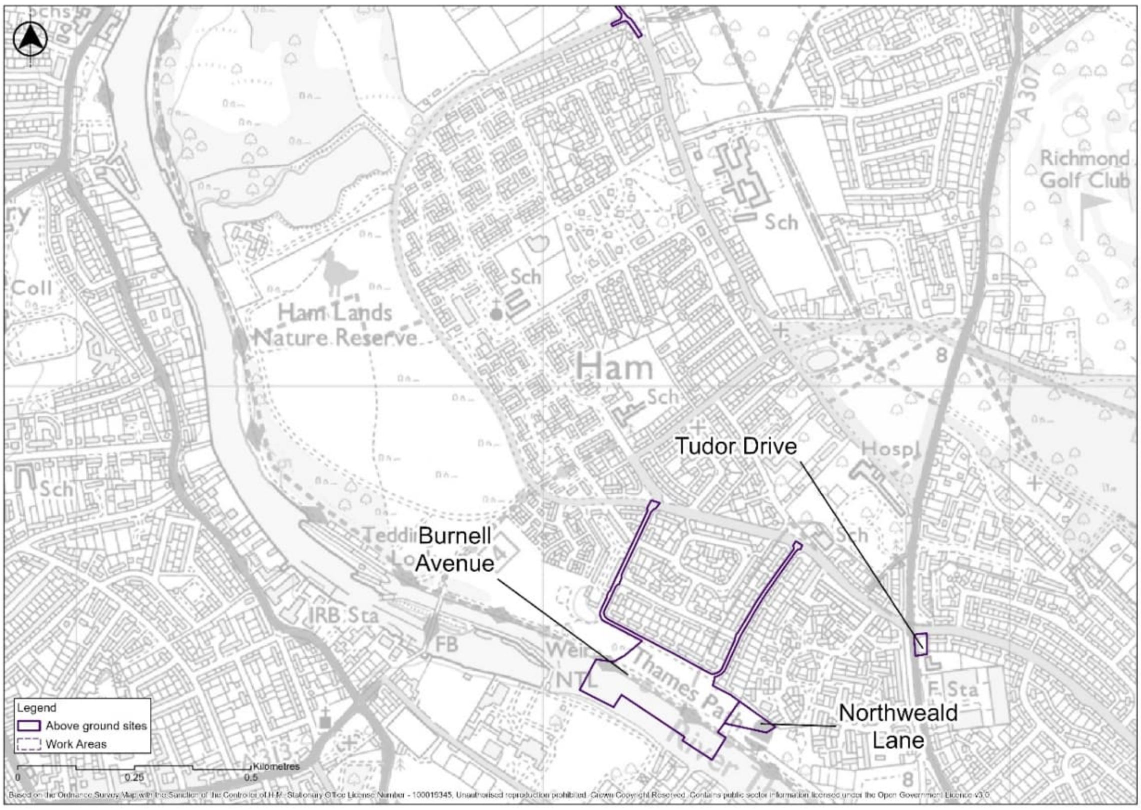


Figure 3.6 Burnell Avenue Site (Reception Shaft, Outfall and River Abstraction), Northweald Lane Site (Thames Lee Tunnel Connection) and Tudor Drive Site (Alternative Thames Lee Tunnel Connection)

Recycled Water Discharge Arrangement

3.2.50 Recycled water would be discharged through a new outfall into the River Thames approximately 150m upstream of the Teddington Weir in the Burnell Avenue site in Figure 3.6. Discussions with the Environment Agency are ongoing regarding the final specification of the outfall, with options for either a bankside discharge or an in-river discharge under consideration.

3.2.51 A bankside outfall structure, as shown indicatively in Figure 3.7, would be buried into the bank to minimise impacts on the landscape and recreational users, although access covers and covers to the control equipment would be required and would be fitted flush to ground level. The recycled water would discharge into the river at surface water level. The riverbank at the location of the discharge outfall would extend over the river edge as a vertical wharf. Vertical bars would be fitted under the wharf structure to prevent unauthorised access and to prevent accumulation of debris when not in use. An internal weir would also form part of the design of a bankside outfall to prevent fish and eels from entering the conveyance tunnel beyond the outfall.

Figure 3.7 An indicative image showing a bankside outfall structure upstream of Teddington Weir

3.2.52 The in-river outfall option being considered would likely comprise a pipe buried along the riverbed rising to a screened outfall diffuser (see Figure 3.8 for the indicative in-river diffuser cross-section). The outfall structure would project upwards from the riverbed by up to 1.5m, leaving a minimum of 2.5m of water above the top of the outfall. This would reduce the potential for the outfall to be clogged by sediment when not in use and meet the navigational requirements of the Environment Agency. The outfall may also have one or multiple diffuser outlets. There may be a requirement to install fender piles around the outfall structure to mitigate against collision from river users/vessels. Further development with the Environment Agency will be required to determine the preferred solution.

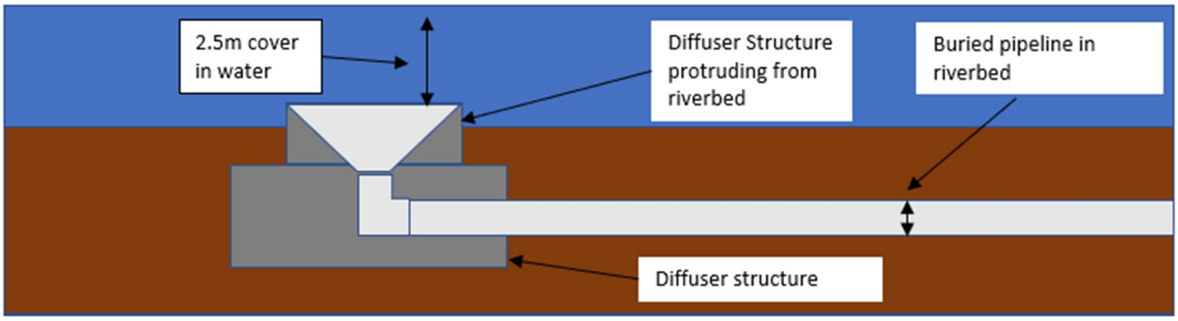


Figure 3.8 Indicative In-River Diffuser Cross-Section

River Abstraction Arrangement

3.2.53 The river intake will be located approximately 150m upstream of the proposed new outfall within Burnell Avenue site (Figure 3.6). The proposed distance between the two structures has been established based on modelling work and through discussions with the Environment Agency, to ensure no risk of recirculation of discharged recycled water into the intake and to minimise the potential for reduced river flow between the intake and outfall. An indication of how an intake structure may look is provided in Figure 3.9

3.2.54 Limited lighting for safe access and maintenance would be required for the river intake. It is envisaged that these will be turned on only when repair, maintenance or inspection are required and will be off at all other times

Figure 3.9 An Indicative Image of Intake Structure upstream of Teddington Weir

Raw Water (River Water) Transfer Pipeline and Connection to TLT

3.2.55 A Thames Lee Tunnel (TLT) connection will enable the transfer of abstracted river water into the existing TLT, which extends south to east across the River Thames. The existing TLT takes water from the River Thames at the Hampton intake to the Lockwood Pumping Station, part of Thames Water's Lee Valley reservoirs.

3.2.56 The abstracted river flows would be conveyed from the new intake structure into a raw water conveyance shaft (approximately 10.5m ID). The abstraction would be controlled from the intake structure by valves, and there will be an inline flowmeter and control interfaces with the discharge flow meter to manage abstraction to match the discharge.

3.2.57 The abstracted river water would then gravitate from the raw water conveyance shaft to a further shaft (known as the TLT connection shaft: approximately 7.5m ID) located near the existing TLT via a new river water pipeline (up to 2.2m ID). The abstraction of river water would be controlled from the intake structure at an agreed and permitted flow rate by valves which further control the water being released into the TLT. Connection to the TLT would be achieved via an adit or a vertical connection from the base of the new TLT connection shaft or connection into the existing shaft at Tudor drive.

3.2.58 There are currently two potential locations for the construction of a new connection into the TLT, as listed below:

- Land to the south of Northweald Lane in close proximity to the intake site, identified as the Northweald Lane site (Figure 3.6).
- A site located to the northeast of the intake site at the junction of Duke's Avenue, Richmond Road/Upper Ham Road (A307) and Tudor Drive, identified as the Tudor Drive site (Figure 3.6).
- Further work is required to determine the most appropriate solution.

Pumping Stations

3.2.59 The key pumping requirements would be as follows. Depending on the final conveyance routes, profiles and further hydraulic analysis, some of these pumps may be removed from the design and control the flow by hydraulic head and flow control valves/ regulators.

- Final Effluent Pumping Station: To abstract final effluent from the existing final effluent culvert in Mogden STW and transfer to the proposed Tertiary Treatment Plant (TTP) in proximity to the abstraction location within the STW. This Pumping Station (PS) would be located within Mogden STW.
- Wastewater Pumping Station: To transfer wastewater generated through treatment in TTP to the inlet of the Mogden STW for treatment. This PS would be located within Mogden STW.
- Recycled Water Pumping Station: To transfer recycled water from the proposed TTP in Mogden STW to the interception shaft of recycled water transfer tunnel. This PS would be located within Mogden STW.
- Burnell Avenue Reception Shaft Discharge Pumps: To lift conveyed recycled water from the reception shaft on the riverbank and discharge through the outfall. The pumps would be located inside the reception shaft at the Burnell Avenue site upstream of Teddington Weir.

- River Abstraction: There may be a requirement for some pumping capacity as part of the abstraction at the intake structure to support commencement and management of flow.

Operating Philosophy

Project Operation Overview

3.2.60 The Project would operate intermittently as required during periods of drought in the Thames Water's Drought Plan framework. Anticipated operational utilisation rates are once every two years on average. The late summer and autumn months were the most common for operation, with August and September having the highest frequency. Expected utilisation of Teddington DRA is described in "Utilisation" in section 2 of the Gate 3 Main Report.

3.2.61 It is planned that the Project would be utilised and operated as one of the strategic drought schemes and that the trigger of utilisation would be same as the strategic drought schemes in the current Drought Plan. Strategic drought schemes are sources of water that are permitted for use during drought period but are not used as part of 'day to day' baseline supply.

3.2.62 As per the Thames Water's Drought Plan, strategic drought schemes are brought into service when reservoir storage drops lower than typically observed at the time of year. The following triggers for utilisation of strategic drought schemes are identified in the Lower Thames Operating Agreement (LTOA):

- Naturalised flow over Teddington Weir receding down to 3000 Ml/d on average for 10 days during the course of a drought event (defined as having a Drought Event Level (DEL) equal to or greater than DEL1), and
- Reservoir storage levels having fallen to the Teddington Weir 800-700/600 Ml/d flow requirement defined in the Lower Thames Control Diagram (LTCD).

3.2.63 If operation is stopped completely during non-drought periods, the TTP would require 6 to 8 weeks or more to re-establish biomass in the MBBR. Therefore, during times when the Project is not required to supply water, there will be a requirement to continue to run the TTP at reduced levels to maintain the operability of the TTP (i.e. Hot Standby mode). During the Hot Standby mode, the TTP would operate at a minimum of 15 Ml/d to maintain biofilm within the Moving Bed Biofilm Reactors (MBBRs). The required flow rate will be confirmed through the pilot plant testing and further investigations.

3.2.64 The recycled water produced during non-drought periods will be discharged through existing Mogden STW outfall at Isleworth Ait in the tidal reach of River Thames. During this period, the conveyance tunnel will be kept dry; recycled water in the conveyance tunnel will be pumped and returned back into the STW.

3.2.65 It is anticipated that it will take approximately two weeks for TTP to ramp up to full capacity (i.e. Normal Operation mode: 75Ml/d). This is for the biomass in the

MBBR to acclimatise and stabilise to the new loading conditions and also for testing the systems and water quality.

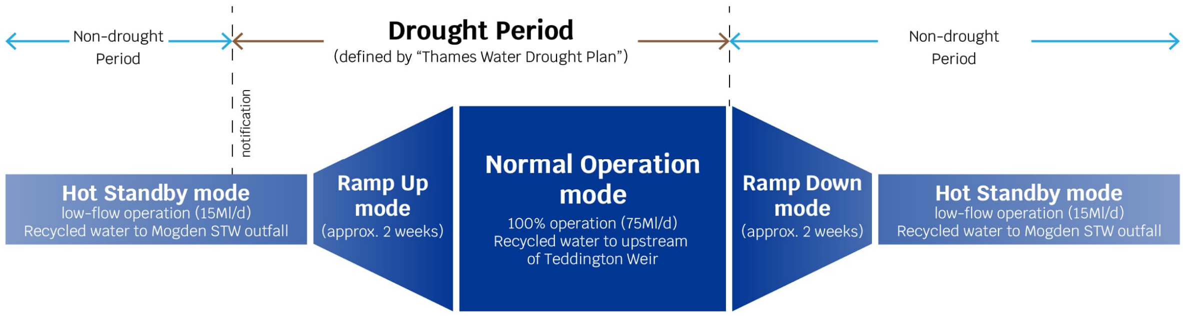


Figure 3.10 Teddington DRA operation

Operation and maintenance of Tertiary Treatment Plant Process Units

3.2.66 It is important to keep a flow through MBBRs constantly to maintain a biofilm on the media.

3.2.67 The mechanical filters would operate by filtering water through filter discs fitted with filter pile type cloth. The filters are generally capable of being started up within a short period of time. They can be operated at low or no flow; however, they will require periodic backwashing when not in use. The water being filtered passes through the pile cloth, so the solids collect on the outside of the pile cloth creating a head loss. At a pre-set water level, the cleaning cycle would be initiated. Cleaning equipment may consist of suction shoes, suction pumps and sludge pumps.

3.2.68 Backwash suction shoes and suction pumps as well as sludge pumps would be maintained and serviced in accordance with the manufacturer's recommendations and might be sent for inspection and rebuild after 10 years operation.

3.2.69 The TTP would not require chemicals for cleaning purposes. Ferric sulphate would be used at the plant for the purposes of phosphorus removal during operation.

Operation and Maintenance of Conveyance System

3.2.70 During operating period of the Project, the recycled water conveyance tunnel from Mogden STW to the outfall would operate with the shafts at either end acting as balancing tanks. Water will be pumped into the interception shaft at the TTP in Mogden STW and pumps at the reception shaft at Burnell Avenue will draw water out at the other end of the tunnel. A single networked control system will simultaneously control the pumps at the two shafts to maintain water levels within a controlled range to suit the pumps and to provide the driving head to push the water along the short outfall connection pipe.

3.2.71 The pumps will need regular maintenance and periodic operation to keep parts operable. The pumps will run on regular cycles to keep the impellers and bearings operable regardless of the operating pattern of the Project. However, depending on the final conveyance routes, profiles and further hydraulic analysis, some of the pumps may be removed from the design and control the flow by hydraulic head and flow control valves/ regulators. This involves recycled water entering the recycled water tunnel and filling it to a low pressure which allows flows to be pushed through to the outfall. This approach would require the intermediate shaft to be sealed.

3.2.72 Maintenance periodic inspections, approximately every 5-10 years, would be undertaken requiring access to all of the shafts. This would be to undertake condition surveys and to clear out of any settled materials or organic matter, as required. Modern tunnels experience very little groundwater ingress, therefore the recycled water tunnel can remain drained during times when the Project is not required to operate with minimal risk. Drainage pumps will fully empty and maintain the tunnel empty, discharging flow back to Mogden STW.

3.2.73 The outfall and the river intake screen on the abstraction structure would typically be visited once a week by operations staff to visually check the condition of all structures. In the event of a security alert, staff would visit site to confirm any damage. Periodic maintenance of screens and mechanical equipment is required. Onsite maintenance would occur once a year on average. Abstraction will occur only when trigger levels are met, specifically when river levels are low, and allowable abstraction rates are insufficient to maintain water levels in London's storage reservoirs, as outlined in the abstraction licence.

Tertiary Treatment Plant Fail Safe Shutdown System

3.2.74 In the event of a water quality failure, the Project would “fail safe”, via a run-to-waste back to the Mogden STW. The treatment facilities would be monitored at Critical Control Points (CCPs) for the required and indicator water quality parameters and will initiate an auto-shutdown/ diversion of flow in the event of registering out of bound (“critical limit”) quality parameters or catastrophic failure of the plant.

3.2.75 If the TTP fails due to events such as power loss and treatment or chemical failure, there would be a lack of flow passing through the plant (with offline balancing tanks to store pass forward flow during shutdown if necessary). The Final Effluent Transfer Pumping Station, which would be feeding the TTP, would automatically shut down on failure.

3.2.76 The locked in process flow would then run-to-waste with all flows passing to the TTP’s Wastewater Equalisation Tank, to return all locked-in flows to the Mogden STW inlet works for treatment.

Inter Site Control System Requirements

3.2.77 The following would be required for the inter site control system:

- Communication links between the Mogden STW and the River Abstraction. This is required to relay operational status and control. In the event of a power outage or fail-safe shutdown at TTP, River Abstraction and raw water transfer to TLT would stop.
- Communication links between the Mogden STW TTP and Burnell Avenue Reception Shaft Discharge Pumps to relay operational status and control.
- Communication link between the River Abstraction and Burnell Avenue Reception Shaft Discharge to manage abstraction to match the discharge. In the event of a power outage or failure at either site, conveyance at the other site would stop.
- Connection to the wider Thames Water's Production Planning system and regional Supervisory Control and Data Acquisition (SCADA) to monitor, data analysis and regulate the raw water storage capacity based on river and reservoir levels.
- Connection of the TTP to the Mogden STW local SCADA and telemetry outstation.

Power Requirements

3.2.78 There are three sites requiring new or upgraded power supplies:

- Tertiary Treatment Plant (TTP) and Tunnel Boring Machine (TBM) in Mogden STW
- Reception shaft discharge pumps and ancillaries in Burnell Avenue site upstream of Teddington Weir
- River Abstraction and ancillaries in Burnell Avenue site upstream of Teddington Weir

Potential Power Requirements at Mogden Sewage Treatment Works

3.2.79 The existing High Voltage (HV) power distribution network within Mogden STW can be utilised to supply power to the new TTP. The existing Mogden STW power supply may need to be upgraded or modified. Additionally, HV feeders to the new HV switchboard or transformer(s) located locally to the treatment process can be provided by the existing HV infrastructure within the STW. This may require the existing HV switchboard to be modified, however, it is expected this will be a change to the protection settings and not extension or modification to the HV switchgear itself.

3.2.80 The power supply to the TTP could be potentially used to provide power to the TBM for tunnel construction, prior to commissioning of the TTP. The supply could be utilised by the TBM on a temporary basis until such time that tunnelling is completed and thereafter the supply would be transferred to the TTP HV Switchboard on a permanent basis. This approach would require a power load and flow analysis study to be undertaken to determine the appropriate method of powering the construction site.

Potential Power Requirements at Discharge in Burnell Avenue Site

3.2.81 The location of the pumping station would require a first-time High Voltage/Low Voltage (HV/LV) power supply similar to the TTP. The power supply would terminate at the LV Motor Control Centre (MCC) via a local transformer. The pumps would be controlled by VSD motor starters housed within the MCC. The MCC would require a building sufficiently sized to include both the MCC alongside communication equipment. Power supply may be required for instrumentation and telemetry communications as well as to building services for the electrical building.

Potential Power Requirement at River Abstraction in Burnell Avenue Site

3.2.82 The River Abstraction location would require a first-time LV power supply provided by the local Distribution Network Operator (DNO). The new power supply to the River Abstraction location would be terminated at the electrical building. The control kiosk would distribute power to the river abstraction band screens, washwater pump, motorised gates, instrumentation, telemetry and communications equipment in addition to the control building domestic services.

3.3 Opportunities and Future Benefits Realisation

3.3.1 Key opportunities identified in the conceptual design are listed in Table 3.6 below. Some of the opportunities identified in Gate 2 were incorporated into the Gate 3 design. These design changes are summarised in “Gate 3 Design Development” in section 2.2.

Table 3.6 Key Opportunities – Teddington DRA Conceptual Design

Category	Opportunities
Process System Design	There is an opportunity to rationalise and develop best outcome treatment requirements through pilot plant trials which are currently being progressed, and/or full engagement with stakeholders with regards to expectation of treatment processes, customer acceptability and engagement and environmental outcomes. There may be an opportunity to reduce the tertiary treatment requirements by optimising the treatment process.
Process System Design	There is an opportunity to reduce the ferric sulphate dosing requirements for phosphorus removal upon confirmation of phosphorus discharge limits.
Conveyance System Design	It may be possible to install some of ancillary facilities for conveyance system at the Discharge and Abstraction site below the ground. This will reduce footprints required in a public recreational site and may improve aesthetic aspects. Further investigation will be required to verify feasibility.
Synergy with other Thames Water’s Objectives for Mogden STW upgrade	There are future requirements for increased capacity at Mogden STW for growth which are likely to require process intensification within the existing plant footprints and tanks. The technology selected could offer a synergy with the TTP as final effluent quality may be improved, meaning less tertiary treatment would be required.

4 Project Delivery

4.1 Overview of Construction Process

Tertiary Treatment Plant

4.1.1 The TTP is proposed to be located in the Eastern Work Area, on a newly constructed platform above some of the existing storm tanks in the south-eastern corner of the Mogden STW site (Figure 4.1). The embankment in the Eastern Work Area of Mogden STW adjacent to the TTP and shaft site would need to be cut back from the existing site road and stabilised by retaining walls to create space for the TTP ancillary infrastructure and the interception shaft. This approach would ensure all temporary and permanent works are located within the existing Mogden STW footprint and retain the crest and external face of the existing embankment. The design of the retaining walls would be informed by on-going ground investigation works.

4.1.2 Construction materials for the TTP, interception shaft and associated ancillary infrastructure would be stored in the Western Work Area and transferred to the Eastern Work Area using existing roads within Mogden STW, or delivered directly to the work area. Any excavation material or arisings from the shaft construction in the Eastern Work Area would either be transferred to the Western Work Area or removed directly out of the Mogden STW site.

4.1.3 During construction of the platform and the TTP, the Eastern Work Area would potentially be equipped with two temporary tower cranes to facilitate lifting. The location of the tower cranes is anticipated to be on the east and the southwest sides of the storm tanks, with this detail being confirmed through further design development. In addition, crawler cranes and potentially gantry cranes will be required to support the proposed works.

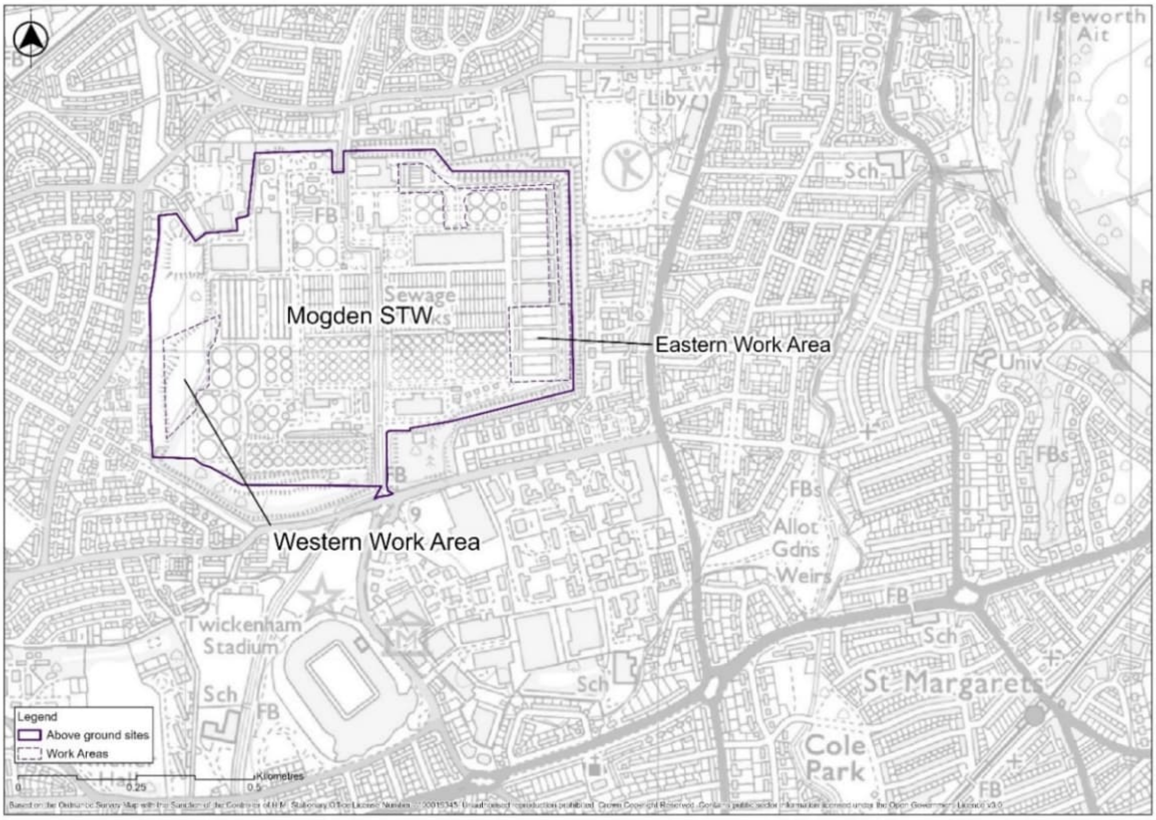


Figure 4.1 Eastern Work Area and Western Work Area in Mogden STW

Conveyance

Tunnel Construction

4.1.4 The tunnel alignment between the drive shaft in Mogden STW Western Work Area and the reception shaft in Burnell Avenue site upstream of Teddington Weir would be excavated using a tunnel boring machine (TBM). The TBM would be lowered to the base of the drive shaft, from where it would excavate, intercepting the intermediate shafts, and ultimately reaching the reception shaft at Teddington. As the TBM advances, it will install a precast concrete segmental lining to form the tunnel lining. The precast concrete segmental lining will have an internal and external diameter of around 3.5m and 4.0m respectively. The TBM will have a cut diameter slightly larger than the segmental lining; this enables to TBM to steer and reduces friction. As the TBM advances, the annular gap between the segmental lining and excavated ground will be grouted.

4.1.5 The pre-cast segments are assembled in the TBM using an erector to form a ring. The segments are held in position during assembly with bolts and dowels. A ring of this diameter would typically be formed of 6 segments and would have a length of between 1-1.2m.

4.1.6 The internal diameter of the tunnel of 3.5m has been assumed as this the minimum recommended diameter for the construction works in order to maintain a clear access envelope of 0.9m wide by 2.0m high, in-line with current health and safety guidelines. This is to allow the escape of workers from the tunnel in an emergency. The ease of emergency evacuation can be difficult in a smaller diameter tunnels, particularly past tunnel services, muck skips and other equipment.

4.1.7 The type of TBM employed depends on the ground conditions. In this area, the subsoil is likely to be London Clay. Typically, an Earth-Pressure Balance (EPB) TBM is selected to excavate in cohesive materials such as London Clay. Ground investigation is required to confirm the exact nature and depths of the clay layers and suitable excavation methods.

4.1.8 The choice to excavate the tunnel from the reception shaft at Mogden STW has been adopted to enable all of the tunnel excavated material and tunnel consumables to be removed and delivered respectively to the Mogden STW. This will reduce the number of deliveries to the other shaft sites in the local communities.

4.1.9 A back shunt may be required at the base of the drive shaft to provide additional space for managing the rolling stock operations during tunnelling. Typically, the back shunt would be constructed with a Sprayed Concrete Lining (SCL) and its length would depend on the length of the carriage train.

Shaft Construction

4.1.10 The following are typical shaft construction methods, but the final choice will depend on many factors, particularly details of the ground conditions as well as construction and operational health and safety considerations. It is common practice to start a shaft by segmental lining with caisson jacking in softer superficial soils and switch construction to underpinning, or Spray Concrete Lining (SCL) shaft construction method, if ground conditions improve.

Segmental Shaft Construction

4.1.11 Segmental lining is the most common method of construction, and often preferred, as it is generally the quickest and least expensive solution, and it can be adapted to many ground conditions. Segments are installed by two methods, caisson jacking or underpinning, and the method used depends on the ground and groundwater conditions:

- Caisson construction jacking involves the assembly of the segmental lining on the surface and the use of hydraulic jacks and a cutting edge to push the lining. The ground is excavated from within the shaft and as the lining advances, additional rings are erected on surface. This method is particularly suitable in soft ground. After it reaches the required depth, the annulus around the shaft is grouted to limit further ground movements and mobilise friction with the surrounding soil. In wet ground, to balance water pressure, the shaft is left full of water, and ground is excavated below water. This is termed a ‘wet caisson’. A long-reach excavator or grab is used from surface level in the technique, whereas during dry excavation an excavator will be lowered into the base of the shaft.

- Underpinning involves excavating ground withing the shaft and installing the segmental lining at the base of the shaft, where the excavated ground is exposed. Following the installation of the segmental ring, it is grouted into position. This process is repeated to the required shaft level. The method is most applicable in stable ground with limited inflows of ground water.

Sprayed Concrete Lining Shaft Construction

4.1.12 SCL construction requires stable ground conditions in a self-supporting soil such as London Clay, meaning its application is only suitable in certain conditions. As openings, such as a tunnel portal, are easier to create in SCL linings than segmental linings, it can be advantageous to switch from segmental to SCL at the base of shafts. Typically, SCL will be used to construct the lower part of the shaft once the London Clay formation has been intercepted. The SCL lining will normally require a secondary in-situ concrete lining to form a smooth surface and for improved watertightness.

Outfall and River Abstraction Construction

4.1.13 Discussions with the Environment Agency are ongoing regarding the requirements, design parameters and specifications of the outfall and the river abstraction.

4.1.14 In order to construct the new outfall and river abstraction, temporary cofferdam structures will be required to provide dry working areas in the river. The cofferdam structures will most likely be formed of sheet piles. Once support piles and sheet piles have been installed, inside of the cofferdam will be pumped dry. The length of the sheet piles required will depend on the site-specific ground conditions and designs of the outfall and river abstraction.

4.1.15 The outfall structure could be cast in situ or formed of pre-cast units, and the new intake structure would be constructed from reinforced concrete. When complete, the excavation would be backfilled around the structure and the mechanical and electrical equipment could be installed. The temporary sheet piles would then be removed and the riverbank profile on either side of the structure would be reinstated. The site would be landscaped after completion of construction.

4.1.16 Mechanical and electrical equipment would be enclosed in surface building or within a buried structure. The permanent works would also include installation of electrical power supply, vehicular access and connection pipework from the reception shaft to the outfall and from the river abstraction to the TLT. It is anticipated that access routes would be implemented using grasscrete or a similar solution to minimise visual impacts.

Raw Water (River Water) Transfer Pipe and Thames Lee Tunnel Connection

4.1.17 The raw water (river water) transfer pipeline to link the raw water conveyance shaft to the TLT connection shaft would differ depending on the selected location for TLT connection. If the Northweald Lane site is selected for TLT connection, the raw water transfer pipe may be constructed using a trenched installation method. If the connection to the existing TLT at Tudor Drive site is selected, the pipe line construction would be using a pipe-jack methodology.

4.1.18 Similar to the shafts associated with the recycled water transfer tunnel, the raw water conveyance shaft and TLT connection shaft would be constructed using either the underpinning or caisson shaft sinking techniques. Additionally, the use of SCL for the shaft construction, as previously outlined in "Shaft Construction" in section 4.1, may be employed once within the London Clay formation. The selected construction methodology would depend on the site ground conditions and other factors.

4.1.19 For safety of construction the TLT connection shaft should be a minimum of 7.5m ID. It is anticipated that this diameter would also provide sufficient space for installing the internal pipework. Connection to the TLT would be achieved via an adit or a vertical connection from the base of the new TLT connection shaft.

4.1.20 The TLT is constructed by a version of Wedge Block Technology called Don-seg, and this works using the external pressure of the ground locking wedge blocks through friction. The connection will have to be carefully designed to ensure structural integrity of the tunnel is maintained and may require internal strengthening of the TLT to support the connection.

4.1.21 The TLT undergoes temporary periodic shutdowns for inspection and maintenance works on an infrequent basis. Upon further discussion with the asset owner this period of time could planned to be used as an opportunity to carry out construction works. Alternatively separate shutdowns for project specific works may need to be planned for and undertaken.

4.2 CDM Implementation

4.2.1 During the Gate 3 process, CDM Principal Contractors for intrusive ground investigation and process pilot plant testing have been appointed along with CDM Principal Designer in accordance with the Construction Design and Management (CDM) Regulations 2015.

4.2.2 The Principal Designer has undertaken a Hazard Identification and Hazard Elimination Risk Reduction process throughout the design process following the principles of the CDM Regulation 2015 to seek to eliminate, reduce, inform or control the hazards during construction, operation, maintenance and demolition.

4.2.3 Intrusive ground investigations for the proposed conveyance route, shaft sites and TTP sites have been started to understand site-specific hazards such as geological conditions, ground contamination and complex hydro-geology. Pre-Construction Information (PCI), including unexploded ordnance (UXO) and existing buried obstructions utilities data, have been gathered and communicated with the Principal Contractor.

4.2.4 Health and safety information on relevant Mogden STW facilities have been communicated with the pilot plant Principal Contractor. A Hazard and Operability Analysis (HAZOP) workshop was held for the pilot plant installation, operation and testing in attendance of Mogden STW operations, the client, the Designers, the Contractors and suppliers.

4.2.5 Findings from the studies, PCI and the HAZOP workshop will be incorporated into the design. The PCI and risk mitigation measures will be provided over to Principal Designer appointed at the next design stage.

4.2.6 Significant health and safety risks associated with the Project include:

- Existing Thames Lee Tunnel (TLT) was constructed in “Don-Seg” segments, which are unbolted and held in position by compression against the ground. There are potential safety risks and difficulties during construction in connection to the TLT, as a result of dismantling these segments, which would need to be internally supported.
- Proposed Tertiary Treatment Plant (TTP) is proposed to be built on a new platform above existing storm tanks in Mogden STW. There are potential safety risks during construction, which are associated with structural integrity of the existing storm tanks and potential excavation through water bearing gravels.
- Ensuring that sufficient space is provided for construction compounds, laydown, deliveries and spoil and waste disposal to allow segregation and separation of plant and workers in Mogden STW.
- The proposed conveyance route includes a river crossing which could lead scour hollow risks.
- The proposed conveyance route passes below piled structure and railway line which may be sensitive to ground movement. As an initial mitigation, the tunnel alignment depth has been increased. Ground investigation and more detail ground assessments will be required to understand the risk more clearly and identify appropriate mitigations, if necessary.

4.2.7 To eliminate potential safety risks associated with construction of the connection to the TLT a survey inside TLT was undertaken during Gate 3. Design development is being carried out based on the findings, which confirmed the asset to be in good condition. The potential of connecting the intake conveyance system to an existing TLT shaft to avoid construction work in “Don-Seg” segments is being investigated.

4.2.8 In Gate 2, it had been proposed to fill some of the storm tanks to build TTP and to deepen other storm tanks to compensate the storage volume. A new platform for TTP above the storm tanks was proposed in Gate 3 to reduce impacts on the existing storm tank structure. Further studies to understand the existing structure is planned.

4.2.9 Mogden STW Western Work Area was introduced to the design in Gate 3. The Western Work Area will provide space suitable for the tunnelling operations, ensuring appropriate storage and work space. It will reduce the risks associated with the limited work space in the Eastern Work Area.

4.2.10 It is expected that the ongoing ground investigation will provide technical data required for safe designs of the tunnel, thus effectively reduce risks from construction.

4.3 Transportation for Construction

Transportation Options

4.3.1 TfL's guidance for Construction Logistic Plans (CLP) recommends investigating rail and river freight modes. Therefore, a review of multi-modal options for construction transportation was conducted.

4.3.2 It was determined that direct rail freight is not feasible due to the absence of suitable railway lines within the site's local vicinity. However, the use of railheads for the import of construction materials will be considered to source materials for last-mile deliveries via Heavy Goods Vehicles (HGVs). Potential goods suppliers with railhead facilities include:

- London Concrete (on Transport Avenue, Brentford) - for construction at Mogden STW
- Day Aggregates (on A240 Kingston Road, Tolworth) - for construction sites outside of Mogden STW to the south of the River Thames

4.3.3 For construction sites north of the river, including Mogden STW, there is no direct access to the River Thames to accommodate marine freight. The option to use existing wharves on the River Thames in proximity to Mogden STW and the use of HGVs to complete the last leg of the journey will be investigated further to consider the benefits compared to materials being transported by HGV only.

4.3.4 For freight south of the river for the Intermediate shaft location and Burnell Avenue sites, the use of barges is being investigated for the delivery of construction materials and removing excavated materials. A marine load-out facility is not considered appropriate for this project when bearing in mind the additional HGVs required to construct the facility, and the extended construction programme associated with it. Nonetheless, further consideration will be given for the use of water freight to transport construction materials, waste and equipment as the design develops.

4.3.5 All construction materials for the recycled water transfer tunnel would be delivered to the drive shaft site in Mogden STW and excavated materials from the tunnel excavation will be removed from the drive shaft to reduce construction operations and traffics outside of Mogden STW. The components of a TBM would be delivered to the Mogden STW for on-site assembly. However, materials for shaft construction will be delivered to each shaft site and excavated materials from shaft construction will be removed from each shaft site. Burnell Avenue site will also have delivery and removal for construction of the outfall and river abstraction construction and their ancillaries. The TBM would be disassembled on the Burnell Avenue site and transported off-site.

Vehicle Movement during Construction

4.3.6 Routes have been investigated for construction traffic to access the construction and shaft sites from the strategic road network (SRN), namely from the M25 as it is an interregional pathway to access material suppliers from across the country. These routes aim to utilise the Permitted Routes as identified in the London Lorry Control Scheme (LLCS). The Transport for London Road Network (TLRN) intersects and shares most of the LLCS Permitted Routes between the sites and the SRN, namely the A316 and A3 corridors.

4.3.7 Moreover, two routes have been developed to account for the potential use of local suppliers with railheads to deliver construction materials, including tunnel segments. For Mogden STW, London Concrete on Transport Avenue, Brentford, has been identified as a potential supplier (accessed from Mogden STW via Mogden Lane, A310 Twickenham Road, B454 Spur Road, B454 Syon Lane, and A4 Great West Road). Day Aggregates on Kingston Road, Tolworth is a potential supplier for Ham Street Playing Fields and Burnell Avenue construction sites (accessed via A307 south, A243 Brighton Road, and A3 Kingston Bypass).

4.4 Delivery Programme

4.4.1 Construction of the project is expected to take approximately three years commencing in 2029 and completing in Winter 2032. The Project would not be in operation immediately after construction, there would be a period of approximately a year and a half of commissioning and performance testing with the Project coming into operation in 2033, as shown in Figure 4.2.

4.4.2 The delivery programme was developed assuming standard working hours of 7am to 7pm. Working hours at the Western Work Area within Mogden STW would however assumed to be 24-hours, 7 days a week during the tunnelling stage.

Activity	2029				2030				2031				2032				2033			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TTP and ancillary infrastructure at Mogden STW	■	■	■	■	■	■	■	■	■	■	■	■								
Recycled water conveyance route from Mogden STW to Burnell Avenue	■	■	■	■	■	■	■	■	■											
Outfall: discharge to River Thames at Burnell Avenue									■	■	■	■								
Intake: abstraction from the River Thames at Burnell Avenue								■	■	■	■	■								
TLT connection works								■	■	■	■	■								
Commissioning and performance testing												■	■	■	■	■				
Water available for use																	■			
Full operations																		■		

Figure 4.2 Indicative Construction Programme

5 Project Sustainability

5.1 Greenhouse Gas Mitigation, Energy Recovery and Renewable Energy Opportunities

5.1.1 Carbon estimates for Teddington DRA is summarised in the "Strategic regional water resource solutions: detailed feasibility and concept design: Gate three submission for London Water Recycling Strategic Resource Option" (Gate 3 Main Report). Further information on the Project's carbon estimates is provided in Annex A: Teddingto9n DRA Cost and Carbon Report.

5.1.2 Opportunities for greenhouse gas mitigation, energy recovery and renewable energy are also discussed in section 5 of the Gate 3 Main Report.

5.2 Resilience and Adaptability to Climate Change

5.2.1 As the Project is a water resources stress and drought resilience project that would provide additional water capacity to London during certain conditions it inherently meets the needs for resilience and adaptability to climate change, in addition the requirements of the ACWG guidance are integral to the design of the Project. Key policy relevant to carbon and vulnerability to climate change are set out in the National Policy Statement (NPS) for Water Resources Infrastructure. Section 4.4 of the NPS for Water Resources Infrastructure provides guidance on the assessments and planning requirements that the applicant should meet with respect to greenhouse gas emissions and climate change mitigation.

5.2.2 The design focuses on ensuring that the infrastructure is capable of withstanding future climate-related stresses, including extreme weather events and incremental changes while minimising environmental impact.

5.2.3 Climate change is anticipated to raise sea levels, intensify peak rainfall, and increase river flows. These changes are likely to heighten future flood risks, expanding flood extents and depths from rivers, sea, and surface water, affecting sites in both high and low flood risk areas. The Water Resources and Flood Risk assessment has shown that without mitigation there is a potential raised flood risk to off-site developed areas through displacing floodwater elsewhere, changing surface water runoff rates and volumes, as well as from displacement of groundwater and alteration of groundwater flows. Also, there is the risk to construction works and construction workers if the sites flood from rivers, watercourses or surface water. Flood risk assessments (FRAs) are required per NPPF guidelines and flood risk will require further assessment in the EIA.

5.2.4 To reduce the Project's vulnerability to climate change during construction and operation, opportunities include designing drainage systems in line with EA and Local Lead Flood Authority guidance, using resilient materials for hotter temperatures, addressing changes in rainfall and ground conditions, and ensuring regular inspections, particularly after extreme weather events.

5.2.5 Additionally, the design anticipates future demand and climate scenarios. This forward-thinking approach is aligned with the ACWG principle of designing for long-term resilience and environmental sustainability. The Project's commitment to reducing carbon emissions and resource use further strengthens its adaptability, ensuring that the Project is both resilient and sustainable in the face of climate change.

5.3 Waste Management and Reduction

5.3.1 The approach to Waste Management and Disposal aligns with the ACWG Design Principles, with a strong emphasis on sustainability and effective waste management practices. Key aspects are described as follows.

Circular Economy and Waste Minimisation

5.3.2 The design for the Project would aim to follow the waste hierarchy by reducing waste generation, increasing the recycling or recovery of waste where feasible, and reducing, where possible, the need for waste disposal. The Project would seek to incorporate principles of the circular economy through the following measures during construction:

- Segregating all arisings on site.
- Identifying reusable materials on site for use on site, storage or resale.
- Importing materials with high recycled content when allowed by design/safety requirements.
- Removing recyclable and recoverable materials from the site to be processed by licensed facilities.
- Using surplus recycling or recovered materials in local community projects, e.g. utilising recycled mulch from tree felling at community facilities.
- Recycling suitable materials for the construction of noise/landscape bunding.

5.3.3 This approach is in line with the ACWG's Climate principle, which emphasises waste reduction and resource efficiency.

5.3.4 The Project will develop a comprehensive Site Waste Management Plan (SWMP) and Materials Management Plan (MMP) in compliance with the National Policy Statement for Water Resources Infrastructure. These plans will ensure that waste is managed according to the waste hierarchy, prioritising reuse and recycling over disposal.

Sustainable Disposal and Recycling

5.3.5 The Project aims to maximise the recycling of materials on-site and ensure that any waste requiring disposal is managed responsibly. The bulk of the estimated 194,900m^3 of excavated waste (spoil) will be London Clay, which will be transported off-site and where feasible reused or recycled in the ceramics industry, cement production or wider construction purposes, significantly reducing environmental impacts.

Resource Availability and Waste Infrastructure

5.3.6 In terms of resource availability, the Project will require substantial quantities of construction materials, including ready-mixed concrete, pre-cast concrete, steel, and cement powder. There is sufficient availability of these materials in the study area, as London and the South East are the largest producers of ready-mixed concrete in the UK, with no anticipated disruptions to supply. During operation, only limited quantities of material would be required for maintenance and water treatment at the TTP, with ferric sulphate being the primary chemical required for tertiary treatment. There are no known issues with the supply of ferric sulphate.

5.3.7 The Project will rely on the well-established regional infrastructure for waste transfer, treatment, and recycling. The available landfill capacity has been assessed, ensuring that the Project's waste generation will not significantly impact regional landfill voids, with forecasts indicating sufficient capacity throughout the Project's timeline.

5.3.8 This holistic approach to waste management supports the Project's commitment to sustainability, environmental protection, and compliance with both national and regional waste policies.

5.4 Communities and Stakeholder Engagement

5.4.1 The approach to Communities and Stakeholder Engagement is fundamental to the Project's success and aligns with the ACWG principles, particularly those emphasising People and Place. The engagement approach prioritises early, meaningful, and continuous involvement with local communities, stakeholders, and relevant authorities throughout the project lifecycle.

5.4.2 The Project aims to build a robust understanding of the social context, ensuring that the design process is informed by the needs and concerns of those directly and indirectly impacted. This includes integrating community feedback into the design of infrastructure, particularly how it is experienced in everyday life, both during construction and operation. While it may not be possible to satisfy everyone, the engagement process should be inclusive, transparent, and genuine, addressing any tensions with integrity and striving to find an equitable balance. Additionally, the design should not only meet the needs of current populations but also anticipate and accommodate future demographic and population changes.

5.4.3 To date, the following engagement has taken place:

- Engagement with LPAs in the London Boroughs of Hounslow, Richmond upon Thames, and Kingston upon Thames has involved discussions on environmental assessments and construction methodologies. Consultations have taken place since 2020, with the Project progressing towards formal and statutory consultations in 2025.

- A non-statutory public consultation was conducted in Autumn 2023 to gather feedback from local communities and stakeholders on the design options of the Project. Input from this consultation has been incorporated into the project design.
- Engagement with the EA, other stakeholders and interested parties was aimed at ensuring that the project design considered ecological, hydrological, recreational and socioeconomic requirements and minimised impact on the River Thames and will be ongoing through the Project.
- As the Project progresses, statutory consultations are planned to inform the design and to address residual concerns.

5.4.4 The Project's commitment to transparent and inclusive engagement will be reflected in ongoing consultation activities, clear communication, and the incorporation of community feedback into the Project's evolving design vision and principles.

5.5 Noise, Traffic and Air Quality

5.5.1 The approach to the consideration of the effects of the Project on noise, traffic and air quality aligns with the ACWG design principles of ensuring that sustainable solutions and environmental enhancement solutions have been developed which provide a wider benefit for the society whilst also minimising impacts during construction and operation.

5.5.2 The construction of the Project is expected to result in additional vehicle movements within the local area due to use of construction HGVs, Large Goods Vehicle (LGV) deliveries and cars by the workforce across several local and national roads. This additional vehicle movement can impact local road users, residents, business and result in safety issues and also cause environmental impacts (i.e., air quality, noise and vibration, human health). The proposed 3.5m-diameter tunnel with four shafts (formerly proposed to be 1.8m pipe jack and eight shafts), would enable reduction of shaft construction in the public realm. Furthermore, all tunnel material would be handled and removed from Mogden STW rather than from each shaft site located within the community. This would further reduce the number of roads that would be used during the construction. To reduce the impacts of traffic, several routing options have been initially appraised and will be assessed further, as well as best practice mitigation measures and the implementation of a construction logistics plan. As part of the EIA, traffic counts for several roads in the study area have been obtained from DfT database and further counts will be undertaken to support the data available. The Traffic and Transport chapter of the EIA will consider alternative modes of transport along with the impact of the construction and operational traffic movements on all transport users and sensitive receptors, including severance for non-motorised users accessing key public rights of way (PRoW) and amenities.

5.5.3 Potential noise and vibration impacts have been identified at nearby sensitive receptors due to construction of the shafts, tunnelling, additional vehicle movements and operation of the proposed TTP and other equipment. Early engagement with the local authorities was initiated to ensure that their concerns have been taken into consideration. It is proposed that as part of the EIA, a targeted baseline monitoring survey would be undertaken to establish existing noise levels. Construction noise and vibration levels at the sensitive receptors would then be predicted based on relevant guidance and these would be compared with the relevant thresholds to determine the significance of the impact. Several mitigation measures which are considered good practice will be in place which would help alleviate noise and vibration impacts, and as such at this stage no further additional measures have been identified.

5.5.4 The construction and operation of the Project has the potential to result in odour, dust and air quality impacts at sensitive receptors due to the operation of the TTP, construction activities and additional vehicles.

5.5.5 An air quality impacts assessment considering the above potential issues would therefore be prepared as part of the EIA, in accordance with the relevant legislation, polices and guidance. In preparation for the EIA, existing air quality in the study area has been reviewed based on available local monitoring and data available from Department for Environment, Food and Rural Affairs (Defra) background maps. This review has established that the Project is located with an air quality management area (AQMA) declared due to exceedances of the air quality objective for nitrogen dioxide (NO_2) and/or particulate matter (PM_{10}) attributable to road traffic emissions. Sufficient baseline data is also available for the study area, and this would be used to establish existing air quality levels to undertake the necessary assessment to understand the significance of any potential effects and derive appropriate mitigation measures.

5.6 Improve Access and Inclusion

5.6.1 The approach to the consideration of the availability of access and inclusion aligns with the ACWG design principles. This includes the consideration of how people move around the project area, seeking to maximise the opportunities to support active travel and improving recreational access to waterside and green spaces that can improve outcomes for wellbeing, health, local economy, social inclusion and education.

5.6.2 An appraisal of locations of walking, cycling and horse riding (WCHR) route surveys have been undertaken and the significance of the impact due to severance, pedestrian delays etc. will be considered.

5.6.3 An accessibility assessment will also be undertaken, and this will draw on the outputs of the Traffic and Transport assessment to determine how changes in traffic flows, parking provision, public transport services and Walker, Cyclist and Horse Rider (WCH) provision may impact the ability of users to access commercial and community assets in the study area. The needs of different user types will be considered including protected characteristic groups (e.g. older people, young people, disabled people), as well as the type of facility (e.g. hospitals or employment hubs) and whether there are alternative facilities available.

5.6.4 The potential to enhance the health and wellbeing of the local community, aligned with local policies and strategies, and to promote equality of opportunity for equality groups will also be explored.

5.7 Landscape and Environmental Net Gain

Landscape

5.7.1 The landscape design approach is grounded in the ACWG principles, prioritising sustainability and environmental enhancement. There is a focus on holistic, landscape-scale approaches that support and deliver biodiversity net gain (BNG) as well as multiple other benefits. the Project seeks to integrate into the surrounding environment harmoniously, whilst emphasising biodiversity net gain and the protection of local ecosystems.

5.7.2 Key sustainability measures include the adoption of nature-based solutions, such as the use of sustainable urban drainage systems (SuDS) to manage surface water runoff and enhance local biodiversity. the Project also focuses on restoring and improving existing habitats, with a commitment to achieving at least a 10% BNG (see section 5.8). This involves careful planning and collaboration with local stakeholders to ensure that the landscape design not only meets regulatory requirements but also contributes positively to the community and environment.

5.7.3 The landscape design will also incorporate measures to enhance public access and recreational opportunities, aligning with the ACWG's principles of improving social value and community well-being. By integrating these sustainability aspects, the Project aims to create a resilient and adaptable landscape that supports both the infrastructure and the natural environment, seeking to ensure long-term benefits for the local area.

Environmental Net Gain

5.7.4 Defra defines achieving Environmental Net Gain (ENG) as “achieving biodiversity net gain first and going further to achieve net increases in the capacity of affected natural capital to deliver ecosystem services”[1].The National Policy Statement (NPS) for Water Resources Infrastructure, published in April 2023, sets out the government's policies for developing water resources infrastructure in England. The NPS requires developers to deliver ENG for their projects. ENG is a development approach that aims to leave the environment in a better state than it was before the development. The NPPF states that sustainable development requires net gains across economic, social, and environmental objectives. Examples include enabling new habitat creation, improving public access to the countryside and enhancing the resilience of ecological networks.

5.7.5 ENG aligns with the ACWG Design Principles, particularly those emphasising sustainability and biodiversity enhancement. The approach to ENG for the Project is rooted in achieving a measurable improvement in biodiversity and environmental metrics, ensuring that the environment is left in a better state post-development.

5.7.6 The ENG approach includes a commitment to achieving at least a 10% BNG (see section 5.8), prioritising nature-based solutions for mitigation and integration wherever feasible. This involves working collaboratively with stakeholders, including local communities and environmental groups, to ensure that the design and implementation of the Project enhance local ecosystems and contribute positively to the recovery of nature.

5.7.7 The Project will look to incorporate sustainable landscape practices, supporting ecosystem services such as carbon sequestration and habitat creation. The design also aims to respect and enhance the local landscape and cultural heritage, ensuring that the Project provides long-term environmental benefits while meeting the broader sustainability goals set out in the ACWG principles.

5.8 Biodiversity Net Gain

5.8.1 The proposed solution will provide a minimum of 10% biodiversity gain with an overall aim to contribute to local nature recovery. The mitigation hierarchy will be followed when assessing impacts to habitats with avoidance measures considered first before mitigation. Required habitat creation or enhancement measures will look to be achieved at a local level where possible and in line with green/blue infrastructure strategies and local nature recovery strategies.

5.8.2 The focus on the BNG assessment will align with the ACWG Design Principles, particularly those emphasising protecting and promoting nature recovery and landscape scale approaches to accommodate infrastructure and shape places. This involves working collaboratively with local communities and environmental groups to ensure recommendations for delivering BNG fit within the local environmental context and provide long-term functioning biodiversity.

5.8.3 When looking at options to provide mitigation and enhancement measures for watercourses, the BNG assessment will prioritise measures that support achieving good ecological condition for affected watercourses and bodies as a whole.

5.9 Value

5.9.1 The proposed solution aligns with the Defra National Policy Statement for Water Resources Infrastructure section 4.13 (Socio-Economic Impacts) (Defra, 2023) and is designed to aim to deliver wider benefits across employment, economy, skills and education, community amenity, and accessibility, as well as recreation.

5.9.2 To quantify and monitor these benefits, specific data gathering and measurement tools will be utilised, ensuring a comprehensive understanding of the added value across the sector. These tools, as discussed in the report Strategic Regional Water Resource Solutions: Detailed Feasibility and Concept Design - Gate 3 submission for London Water Recycling SRO (Gate 3 Report), are crucial for the ongoing assessment and adaptation of the Project as it progresses.

Cost Benefit Analysis (CBA) and Investment Case

5.9.3 The benefits identified through data gathering and measurement are integrated into the CBA and the investment case for the Project. The Gate 3 Report outlines how these values are crucial for understanding the long-term impact and sustainability of the Project, contributing to the decision-making within the WRSE framework. Through incorporating metrics from the Best Value Regional Plan (WRSE, 2022)[2], option selection can be aligned with the broader goals of economic and environmental sustainability.

Contribution to Society & Communication

5.9.4 The Project has wider societal benefits, which will be communicated to stakeholders through the EIA and DCO stakeholder engagement processes. Such wider societal benefits include:

- Direct, indirect, and induced employment opportunities, particularly during the construction phase.
- Economic growth.
- Development of skills and educational opportunities, particularly during the construction phase.
- Improved community amenities and infrastructure.
- Long-term recreational opportunities.

Monitoring and Development at Subsequent Gates

5.9.5 As the Project progresses, development, enhancement and monitoring of benefits will be undertaken through monitoring tools and processes, ensuring that the value added continues to align with the evolving needs of society and the strategic goals of the Project. Socio-economic impacts will be further assessed through the EIA process, and measures to mitigate impacts on, for example, community access, will be set out in the CoCP. This may include ongoing assessments of employment impacts, economic contributions, and the enhancement and use of community amenities, which would be documented and reviewed through the various stages of the Project.

Community and Stakeholder Value

5.9.6 Tangible benefits provided by the Project will include those associated with the provision of water during drought periods. The Project offers the provision of jobs and has the potential to enhance learning and local economic opportunities, as well as recreational amenity. By focusing the Project on long-term sustainability, benefits will accrue, enhancing community well-being, standard of living, and overall resilience.

5.10 Security and Emergency Requirements

5.10.1 Teddington DRA is included in WRMP24 to increase drought resilience in London to 1 in 200-year by the early 2030s. The security and protection of the Project is essential to safeguard robustness as a resilience measure and to ensure sustainability to supply a significant population in London. Supplied water needs to be wholesome, resilient and protected.

5.10.2 A preliminary assessment of potential major accidents and disasters, including man-made/ external hazards (such as an act of terrorism) and natural hazards which could threaten immediate or delayed serious environmental effects to human health, welfare and/or the environment and could require the use of resources beyond those of the client or its appointed representatives (i.e. contractors) to manage, was undertaken (refer to Annex C: Teddington DRA EIA Scoping Report for details). The potential key risks identified in the assessment of the Project include:

- Flood risk due to the location of the Project, especially with changes in weather patterns. The area may be susceptible to both fluvial and surface water flooding, which can affect operational and security integrity.
- Extreme weather events, such as storms, heavy rainfall, or extreme temperatures, which may be exacerbated due to climate change.
- The integration of digital technologies in managing modern infrastructure projects introduces vulnerabilities to cyber-attacks, which could affect operational technology, safety systems, and data security. Vulnerabilities to cyber-attacks given reliance on digital systems.
- Physical security threats, such as acts of terrorism or vandalism, are significant, given the Project’s visibility and importance.
- Industrial accidents such as chemical spills or machinery failure.

5.10.3 The security and emergency measures for the new assets will be designed considering these project-specific risks. Mitigation measures would include appropriate design and risk assessment, security and cybersecurity measures, collaboration with authorities, real-time monitoring systems to detect and respond to structural, mechanical or digital vulnerabilities, development of emergency response plans in consultation with local emergency services, and installation of advanced fire detection and suppression systems.

5.10.4 Critical systems that cause an impact of sufficient scale to fall under the remit of the Network and Information Systems (NIS) Regulations 2018 will be highlighted in security design. Systems will be designed to be resilient, where this is not possible, vulnerable systems will be designed with redundancy or backup as appropriate. The downstream impact of these systems will be documented, and also include details of further mitigation if required.

5.10.5 Security of assets will be designed in accordance with the policies of Thames Water and the advice from our security advisors. This will ensure all designs comply with the Security and Emergency Measures (Water and Sewerage Undertakers and Water Supply Licensees) Direction 2022 (SEMD). Designs will specify minimum security ratings required for each asset to be protected, including details such as Loss Prevention Standard 1175 Security Rating 4, or other as applicable.

5.10.6 Security can come in many forms, for example deterrents or methods of detection such as alarms. We will explore options to obscure or camouflage new assets to make them less obvious to casual observers. If this can be achieved whilst still maintaining the required minimum security standards, the visual impact to the community would be minimal, benefitting the local community too, minimising disruption to the local green space, community spaces and recreational activities.

5.10.7 Engagement will take place with relevant authorities and interested parties regarding the risks that have been identified and the proposed approach and mitigation measures.

5.11 Digital Twin Strategies

5.11.1 Thames Water intend to develop a digital twin strategy through 2025 as a part of the Gate 4 activities that will enable digital capabilities to support and test the design, construction commissioning and operation of Teddington DRA.

5.11.2 The strategy will align with Thames Water's digital strategy and national guidance such as Royal Institute of British Architects (RIBA) Plan of Works, ISO1960 and CDBB Gemini Principles. Throughout Gate 4 and DCO preparation, the proposed system will be tested using the digital twin to support and refine the Project including existing environmental models of the River Thames and Thames Tideway. The Project's digital twin strategy will be based on set of requirements that include, Organisation and people, Governance, Technology, and Information management. The strategy will be evolved to ensure it reflects the latest technologies, good practices and the project requirements.

5.11.3 Adopting the digital twin should bring many benefits including, common data sharing, revision control and consistent standards across stakeholders. Testing through the digital twin could validate various aspects of the Project including spatial coordination, constructability, construction sequencing, material volumes and flow analysis, operability, and cost and carbon estimates.

5.11.4 Necessary updates of the Project and the model will be implemented based on feedback from end users and stakeholders. Integration of the proposed project into the existing assets (e.g. the existing Thames Water's pumping connections, SCADA system and Mogden STW treatment process) may also be tested through the digital twin. Innovative techniques using Geographic Information Systems (GIS), remote and mass data-capture, parametric asset modelling and process simulation, will be adopted. The digital twin will evolve from design stage to a "construction support twin", "as-built digital twin" and "operational digital twin" to support validation and decision making in each phase of the Project.

6 Water Resources

6.1.1 Teddington DRA would be operated largely during the time in a dry year when demand is greatest, e.g., Dry Year Critical Period (DYCP) and provide that benefit to the London WRZ. Details of the estimation of deployable output (DO) can be found in the WRMP24. The estimates of DO values both for the Dry Year Annual Average (DYAA) and the DYCP would be 67Ml/day for a capacity of 75Ml/d.

6.1.2 The DO modelling has established that the DO benefit for Teddington DRA is the same for 1:2, 1:200 and 1:500-year drought scenarios as the schemes provide the full capacity yield in all scenarios.

6.1.3 London Water Recycling SRO Teddington DRA will benefit the London WRZ.

6.1.4 Drinking Water Inspectorate (DWI) issued “Guidance Note on Resilience of Water Supplies in Water Resources Planning – A Supplementary Note to Long Term Planning for the Quality of Drinking Water Supplies” (July 2021) to provide water companies with guidance on the resilience of water supplies in water resource planning, with emphasis on the consideration of impacts on drinking water quality when planning for sufficiency of supplies and development of water resource schemes, including the development of the SROs being managed by RAPID. Forming a part of WRMP24, Teddington DRA is being developed in alignment with the DWI guidance.

7 Assumptions and Risks

7.1.1 The information presented in this document relates to material or data which is still in the course of completion. Should the solutions presented in this document be taken forward, Thames Water will be subject to the statutory duties pursuant to the necessary consenting process, including environmental assessment and consultation as required. This document should be read with those duties in mind.

7.2 Key Assumptions

7.2.1 Key assumptions that have been made in this conceptual design report are listed below:

- The TTP would be situated on the site of the existing storm tanks requiring construction of a new platform above the storm tanks. TTP ancillary facilities would be built in space created with a new retaining wall along the existing embankment to the east of the storm tanks. It was assumed structural conditions of existing facilities and geotechnical conditions will be suitable to perform required work.
- It has been assumed that wastewater from the proposed Tertiary Treatment Plant will be directed to the head of the Mogden STW. These flows are assumed not to cause any impacts to the hydraulic and treatment capacity in the Mogden STW.
- It was assumed that the abstraction location will be the north bank of the River Thames upstream of the Recycled Water discharge location and Teddington Weir.
- It has been used as a working assumption that the discharge consent for the Hogsmill STW will be indicative of the acceptable discharge consent for the Project whilst the process of developing the draft permit requirements with NPS is ongoing, Hogsmill STW discharges relatively upstream of the proposed TTP discharge location. This will be reviewed and revised, and changes will be incorporated into the design once the discharge consent for this project has been confirmed.
- It is assumed that a suitable stratum at depth can be developed for the TBM at where there are permissible settlements at ground level. The depth of the tunnel may need to be adjusted to locate the most suitable stratum.
- It has been assumed that the proposed alignment, and notably railway crossing location, will be acceptable to relevant third-party stakeholders.

7.3 Key Risks

7.3.1 Key risks and mitigation measures are listed in section 6 of the Gate 3 Main Report. Risks which could impact costs and delivery are also described in Annex A2: Teddington DRA Cost and Carbon Report.

8 Appendix A

Table A.1 Overview of Gate 3 Design Approaches to ACWG Design Principles

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
Cross Cutting Design Principles 1. Be specific: Develop project-specific design vision and principles based on an understanding of the objectives of each project and the people and places it will affect.	1.1. Development of project-specific vision and principles mapped against the NIC and ACWG Principles. 1.2. Development of a clear, concise narrative describing the story behind your Vision and Principles.	1. Draft Design Vision, Narrative and Principles.	The report Strategic Regional Water Resource Solutions: Detailed Feasibility and Concept Design - Gate Three submission for London Water Recycling SRO (Gate 3 Report) gives an overview of the design vision for this project. See section 3.1 of this report for Design Vision of London Water Recycling SRO.	Gate 3 Report- section 2 Solution Design CDR section 3.1
2. Safe and well: Actively and collectively develop designs that can be built, used, and maintained without unacceptable risks to the health and safety of workers - particularly during hazardous	2.1. No accidents, incidents or harm to people during construction and operation. 2.2. Use of best practice procedures in design risk management following HSE Guidance and CDM Legislation. 2.3. Design informed by understanding potential risks	2. Outline Designer's Risk Assessment highlighting potential significant and/or unusual risks with potential mitigations.	Initial pre-construction information has been gathered to eliminate/ mitigate H&S hazards. Intrusive surveys are being undertaken in conformance with the CDM Regulations 2015. Potential CDM risks were reviewed and updated (CDR section 4.2).	Gate 3 Report- section 2 Solution Design Gate 3 Report- section 3 Drinking Water Safety CDR Sections 4.2 and 5.10

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
construction and operational activity. Manage risks to members of the public thoughtfully with an approach that balances maximising wellbeing benefits with protection from risks that could cause significant harm.	to the public and management of these so far as reasonably practicable. Use of appropriate guidance including but not limited to: a. Royal Society for the Prevention of Accidents (RoSPA) and the National Water Safety Forum's Guiding Principles for Managing Drowning and Water Safety Risks. b. Visitor Safety in the Countryside. 2.4. Consideration of security early in the design of fence, gate and boundary treatments.		Hazards and risks related to drinking water safety were re-assessed in Gate 3 based on new data, and further updates will be undertaken through Gate 4 and beyond as the Project progresses. (Annex B: Water Safety Plan) A preliminary assessment of potential major accidents and disasters was undertaken, and security requirements and measures were discussed (CDR section 5.10, Annex C: EIA Scoping Report)	Annex B: Water Safety Plan Annex C: EIA Scoping Report
Climate 1. Nature knows no boundaries: Water is essential to all life and managing our response to climate change is a collective and urgent activity. Projects must be	1.1. Collaborative working across companies and with stakeholders. 1.2. Timely - preparation of proposals ready to construct in 2025-2030 will involve early and rigorous development of	1. Evidence of collaborative working across companies. 2. Evidence of working with Regulatory, Statutory (and, where practicable, local) stakeholders including Catchment Partnerships where appropriate.	Design work and project selection have been carried out in coordination with the regional group (WRSE) and the All Company Working Group (AWCG) to ensure collaboration across companies.	Gate 3 Report- section 2 Solution Design Gate 3 Report- section 4 Environmental

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
developed to work across companies and/or legislative boundaries to develop sustainable solutions and environmental enhancement for the wider benefit of society.	design objectives followed by proposals. 1.3. Alignment with other relevant environmental policy, plans and strategies such as Catchment Management and Local Nature Recovery Plans (see also Place 2).	3. Design Vision and Principles informed by this engagement (Stages 1-6 of design process).	The Gate 3 Report the overarching goals of the Project, which include the need for regional planning, sustainability, and environmental protection as part of the broader response to climate change. The Gate 3 Report mentions collaboration between different water companies, regulatory bodies and local authorities to address long-term water needs, including drought resilience and environmental protection, which aligns with the principle of working across boundaries for the wider benefit of society. Alignment with the relevant environmental policy was reviewed as a part of Environmental Impact Assessment (EIA) scoping.	Gate 3 Report – Section 9 Stakeholder Engagement Annex C: EIA Scoping Report
2. Resource and carbon efficient throughout: Projects	2.1. Lifecycle Carbon: Projects shall support the water industry commitment to	1. Submissions to meet expectations of RAPID Gate 2 Guidance.	Carbon efficient strategies based on Net Zero 2030 route map, as well as Publicly Available	Gate 3 Report – Section 5 Carbon

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
shall seek to reuse existing assets, eliminate waste (including waste of water) and make efficient use of materials and transport across the whole of the project lifecycle.	achieve Net Zero in terms of operational carbon in accordance with the industry roadmap. Projects must be efficient in embodied carbon in both construction and operation. 2.2. Projects should investigate if existing infrastructure assets could be repurposed and reused. 2.3. Projects should look to avoid unnecessary construction and minimise use of materials. 2.4. Projects should seek to minimise the use and waste of water.	2. Narrative on the SRO approach to avoiding and reducing the use of carbon and other resources and Inclusion of the approach in the Design Vision and Principles.	Specification (PAS) 2080 have been prepared. Carbon assessment and carbon-efficient strategies are in section 5 in Gate 3 Report. The waste management and reduction strategy for the project construction and operation was described in section 5.3 of this report. Initial transport assessment was undertaken and a multi-modal approach for construction transportation is investigated (Annex C: EIA Scoping Report).	CDR Section 4.3, 5.1, 5.2, 5.3 and 5.7 Annex C: EIA Scoping Report
3. Resilient and adaptable: Design for anticipated future demand at the appropriate scale. Build in the resilience to absorb and recover from the impacts of the extreme events and	3.1. Designs should be developed to include proportionate measures to anticipate future extreme events and stresses so that they can resist, absorb, recover and, where necessary, be adapted.	1. Submissions to meet expectations of RAPID Gate 2 Guidance noting the climate change scenario(s) the projects have been designed to cope with.	The Project is expected to cope with 1:200year drought resilience by 2030s. Deployable outputs of the Project was analysed for climate change scenarios with 1:200 and 1:500year scenarios. Availability of source flow was examined based on drought conditions/ scenario, excluding	CDR section 5.2 and 6. Annex C: EIA Scoping Report .

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
incremental stresses likely to arise from climate change.	3.2. Designs would support the digitisation of the network at a catchment level using data to inform design, optimise solutions and improve operational efficiency in real time. 3.3. Where proposals add to the resilience of the broader system this should be accounted for in its social value (see Value 3). 3.4. The layout and design of specific elements of infrastructure should be taken in cognisance of planned future development of the immediate area. 3.5. Deploy nature-based approaches to resilience wherever possible (see also Place 2).	2. Review of local plans and strategies that may impact resilience*	infiltration and trade flow (see section 5.2 and 6). Water Resources and Flood Risk assessment was undertaken in Gate 3, and further flood risk assessments (FRAs) will be carried out per National Planning Policy Framework (NPPF) guidelines and in the EIA. To reduce the Project's vulnerability to climate change during construction and operation, drainage systems would be designed in line with EA and Local Lead Flood Authority guidance, using resilient materials for hotter temperatures, addressing changes in rainfall and ground conditions, and ensuring regular inspections, particularly after extreme weather events. Further details in resilience and adoptability to climate change are in section 5.2 of this CDR and Annex C: EIA Scoping Report.	

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
People 1. Understand and respond to your Community's needs: Develop a full understanding of the social context that will be impacted by the project over its lifecycle. Design for how local communities will encounter the infrastructure in their everyday lives during both construction and operation.	1.1. Reliable supply of water to customers 1.2. Designs developed to maximise their social value. 1.3. Proposals reflect local community views as to how they interact with and experience the infrastructure as far as possible.	1. Indicator for Target 1.1 to be decided by others. 2. Initial appraisal of the project and its potential to contribute to the UN's Sustainable Development Goals - or other Social Value evaluation process (see also Value 2 and 3). 3. Review of relevant regional/local policy and demographic information and narrative around how it has shaped the draft Vision and Principles for the option.	The Design Vision sets out the key principle of customer engagement to demonstrate the quality and security that water reuse brings. Drinking Water Safety Plans were carried out and a Planning Consultant and EIA Scoping provided detailed input and direction to meet the requirements of regional/local policy. A non-statutory public consultation was conducted in Autumn 2023 to gather feedback from local communities and stakeholders on the design and environmental impact of the Project. Input from this consultation has been incorporated into the project design. Community engagements undertaken so far and planned engagement activities are outlined in Gate 3 Report and section 5.4 of this CDR.	Gate 3 Report – section 9 Stakeholder Engagement CDR section 3.1 and 5.4 Annex B: Water Safety Plan Annex C: EIA Scoping Report Annex E: Consultation Brochure Annex F: Statement of Community Involvement

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
2. Engage widely, early and meaningfully: Work with stakeholders and local communities to develop their understanding of the importance of nature and water conservation. Develop co-design approaches to aspects of the design of infrastructure and associated landscape where practicable.	2.1. Stakeholders and communities understand the need for the project and the nature/appearance of the proposed solution(s). 2.2. The views of local stakeholders have shaped the design, where possible. 2.3. Engagement and consultation with communities has influenced the design (including but not limited to site selection, layout, materials, detailing) making it more acceptable to them. 2.4. The project provides the public with information on the importance of water and/or nature conservation (e.g. through information boards, artwork or digital information).	1. Summary of feedback from stakeholders (either project specific or received to date through the WRMP/Regional Plan process) and narrative around how it has shaped the draft Vision and Principles for the option. 2. Inclusion of engagement activities within the design programme of the project plan for Gate 3 and beyond showing adequate time for community (public) consultation to inform both site selection (where possible) and developed design. 3. The development of tools that will enable successful engagement (e.g. digital models for visualisation/animation, GIS systems, precedent pictures of similar projects/components) *.	Continuous and open communication between stakeholders has been carried out with stakeholders such as the EA, Natural England (NE), Port of London Authority (PLA), DWI, National Appraisal Unit (NAU) and Ofwat. Non-statutory public consultation for site selection was undertaken in Autumn 2023. Input from this consultation has been incorporated in the design. Consultation brochure and materials including digital 3D graphics have been prepared to enhance effective communication with stakeholders and communities. Early and collaborative engagement has been undertaken with regulators and key stakeholders as above to identify	Gate 3 Report – section 9 Stakeholder Engagement CDR section 2.3, 5.4 and 5.5 Annex B: Water Safety Plan Annex C: EIA Scoping Report Annex E: Consultation Brochure Annex F: Statement of Community Involvement

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
		4. Survey information on local needs and preferences in design*	key issues, agree approaches to monitoring and assessment, and then review findings and consider mitigation requirements. Surveys on local socioeconomic, community, access and recreation, as well as noise, traffic and air quality, are being undertaken as parts of EIA preparation. Stakeholder and community engagements are outlined in Gate 3 Report and section 5.4 of CDR. Surveys on community needs and environments are in Annex C: EIA Scoping Report and section 5.5 of this CDR. Design changes based on community feedback are in section 2.2 of this CDR.	
3. Improve access and inclusion: Consider how people move around your works. Maximise opportunities to support active travel	3.1. Find opportunities to improve people's health, wellbeing and understanding of the natural environment, through access to waterside and green spaces for	1. Mapping of interface with Public Right of Way (PRoW) network* 2. Evidence of engagement with local access groups*	Through Gate 3 and the EIA Scoping process, the need for maintaining access to commercial properties, community assets, recreational resources, and residential properties has been	CDR section 4.3 and 5.6 Annex C: EIA Scoping Report

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
and improve recreational access to waterside and green spaces that can improve outcomes for wellbeing, health, local economy, social inclusion and education.	recreational and other purposes (see Note 1). 3.2. Maximise opportunities for workers to access sites via sustainable transport during construction and operation. Minimise disruption to travel routes in areas affected by a project during construction and operation.	3. Review of Local Cycling and Walking and Infrastructure Plans (LCWIPs) information or similar and note of how the project may impact/enhance it.*	assessed. Sites have been selected minimise disruption. Mitigation measures, such as implementing diversions for Public Rights of Way (PRoW), are proposed to ensure accessibility is maintained. Improving water quality is one of the Project's beneficial outcomes, and there is the potential to create lasting legacy benefits in education, recreation, community, and amenity during project operation. Proposed approaches and assessment related to access and transportation can be found in EIA Scoping Report, section 4.3 and 5.6 of this CDR.	
Place 1. Take care: Develop proposals in the spirit of stewardship looking to both the past and future of each context to understand and	1.1. Achieve Environmental Net Gain (ENG). 1.2. Adopt measures in the design that enhance the environment and help avoid future problems - e.g. adoption of SuDS solutions	1. Evidence of place-based balanced, holistic and long-term decision making in the description of design considerations and development of design vision and principles.	Option and site appraisal includes detail of frequent collaborative reviews between the engineering, environmental, planning and commercial designers. These reviews significantly influence the design development of the	Gate 3 Report- section 2 Solution Design Gate 3 Report- section 4 Environmental

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
develop its landscape, cultural heritage, health and sustainability. Work with partners to secure the long-term success of all measures.	that improve cooling, attenuate surface water run-off and improve infiltration and biodiversity. 1.3. Have clear and realistic long-term strategies for how operational and mitigation proposals will be managed and maintained. Develop partnerships with local communities where this has a mutual benefit. 1.4. Develop proposals in light of a clear understanding of the area's landscape and history.	2. Statement on SRO approach to achieving Environmental Net Gain within the Design Vision and Principles. 3. Evidence of review of adopted (or emerging) spatial plans, strategies for the areas impacted by your works*. 4. Landscape/townscape character assessments and approach to design specific to context.*	projects in line with the place-based principles as outlined in Gate 3 Report. SRO's approach to achieving Environmental Net Gain is stated in section 5.7 of this CDR and in the design principles. Review of spatial plans and landscape/ townscape assessments were undertaken in EIA Scoping and strategies/approach for the impacted areas are outlined in section 5.7 and 5.8 of this CDR and Gate 3 Report.	CDR section 5.7 and 5.8. Annex C: EIA Scoping Report
2. Protect and promote the recovery of nature: Focus on the role of landscape, its capacity to accommodate infrastructure and shape places. Work collaboratively and employ holistic, landscape-scale	2.1. Achieve at least 10% Biodiversity Net Gain (BNG). 2.2. Deploy nature-based approaches to integration and mitigation as the first-choice solution where possible. 2.3. When looking at options to provide compensation or enhancement prioritise	1. Statements on your approach to achieving BNG and aspirations to contribute to the recovery of nature within Design Vision and Principles. May include specific reference to local Green-Blue Infrastructure Strategies/ (emerging) Local Nature	A minimum of 10% of BNG will be achieved. This is stated in the Project's design principle. The Project includes enhancing and improving existing habitats downstream. This reflects the principle of focusing on the role of landscape and delivering multiple	Gate 3 Report- section 2 Solution Design Gate 3 Report- section 4 Environmental CDR section 5.7 and 5.8.

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
approaches that support and deliver biodiversity net gain as well as multiple other benefits.	measures that support achieving good ecological condition for affected watercourses and bodies as a whole. When making an intervention, mitigate infrequent impacts by developing proposals that keep them local and short lived. 2.4. Work with landowners and land managers to develop mutually beneficial solutions where practicable.	Recovery Plans, catchment management plans and other measures to improve watercourse quality.	benefits through a landscape-scale approach. Baseline ecological surveys have been carried out in the potential plant sites and conveyance routes where the Project could impact the local ecosystem and the nature. The findings of surveys were used in the site appraisal process. A BNG assessment was undertaken for the preferred solution. This aligns with the principle of promoting the recovery of nature and delivering biodiversity net gain as part of the Project. An informal Habitats Regulations Assessment Stage 1 Screening was undertaken. The study highlights efforts to mitigate impacts on specific habitats, such as the Richmond Park SAC and stag beetle habitats, demonstrating a commitment to protecting nature and working with the landscape.	

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
3. Design all features beautifully, with honesty and creativity: Our utility infrastructure can be a source of pride and a positive contribution to its context. Develop proposals that reveal and celebrate its importance, provide visual delight and leave a positive legacy.	3.1. Develop a utilities architecture that speaks to its purpose and enhances its context. This applies to buildings, structures and landscape. 3.2. Develop designs and, where appropriate, artworks that bring narrative (meaning), beauty and interest to the proposals. 3.3. Consideration of context in every aspect of design including its location, layout, form, scale, appearance, landscape, materials and detailing.	1. Set out with opportunities and aspirations for high quality design within Design Vision and Principles. 2. Development of a project plan stating how these aspirations will be developed/achieved. 3. Favourable independent design review outcomes* 4. See also Place 1.	The Gate 3 Report outlines the design principles that ensure the infrastructure contributes positively to the local context. The HRA includes mitigation efforts such as the creation of exclusion zones around suitable habitats. This aligns with the goal of integrating infrastructure harmoniously with its surroundings and contributing to the visual and ecological landscape. The proposed River Abstraction and Outfall would be located on the River Thames which is an iconic natural heritage location for Londoners and for the world. Ensuring engineering and functional integrity, the Project will deliver designs of these components beautifully with a pride of being a part of the community. Architects and landscaping specialists will be engaged in design work with	Gate 3 Report- section 2 Solution Design Gate 3 Report- section 4 Environmental Gate 3 Report – section 9 Stakeholder Engagement CDR section 3.1, 5.7 and 5.8.

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
			minimal consequences visually and for local access. Local legacy benefits include job creation, training, and environmental and biodiversity net gain, all of which contribute to the positive impact and lasting legacy of the infrastructure. Community and stakeholder engagement will shape the Project, ensuring that the design aligns with community expectations and enhances the local environment.	
Value 1. Maximise embedded value: Work collaboratively across specialisms and with stakeholders to maximise the benefits of the project by being smart with the location and arrangement of elements and design of	1.1. Early multidisciplinary input informing a design that solves multiple problems at once. 1.2. Design of infrastructure capable of adaptation to reasonable future demands (see also Climate 3). 1.3. Site selection processes and layouts that assist (or as a minimum, do not prevent)	1. Evidence of multi-disciplinary input into site selection* (See Note 2). 2. Initial project and, where appropriate, site appraisals (including constraints and opportunities) undertaken by a multi-disciplinary team (steps 1-5 in design development process).	In Gate 3, the preferred solution was selected and refined through collaboration with stakeholders and multidisciplinary teams to optimise the location, arrangement, and design elements to maximise benefits within the Project's scope. This includes considerations for site selection and the adaptability of infrastructure to future demands.	Gate 3 Report- section 2 Solution Design Gate 3 Report- section 4 Environmental CDR section 3.1, 5.7, 5.8 and 5.9

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
mitigation within the project scope and budget.	local development except where absolutely necessary. 1.4. Reinstatement, landscape and mitigation proposals that improve the existing situation, - e.g. through better biodiversity, carbon sequestration, surface water infiltration and reduced run-off. 1.5. Deliver benefits efficiently by exploiting the two-way relationship between infrastructure and natural capital to enable multiple benefits to be delivered simultaneously.	3. A statement within the Design Vision on the SRO's aspirations and capability to deliver embedded value which should include Social Value, BNG and ENG.	Compliance with the WFD prioritises reinstatement, landscape, and mitigation proposals that improve the existing situation, such as better biodiversity, carbon sequestration, and surface water infiltration. This aligns with the goal of maximising embedded value through smart environmental design.	
2. Understand how you could provide additional value: Identify opportunities to contribute wider regional benefits outside of the project scope. In particular, look for synergies with relevant catchment management plans	2.1. Strategic project selection is informed by cross-sectoral engagement to maximise social benefit and reduce the use of customers money (see note 3). 2.2. Work closely with partners and focus on landscape scale projects that improve hydrology, aquatic ecology and reduce/sequester carbon	1. A description of potential opportunities to work with other projects/partners to achieve wider benefits. 2. A statement within the Design Vision on the SRO's aspirations and capability to deliver additional value.	the Project was selected as the best value plan being informed by cross-sectoral engagement and work with the regional group (WRSE). Teddington DRA is identified as one of the potential water source options for T2AT SRO. There is a potential opportunity that DO from Teddington DRA would replace raw water from Hampton Intake	Gate 3 Report- section 2 Solution Design Gate 3 Report – section 9 Stakeholder Engagement CDR section 5.9

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
and proposals that support the delivery and enjoyment of a healthy water environment.	and provide opportunities for access to recreation and visual delight. 2.3. Be honest and realistic with partners as to what you might be able to offer as an organisation.		and provide benefit to West London. The potential for providing long-term environmental benefits such as habitat enhancement and BNG align with the principle of contributing wider regional benefits and supporting a healthy water environment. Stakeholder engagement, including regulators and local communities, ensures that the Project aligns with broader regional goals. Cross-sectoral engagement maximises social benefits and reduces costs, contributing additional value beyond the immediate project needs.	
3. Capture and measure embedded and additional value: Have clear narratives about how you are contributing to society beyond the core scope of your project. Quantify these benefits	3.1. Gathering of project specific data and improvement in the tools we have to measure and monitor added and additional value across the sector. 3.2. Full consideration of potential benefits in the Cost	1. Details of the best-value metrics used in determination of the Regional Plans and WRMPs and a clear narrative on how these have influenced option selection so far. 2. Inclusion of a description within the project plan of	Details of the best-value metrics and option selection methods are described in Gate 3 Report. As the Project progresses, development, enhancement and monitoring of benefits will be undertaken. Socio-economic impacts will be further assessed	Gate 3 Report- section 2 Solution Design CDR section 5.9

ACWG Design Principles	Targets	ACWG Gate 2 Indicators *Activity may occur at Gate 2 or Gate 3 depending on maturity of the proposals.	Approach in Teddington DRA Gate 3	Documentation in Gate 3 Submission
so they can be considered meaningfully in conversations on value, financing and risk. Share your experience and knowledge widely.	Benefit analysis and investment case for the SRO. 3.3. Clear communication of value of the project to stakeholders, communities and within the industry.	how these will be developed and monitored at subsequent gates. 3. Initial narrative (description) of the value of the project in plain English.	through the EIA process, and measures to mitigate impacts on, for example, community access, will be set out in the CoCP. This may include ongoing assessments of employment impacts, economic contributions, and the enhancement and use of community amenities, which would be documented and reviewed through the various stages of the Project. Wider benefits of the Project were described in Gate 3 Report.	

Acronyms and Glossary

Term	Definition
London Water Recycling SRO	Term to describe the Strategic Resource Option group consisting of Beckton Water Recycling scheme, Mogden Water Recycling scheme and Teddington DRA, as recommended to be progressed in Gate 3.
Beckton Water Recycling scheme	Option to develop a water recycling plant at Beckton STW including abstraction, treatment and conveyance scope. One of the three schemes in London Water Recycling SRO.
Mogden Water Recycling scheme	Option to develop a water recycling plant at a site near Kempton WTW for Mogden STW effluent including abstraction, treatment and conveyance scope. One of the three schemes in London Water Recycling SRO.
Teddington DRA	Option to develop a water recycling plant at Mogden STW taking effluent for tertiary treatment then discharging to River Thames including abstraction, treatment and conveyance scope. One of the three schemes in London Water Recycling SRO.
Final Effluent	Water treated and discharged from existing secondary treatment process in Beckton Sewage Treatment Works or Mogden Sewage Treatment Works
recycled water	Water treated in the proposed Tertiary Treatment Plant (TTP) or Advanced Water Recycling Plant (AWRP)
component	The key engineering items that contribute to each option e.g. pipeline, advanced water recycling plant.
conveyance	Refers to the assets which make up a transfer of fluid from one location to another, e.g. pipeline, tunnel, pumping station and outfall.
scheme	Refers to the overall system for one of three 'Options' within the London Water Recycling SRO for providing water resource benefit to the region, e.g. Beckton Water Recycling, Mogden Water Recycling and Teddington DRA.

Acronym	Definition
ACWG	All Company Working Group
AMP	Asset Management Plan
AQMA	Air Quality Management Area
AWRP	Advanced Water Recycling Plant
BNG	Biodiversity Net Gain
BOD	Biological Oxygen Demand
CBA	Cost Benefit Analysis
CCPs	Critical Control Points
CDBB	Centre for Digital Built Britain
CDM	Construction Design Management
CDR	Conceptual Design Report
Defra	Department for Environment, Food and Rural Affairs
DEL	Drought Event Level
DCO	Development Consent Order
DNO	Distribution Network Operator
DO	Deployable Output
DRA	Direct River Abstraction
DWI	Drinking Water Inspectorate
dWRMP	Draft Water Resource Management Plan
DYAA	Dry Year Annual Average
DYCP	Dry Year Critical Period
EA	Environment Agency
EIA	Environmental Impact Assessment
ELV	Emission Limit Value
ENG	Environmental Net Gain
EPB	Earth Pressure Balance
EQS	Environmental Quality Standard
GIS	Geographic Information System
HAZOP	Hazard and Operability Analysis
HGV	Heavy Goods Vehicle
HSE	Health and Safety Executive

Acronym	Definition
HV	High Voltage
ID	Internal Diameter
KGV	King George V Reservoir
LGV	Large Goods Vehicle
LLCS	London Lorry Control Project
LTCD	Lower Thames Control Diagram
LTOA	Lower Thames Operating Agreement
LV	Low Voltage
LWR	London Water Recycling
MBBR	Moving Bed Biofilm Reactor
MCC	Motor Control Centres
MF	Mechanical Filters
Ml/d	Mega litres per day
MMC	Modern Methods of Construction
MMP	Materials Management Plan
NAU	National Appraisal Unit
NE	Natural England
NIC	National Infrastructure Commission
NIS	Network and Information Systems
NPPF	National Planning Policy Framework
NPS	National Permitting Service
NSF	Nitrifying Sand Filters
PAS	Publicly Available Specification
PCI	Pre-Construction Information
PLA	Port of London Authority
PR19	Price Review 2019
PRoW	Public Right of Way
PS	Pumping Station
RAPID	Regulatory Alliance for Progressing Infrastructure Development
RIBA	Royal Institute of British Architects
RoSPA	Royal Society for the Prevention of Accidents

Acronym	Definition
SCADA	Supervisory Control and Data Acquisition
SCL	Sprayed Concrete Lining
SEMD	Security and Emergency Measures
SESRO	South East Strategic Reservoir Option
SOLAR	Strategic Overview of Long term Assets and Resources
SRO	Strategic Resource Option
SRN	Strategic Road Network
STW	Sewage Treatment Works
SWMP	Site Waste Management Plan
TBM	Tunnel Boring Machine
Teddington DRA	Teddington Direct River Abstraction
TLRN	Transport for London Road Network
TLT	Thames Lee Tunnel
TSS	Total Suspended Solid
TTP	Tertiary Treatment Plant
Thames Water	Thames Water Utilities Ltd
T2AT	Thames to Affinity Transfer
UK	United Kingdom
UV	Ultraviolet
UXO	Unexploded Ordnance
VSD	Variable Speed Drive
WCH	Walker, Cyclist and Horse Rider
WCHR	Walking, Cycling and Horse Riding
WFD	Water Framework Directive
WRMP19	Water Resources Management Plan 2019
WRMP24	Water Resources Management Plan 2024
WRSE	Water Resources South East
WRZ	Water Resource Zone
WTW	Water Treatment Works

[1] EIC, 2019. Delivering environmental net gain: a fresh approach. [pdf] Available at: https://eic-uk.co.uk/media/eebhjdb3/delivering-environmental-net-gain-2019.pdf [Accessed 3 October 2024].

[2] WRSE. (2022). Method Statement: Best Value Planning. Available at: https://www.wrse.org.uk/media/sy1bu4to/method-statement-best-value-planning.pdf [Accessed 27 Sep. 2024]