Annex B5: Initial Environmental Appraisal Report

Standard Gate two submission for London Water Recycling SRO

Notice – Position Statement

This document has been produced as the part of the process set out by RAPID for the development of the Strategic Resource Options (SROs). This is a regulatory gated process allowing there to be control and appropriate scrutiny on the activities that are undertaken by the water companies to investigate and develop efficient solutions on behalf of customers to meet future drought resilience challenges.

This report forms part of suite of documents that make up the 'Gate 2 submission.' That submission details all the work undertaken by Thames Water in the ongoing development of the proposed SRO. The intention at this stage is to provide RAPID with an update on the concept design, feasibility, cost estimates and programme for the schemes, allowing decisions to be made on their progress.

Should a scheme be selected and confirmed in the Thames Water final Water Resources Management Plan (WRMP), in most cases it would need to enter a separate process to gain permission to build and run the final solution. That could be through either the Town and Country Planning Act 1990 or the Planning Act 2008 development consent order process. Both options require the designs to be fully appraised and, in most cases, an environmental statement to be produced. Where required that statement sets out the likely environmental impacts and what mitigation is required.

Community and stakeholder engagement is crucial to the development of the SROs. Some high-level activity has been undertaken to date. Much more detailed community engagement and formal consultation is required on all the schemes at the appropriate point. Before applying for permission Thames Water will need to demonstrate that they have presented information about the proposals to the community, gathered feedback and considered the views of stakeholders. We will have regard to that feedback and, where possible, make changes to the designs as a result.

The SROs are at a very early stage of development, despite some options having been considered for several years. The details set out in the Gate 2 documents are still at a formative stage.

Disclaimer

This document has been written in line with the requirements of the RAPID Gate 2 Guidance and to comply with the regulatory process pursuant to Thames Water's 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.

LONDON EFFLUENT REUSE SRO

Annex B.5. Initial Environmental Appraisal (IEA) Report

Report for: Thames Water Utilities Ltd

Ref. **4700399659**

Ricardo ref. ED13591 Issue: 1.2 13/10/2022

Version Control

Version 1.0 – 19/08/2022		First Draft
Version 1.1 – 07/10/2022		Inclusion of Teddington 100 and 150Ml/d sized schemes Incorporation of L2 Assurance Comments Incorporation of Legal Comments

Customer:
Thames Water Utilities Ltd

Customer reference:
4700399659

Confidentiality, copyright and reproduction:

Ricardo reference:
ED13591

EXECUTIVE SUMMARY

London Effluent Reuse has been identified as a Strategic Resource Option (SRO) in the Price Review 2019 Final Determination, following submission of Water Resources Management Plans in 2019, with funding allocated to Thames Water. As part of the assessment of water companies' PR19 business plans, Ofwat introduced proposals to support the delivery of SROs and set out an associated gated process for the co-ordination and development of a consistent set of strategic water resource options. This gated process provides a mechanism for the industry, regulators, stakeholders and customers to input into the development and scheduling of strategic solutions, through a combined set of statutory and regulatory processes.

A Strategic Environmental Assessment (SEA) level options assessment was produced to support Thames Water's Gate 1 submission in June 2021 and included early consultation with the National Appraisal Unit (NAU). This Initial Environmental Appraisal (IEA) builds on the work of the Gate 1 assessment and, as per the All Company Working Group (ACWG) guidelines[1], aims to improve the detail and breadth of studies. This has been completed alongside the further development of the concept solution designs, helping to identify risks to feasibility and deliverability of the elements and reduce uncertainty in terms of environmental impact for a key decision point for strategic solutions.

For Gate 1, the London Effluent Reuse SRO was set out as four source options and a range of sizes. One option was in east London, utilising final effluent from Beckton Sewage Treatment Works (STW) (Beckton water recycling scheme). The other three options were in west London, utilising crude sewage or final effluent from Mogden STW to a maximum total reduction of 200 Ml/d, with differing discharge locations in the freshwater River Thames: Mogden water recycling scheme, Mogden South Sewer scheme and Teddington Direct River Abstraction (DRA) scheme. During the course of Gate 2, Thames Water took the decision to pause development of the Mogden South Sewer scheme due to limitations on available flow within the sewer, cost of the scheme and regional modelling not selecting the scheme under any water resources planning horizon scenario. Similarly, development of the pipeline variant associated with the Beckton water recycling scheme was paused, due to the increasing costs associated with trenchless pipeline installation. This was determined to be required for increasing proportions of the pipeline length to avoid environmental and planning constraints. Therefore, the Beckton water recycling scheme progressed through Gate 2 featuring the tunnel conveyance route only.

Therefore, the Gate 2 IEA has revisited the three remaining options, informed by a more detailed conceptual design produced by the team engineers; notably the refinement of the conveyance routes and associated infrastructure (e.g., shaft locations). The assessments undertaken in Gate 1 had a primarily aquatic and operational phase focus. The understanding of the operational impacts has been refined since Gate 1, with further baseline data collection and refinement of the modelling scenarios and outputs, to provide greater clarity in the physical environment and water quality effects, and therefore impacts to aquatic ecology.

To further support the initial appraisal of the conveyance routes, infrastructure sites and construction phase impacts, additional desk-based supporting studies have been undertaken in Gate 2 for predominantly land-based environmental topic areas not previously considered at Gate 1, notably archaeology, landscape, terrestrial ecology and visual amenity, noise and air quality. These desk-based studies have been supported by some initial site visits (e.g. landscape, terrestrial ecology), which is considered proportionate to assess the feasibility and conceptual design at Gate 2. Further site-based survey work will be required to inform the Gate 3 assessment.

It should be noted however that the Gate 2 submission is still to support "*detailed feasibility, concept design and multi-solution decision making".* As such, a number of assumptions have been made to provide an initial appraisal of likely impacts and the severity, with further refinement of the conveyance routes and infrastructure sites required through the ongoing options appraisal process, and construction techniques, methods and programmes to be developed. The operational assessments also need to be developed as the design and understanding of the infrastructure components is developed. As such, the results in this report should be considered as preliminary with an indication of the types of mitigation measures required where impacts are considered to affect a receptor.

---

[1] Environment Agency, Drinking Water Inspectorate & Ofwat (2022). Strategic regional water resource solutions guidance for gate two. RAPID, 1 – 35.

Beckton water recycling scheme

The Beckton water recycling scheme requires a significant length of conveyance route (c 22.3 km) transferring water from the treatment plant at Beckton STW to the River Lee Diversion Channel north of the King George V reservoir. The conveyance route will be constructed in two parts: Beckton Advanced Water Recycling Plant (AWRP) to Lockwood Reservoir Pumping Station and Lockwood Reservoir Pumping Station to King George V (Thames Lee Tunnel Extension). The multi-disciplinary team has worked to create a design that minimises potential environmental impacts by utilising hardstanding or poorer quality habitats along the conveyance route for shaft locations, and considering construction techniques to minimise traffic on the local road network by removing spoil from the tunnel boring works at the start and end points. The majority of construction related impacts are considered to be mitigatable with best practice measures and in some cases specific additional mitigation measures, the effectiveness of which needs further investigation to Gate 3.

Operationally, flow impacts are limited to c.600 m of the Enfield Island Loop where there will be major increases in flow and velocities, under very low flow conditions, prior to abstraction. This is in the context of the baseline low flow conditions being non-natural, and the channel being heavily modified (steep banks and limited bed variability). The reductions in Beckton STW final effluent input into the middle Tideway associated with a Beckton water recycling scheme (max of 300 Ml/d) would not impact upon the Thames Tideway, which has a significantly larger volume in comparison to the discharge.

Key risks from the Beckton water recycling scheme (assuming only embedded mitigation measures are adopted) identified at this appraisal stage, which will require further investigation at Gate 3 and/or additional mitigation, are (these apply to all Beckton size variants and are listed in order of severity):

- Careful management of construction activities will be required when working at Lockwood Reservoir as this is within the Lee Valley SPA and Ramsar site, requiring a small area of permanent habitat loss. Construction of infrastructure and shaft sites along the Lee Valley Reservoir complex (e.g., Coppermills site) will need to ensure disturbance and habitat degradation is minimised.
- Risk of ground gas is high as the two shaft locations (shafts 4 and 9) and conveyance route intersects three landfills which may require significant mitigation or a re-routing of the conveyance. Further investigation (e.g., Envirocheck report, establish conceptual model, intrusive site-based investigations) required to refine risk.
- Risks from air quality are considered to be significant, however further refinement will be required with modelling work undertaken to identify any exceedances in targets.
- Temporary disruption to community wellbeing (during construction) arising from noise, dust, vibration and traffic.
- Temporary disruption to recreational facilities and impact to landscape and visual amenity where shafts are constructed in, or in close proximity to open land (e.g., Wanstead Flats).
- Potential loss of habitats (including a small amount of priority habitat) and disturbance to a range of protected species at the site of the treatment plant, with further surveys required to determine presence/likely absence.
- Flood risk and potential need for compensation at Beckton AWRP site and River Lee Diversion outfall. Flood risk assessments and drainage strategies required for these sites, and some shaft locations.
- There is the potential for permanent negative effects on the setting of heritage assets, including the Grade II listed building Retort House and King George Pumping Station, at the River Lee Diversion outfall site.
- There is an uncertain impact upon greenhouse gas emission levels during operation, as data for this is currently unavailable.

Mogden water recycling scheme

The Mogden water recycling scheme requires two sections of conveyance route, one trenchless between Mogden STW and the site of the new AWRP near Kempton WTW. This will be one corridor but containing two pipelines: final effluent to the AWRP, reverse osmosis waste stream back to Mogden STW for discharge. The second section of conveyance route takes the recycled water from the AWRP to the discharge location at Walton Bridge. This route, c5.9 km, will be predominantly trenched, with small sections of trenchless (e.g., under the River Ash).

The key risk associated with this scheme is the use of the potential AWRP site near Kempton WTW for the treatment plant, given the location next to the South West London Waterbodies SPA and Ramsar, its local designation as a Site of Importance for Nature Conservation (SINC) and the habitats and potential for protected species on the site. The layout within the site has been devised to minimise habitat loss, however between Gate 2 and Gate 3, alternative sites for the treatment plant are to be optioneered to ensure that the site with the least environmental, planning and engineering constraints is selected. Due to the built-up nature of the latter section of the conveyance route, approximately 1.4 km of trenching will be required in highways/road network which is likely to lead to increased disturbance and disruption to local residents. The majority of construction related impacts are considered to be mitigatable with best practice measures and in some cases specific additional mitigation measures, the effectiveness of which needs further investigation to Gate 3.

Operationally, moderate impacts on flows are predicted when compared to the baseline conditions in the River Thames. However, these changes are negligible when considering impacts to water level, depth and average flow velocities. No impacts have been identified on fish pass barrier passability, wetted habitat, water level and suspended sediment concentration in the Thames Tideway.

Key risks from the Mogden water recycling scheme (assuming only embedded mitigation is adopted) identified at this appraisal stage, which will require further investigation at Gate 3 and/or additional mitigation, are (these apply to all Mogden size variants unless otherwise stated and are listed in order of severity):

- Temporary construction, and potential permanent (e.g., lighting, noise) disturbance to the South West London Waterbodies SPA and Ramsar given direct proximity.
- Potential permitting issues with the larger scheme sizes (150 and 200 Ml/d only) have been identified in relation to the discharge temperature during rare and infrequent river and effluent temperature conditions.
- Risks from air quality are considered to be significant, however further refinement will be required with modelling work undertaken to identify any exceedances in targets. Permanent change in character of the immediate area around new AWRP near Kempton WTW and Walton Bridge discharge. Visual amenity changes at Walton Bridge for recreational users of local rights of way, the Thames Path and users of Walton Bridge.
- Loss of habitat and area of a non-statutory designated site of local importance depending on the exact location of the AWRP as well as priority habitats including lowland calcareous grassland and deciduous woodland.
- High levels of traffic movements around the Kempton WTW area where the new AWRP is to be located, potentially on small road network, and when trenching pipeline at Kempton Park and for c.1.4 km in local highways. Further consideration of the haul routes to be used and exact traffic numbers to be undertaken for Gate 3.
- Majority of sites will need further consideration of flood risk and potential for drainage strategies to reduce surface water runoff.
- Risk of ground gas is high as the two shaft locations and the conveyance routes intersects four landfills for Mogden water recycling scheme. Further investigation (e.g., Envirocheck report, establish conceptual model) is required to refine the risk.
- Potential permanent negative effect upon setting of Rosecraft Gardens Conservation Area.
- There is an uncertain impact upon greenhouse gas emission levels during operation, as data for this is currently unavailable.

Teddington Direct River Abstraction scheme

The Teddington DRA scheme involves the rearrangement of storm tanks at Mogden STW to accommodate a tertiary treatment plant (TTP) to treat a portion of the final effluent. A short conveyance route (c. 4.7 km) is required between Mogden STW and the proposed outfall south of Ham, above Teddington Weir. A new abstraction on the River Thames to the existing Thames Lee Tunnel is proposed c.140 m upstream of the outfall.

The key risk associated with this scheme relates to the new infrastructure required at the intake and outfall location. The multi-disciplinary team has worked to minimise the environmental impacts of this part of the scheme, by placing the main structures outside the boundaries of the SINCs where possible, noting the River Thames and tidal tributaries SINC extends along the banks of the River Thames where the intake and outfall will be sited, and minimising habitat loss. Further work will be required to Gate 3 around the connections to the Thames Lee Tunnel and investigating any alternative locations, that would still meet the engineering requirements for the connection. Although new infrastructure is required at Mogden STW, this will be within the existing site boundary rather than occupying a previously undeveloped space.

The majority of construction related impacts are considered to be mitigatable with best practice measures and in some cases specific additional mitigation measures, the effectiveness of which needs further investigation to Gate 3. Operationally, the Teddington DRA scheme may lead to up to moderate reduction in flows when compared to the baseline conditions in the ~250m of the River Thames between the intake and outfall. However, these changes are negligible when considering impacts to water level depth and flow velocities. No impacts have been identified regarding fish pass barrier passibility, wetted habitat, water level and suspended sediment concentration in the Thames Tideway.

Key risks from the Teddington DRA scheme (assuming only embedded mitigation is adopted) identified at this appraisal stage, which will require further investigation at Gate 3 and/or additional mitigation, are (these apply to every Teddington scheme variant unless otherwise stated and are listed in order of severity):

- Conveyance route intersects one landfill site. Further investigation (e.g., Envirocheck report, establish conceptual model) required to refine risk.
- Construction on the Thames Path and Ham Lands, which is in proximity of a number of different recreational assets, impacting upon their community value during construction.
- Potential permitting issues with the larger scheme sizes (150 Ml/d only) have been identified in relation to the discharge temperature during rare and infrequent river and effluent temperature conditions.
- Potential permanent negative effect upon setting and character of Riverside North Conservation Area (intake and outfall location).
- Risks from air quality are considered to be significant, however further refinement will be required with modelling work undertaken to identify any exceedances in targets.
- Permanent change in the open character of the riverside as a result of the intake structure, with views for the local community and recreational users permanently altered, and will impact on the existing open views of the undeveloped riverside. However, intake and outfall structures are not uncommon across the whole stretch of the River Thames, but the design and landscaping of the area will need careful consideration to Gate 3.
- There is an uncertain impact upon greenhouse gas emission levels during operation, as data for this is currently unavailable.

Cumulative Assessment

The cumulative effects and in-combinations assessment uses a receptor-based approach, as detailed in Section 5. Potentially, local communities (including schools) and biodiversity receptors could be affected by multiple environmental effects during the construction of the project. Further assessment will be required during Gate 3 to establish cumulative effects on specific receptors once construction phase programming (overlapping phases) and haul routes are confirmed.

Only one separate, approved scheme, was considered to have the potential to create cumulative impacts with any of the proposed schemes (Teddington DRA) – Ham Close. Given the proximity to the potential intake and outfall location, and indicative construction programmes for both schemes showing potential for overlap, further consideration will be required at Gate 3 as to the need to coordinate HGV movements, for example, to reduce impacts to the local road network.

CONTENTS

List of Figures

List of Tables

List of Appendices

1 INTRODUCTION

1.1 OVERVIEW

This Initial Environmental Appraisal (IEA) report is part of the series of environmental assessment reports which catalogue the set of environmental assessment of the London Effluent Reuse Strategic Resource Option (SRO) through Regulators' Alliance for Progressing Infrastructure Development (RAPID) Gate 2. The reports set out the environmental assessments, which will in turn support regulatory assessment requirements proportionate to RAPID Gate 2 (*Detailed feasibility, concept design and multi-solution decision making*) and onward to RAPID Gate 3 (*Developed design, finalised feasibility, pre-planning investigations and planning applications*). The scope and approach to the environmental evidence provided in these reports was set out in the London Effluent Reuse SRO Gate 2 Scoping Report[2] and consulted on with the National Appraisal Unit (NAU) in November 2021.

This document has been produced as the part of the process set out by RAPID for the development of the 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 2 submission.' That submission details all the work undertaken by Thames Water (TWUL) in the ongoing development of the proposed SRO. The intention at this stage is to provide RAPID with an update on the concept design, feasibility, cost estimates and programme for the schemes, allowing decisions to be made on their progress.

Should a scheme be selected and confirmed in the TWUL final Water Resources Management Plan (WRMP), in most cases it would need to enter a separate process to gain permission to build and run the final solution. That could be through either the Town and Country Planning Act 1990 or the Planning Act 2008 development consent order process. Both options require the designs to be fully appraised and, in most cases, an environmental statement to be produced. Where required that statement sets out the likely environmental impacts and what mitigation is required.

Community and stakeholder engagement is crucial to the development of the SROs. Some high-level activity has been undertaken to date. Much more detailed community engagement and formal consultation is required on all the schemes at the appropriate point. Before applying for permission TWUL will need to demonstrate that they have presented information about the proposals to the community, gathered feedback and considered the views of stakeholders. We will have regard to that feedback and, where possible, make changes to the designs as a result.

The SROs are at a very early stage of development, despite some options having been considered for several years. The details set out in the Gate 2 documents are still at a formative stage.

1.2 THE SCHEMES

For Gate 1, the London Effluent Reuse SRO was set out as four source options and a range of sizes. One option was in east London, utilising final effluent from Beckton Sewage Treatment Works (STW) (Beckton water recycling scheme) via either a tunnelled or a trenchless pipeline convenance. The other three options were in west London, utilising crude sewage or final effluent from Mogden STW to a maximum total reduction of 200 Ml/d, with differing discharge locations in the freshwater River Thames: Mogden water recycling scheme, Mogden South Sewer scheme and Teddington Direct River Abstraction (DRA) scheme. During the course of Gate 2, Thames Water took the decision to pause development of the Mogden South Sewer scheme due to limitations on available flow within the sewer, cost of the scheme and regional modelling not selecting the scheme under any water resources planning horizon scenario[3]. Similarly, development of the pipeline variant associated with the Beckton water recycling scheme was paused due to the increasing costs associated with trenchless pipeline installation for greater lengths of the route to avoid environmental and

---

[2] Ricardo Energy and Environment (November 2021) London Effluent Reuse SRO Gate 2 Environmental Studies Scoping Report. On behalf of Thames Water.

[3] Mogden South Sewer scheme has not been progressed through Gate 2 environmental assessments, and so a dedicated assessment section is not included within this report. However, due to the similarities with the 50 Ml/d Mogden Effluent Reuse scheme (AWRP, discharge location and volume), the outcomes of that assessment can be considered representative of a 50 Ml/d Mogden South Sewer scheme.

planning issues, with the Beckton water recycling scheme progressed through Gate 2 featuring a tunnel conveyance.

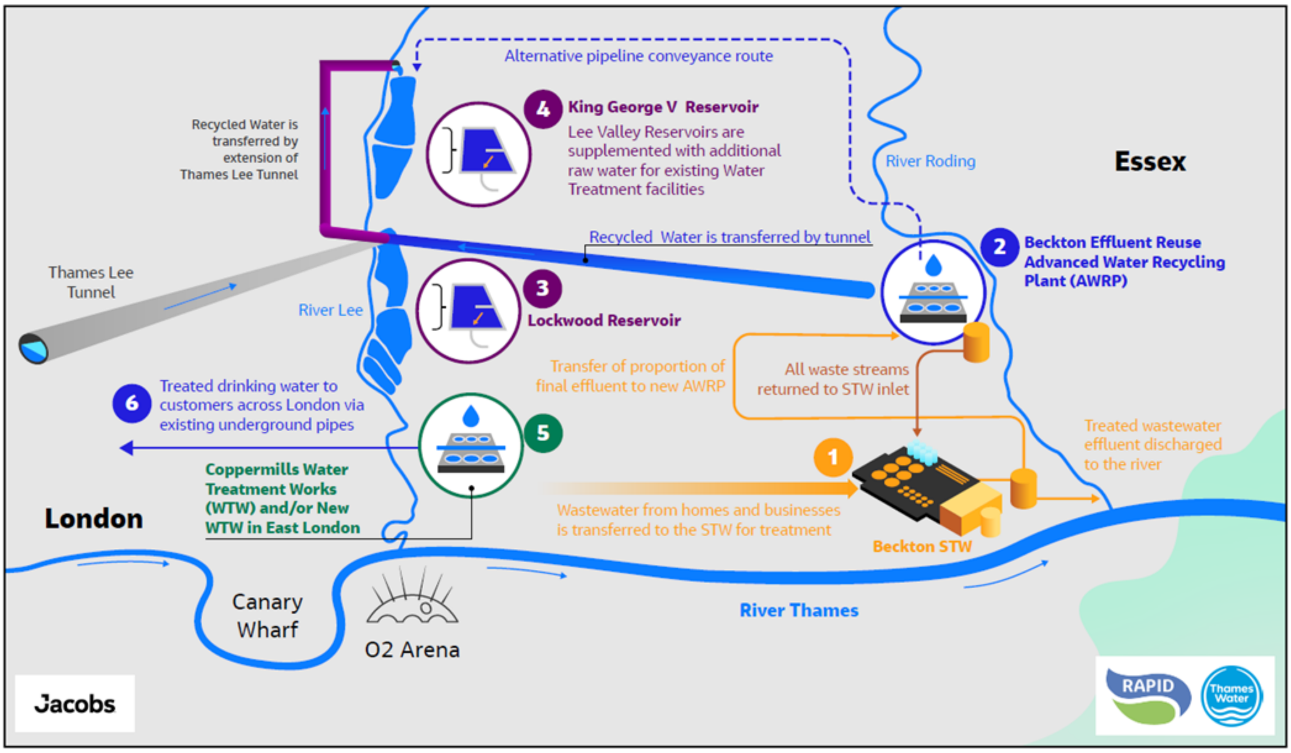
Therefore, the Gate 2 IEA has revisited the three remaining options, informed by a more detailed conceptual design produced by the team engineers; notably the refinement of the conveyance routes and associated infrastructure (e.g., shaft locations), to identify if any of the elements could lead to a significant adverse impact on receptors within the Zone of Influence (ZoI) of the scheme (appropriate to each environmental topic area). Full details of the conceptual design of the schemes are provided in the Annex A. Conceptual Design Reports[4] (CDR) with high level summaries of each option provided below.

1.2.1 Beckton water recycling scheme

Final effluent from Beckton STW would be treated at a new Advanced Water Recycling Plant (AWRP) within Beckton STW for advanced treatment. Recycled water would be conveyed via a new tunnel from the Beckton AWRP to Lockwood Reservoir Pumping Station and then a Thames-Lee-Tunnel (TLT) extension from Lockwood Pumping Station to a proposed new outfall located on a side channel of the freshwater Lee Diversion, known as the Enfield Island Loop, upstream of the existing Thames Water Enfield intake to the King George V Reservoir. Additional abstraction for public water supply on a put/take basis would be through existing intakes in the lower Lee, to supplement the raw water supply to the Lee Valley reservoirs. The option reduces the final effluent at the extant Beckton STW outfall to the estuarine Thames Tideway.

The Beckton water recycling scheme has been assessed for Gate 2 independently at 100 Ml/d, 200 Ml/d and 300 Ml/d.

Figure 1-1 Schematic of Beckton water recycling scheme



1.2.2 Mogden water recycling scheme

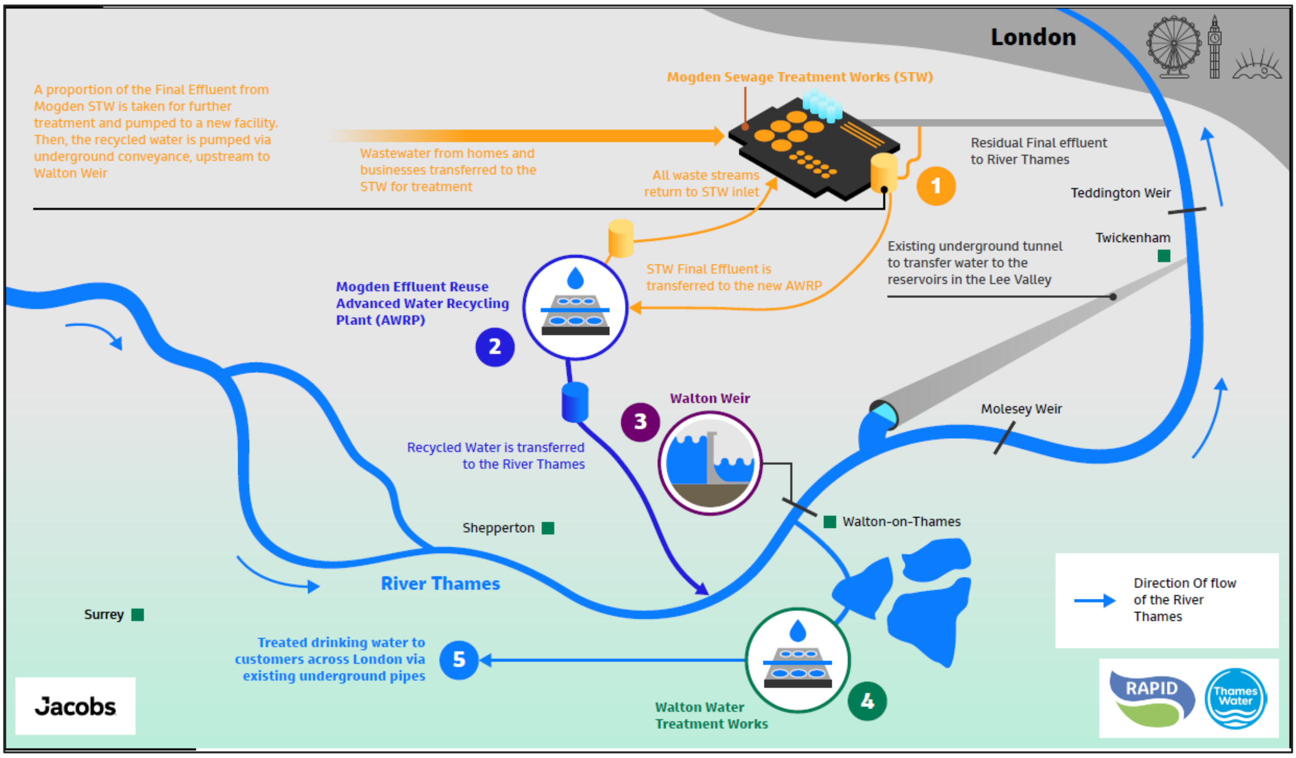
Final effluent from Mogden STW would be pumped in a new pipeline to a new water recycling plant located at a site near Kempton water treatment works (WTW)) for advanced treatment via a new AWRP. Recycled water would be transferred in a new pipeline for discharge into the freshwater River Thames at a new outfall upstream of the existing Thames Water Walton intake. Additional abstraction for public water supply on a put-take basis would be through existing downstream intakes on the River Thames. AWRP wastewater and reverse osmosis (RO) concentrate would be conveyed back to Mogden STW inlet works via a return pipeline(s). There is an

[4] Jacobs (2022) London Effluent Reuse Strategic Resource Option, Gate 2 Conceptual Design Reports.

option that the AWRP wastewater could be discharged to the South Sewer for return to Mogden STW, but it is not possible to return the RO concentrate by this means. The scheme reduces the final effluent at the extant Mogden STW outfall to the estuarine Thames Tideway.

The Mogden water recycling scheme has been assessed for Gate 2 independently at 50 Ml/d, 100 Ml/d, 150 Ml/d and 200 Ml/d.

Figure 1-2 Schematic of Mogden water recycling scheme

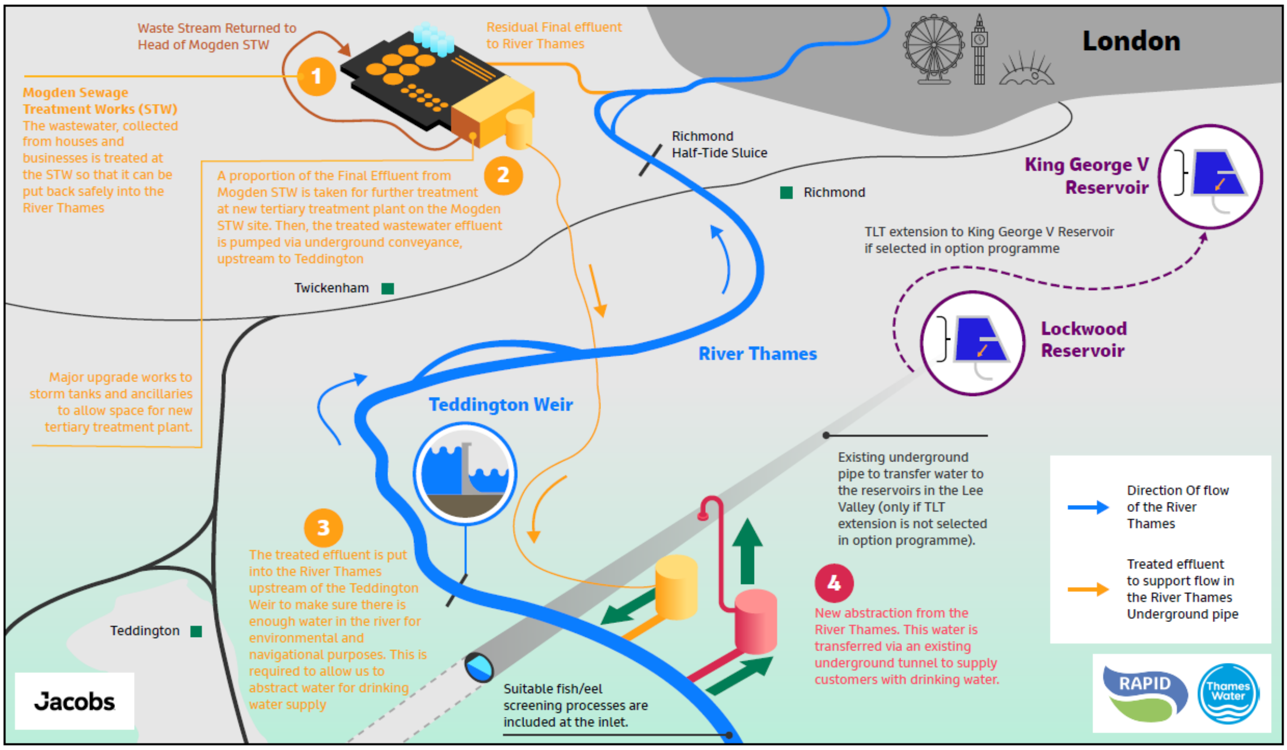


1.2.3 Teddington Direct River Abstraction (DRA) scheme

Final effluent from Mogden STW would be subject to further treatment at a new tertiary treatment plant (TTP) at Mogden STW. The treated water would be transferred in a new pipe-jacked tunnel for discharge into the freshwater River Thames at a new outfall upstream of the tidal limit at Teddington Weir. Additional abstraction for public water supply on a take-put basis would be through a new intake from the freshwater River Thames, upstream of the new outfall. Abstracted water would be pumped into the nearby TLT for transfer to Lockwood Reservoir Pumping Station, part of Thames Water's Lee Valley reservoirs in North London. The option reduces the final effluent at the extant Mogden STW outfall to the estuarine Thames Tideway.

The Teddington DRA scheme has been assessed for Gate 2 independently at 50 Ml/d, 75 Ml/d, 100 Ml/d and 150 Ml/d.

Figure 1-3 Schematic of Teddington DRA scheme



1.3 ENGAGEMENT

In order to engage with regulators over the approach, evidence collection, monitoring programmes, and data analysis for Gate 2, the environmental assessment team held a suite of technical meetings and workshops through Gate 2 for the purpose of either developing consistent approaches or sharing technical information and collaborative working with regulators and stakeholders. Technical Working Groups (TWGs) were set up with the NAU, Environment Agency, Natural England, Historic England and Port of London Authority where scopes of work were developed, methodological approaches agreed and outputs on critical topics shared. Over 35 technical workshops were held through Gate 2 covering the following areas of interest.

- Engineering design
- Terrestrial ecology and BNG
- Fisheries
- Water Quality
- Aquatic modelling
- Aquatic ecology
- Regulatory Assessments
- Temperature
- Navigation
- Historic Environment

Feedback from the TWGs were included in the delivery programme with the outputs reflected in the reports prepared as part of Gate 2. In the sessions with technical specialists, each of the proposed approaches to the topics and statutory reports have been set out and explained. Drafts of documents have been issued, plus other technical notes, to the regulators to solicit feedback on the proposed approaches. Feedback on the drafts has been used to inform the wider environmental assessment for Gate 2 and finalise the approach and reporting. Annex D of the Gate 2 Summary Report provides further detail of this engagement activity through Gate 2.

1.4 RELATIONSHIP WITH REGIONAL PLANS AND WRMPS

The focus of Gate 2 in RAPID's gated process is on ensuring that funding for continued investigation and development of solutions is aligned to water resources planning[5]. Decisions about whether or not a solution goes ahead will be made through water resources planning and subsequently applications for planning and environmental consents.

The Environment Agency has also set out a National Framework[6] for water resources that requires water companies to work together to produce regional plans. London Effluent Reuse SRO and the other SROs are included in the current round of water resource management plans (WRMP24), regional and company plans, and these plans will determine whether and when the options will be needed. The emerging regional Water Resources South East (WRSE) plan published on the 20 January 2022, identified a need for the Teddington Direct River Abstraction (DRA) scheme from 2031, and Beckton water recycling scheme in c.2040. Mogden water recycling scheme was not selected within the plan period. This remains the case at submission of the draft WRMP24 in October 2022.

Appendix 2 of the National Framework 'Regional Planning' sets out the actions that 'must, should and could' feature in regional plans. Amongst the requirements are that it:

- Must include enhance environmental improvements;
- Must comply with Strategic Environmental Assessment[7] (SEA) and Habitats Regulation Assessment[8] (HRA) legislation;
- Should look to use the natural capital approach in their decision making where appropriate; and
- Must include environmental net gain in their decision making, to achieve measurable improvements for the environment on a regional and local level.

The decision making process for determining regional plan solutions to regional and national needs will be developed following the EA Water Resources Planning Guidelines (WRPG[5]) and supplementary guidance[9] which contain a number of requirements and recommendations regarding the scope of WRMP environmental assessment, in particular in relation to the SEA, Biodiversity Net Gain (BNG) and Natural Capital Assessment (NCA). The Regional Plans will need to be reflected in the WRMPs and the assessment therefore need to be consistent with the requirements of the WRPG.

1.5 PURPOSE OF THE INITIAL ENVIRONMENTAL APPRAISAL (IEA)

The purpose of Gate 2 is to refine the Gate 1 activities to improve the detail and breadth of feasibility studies and to develop concept solution designs with reduced uncertainty in costs and benefits. With respect to environmental assessment, SRO schemes are to be developed to a standard suitable for submitting into final Regional Plans and / or final WRMPS. The four RAPID gates are defined as follows:

- Gate 1: Initial concept design and decision making
- Gate 2: Detailed feasibility, concept design and multi-solution decision making
- Gate 3: Developed design, finalised feasibility, pre-planning investigations and planning applications
- Gate 4: Planning applications, procurement and land purchase

The IEA of the London Effluent Reuse SRO at Gate 2 (this document) is an overarching document, pulling together various workstreams and providing an overview of key results and findings. The IEA draws upon the separate *informal* regulatory reports being produced (Annex B.4. Water Framework Directive (WFD), Annex B.3. HRA, Annex B.2.5. Invasive Non-Native Species (INNS), Annex B.6. BNG & NCA, Annex B.7. Marine Conservation Zone (MCZ) Screening) as well as the supporting environmental evidence and assessment reports, including a number of other environmental topic areas not previously considered (e.g., landscape, archaeology, noise and air quality initial risk appraisals). The IEA provides a summary of other relevant

[5] Environment Agency (2021) Water resources planning guideline, July 2021. Available at Water resources planning guideline - GOV.UK (www.gov.uk)

[6] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources

[7] Strategic Environmental Assessment Directive, European Directive 2001/42/EC

[8] Habitats Regulation Assessment, Conservation of Habitats and Species Regulations 2017

[9] Environment Agency (2021) Water resources planning guideline supplementary guidance – Environment and society in decision-making, External guidance: 18643. November 2021.

workstreams, signposting to where further information can be found if published at Gate 2, such that the report acts as a standalone document that can be read to understand the environmental risks and opportunities of the solution proposed at Gate 2.

As the Gate 2 submission does not form a statutory plan or project, there is no statutory SEA required to be undertaken for Gate 2; however, the Gate 2 guidance[10] does state that "*some SROs may require an SEA, in particular where they are forming a plan or programme of works. Legal advice should be sought by the water company to determine the need for a statutory SEA.*" This report is prepared on the basis that there is no requirement for a formal SEA for the London Effluent Reuse SRO at Gate 2.

Having regard to the maturity of the design of the London Effluent Reuse SRO schemes, which are still at feasibility and concept design stage in Gate 2, the environmental assessment undertaken in Gate 2 comprises an initial high-level appraisal, although this appraisal is cognisant of the likely Environmental Impact Assessment (EIA) requirements at Gate 3.

Some aspects of the SEA and EIA are common to both requirements, including consideration of similar environmental topics as set out in Schedule 2 of the SEA Regulations[11] and Schedule 4 of the EIA Regulations[12]. The structure of the IEA report has regard to these common topic areas.

1.6 STRUCTURE OF THE IEA

The IEA is intended as a summary of the London Effluent Reuse SRO workstreams and environmental assessments undertaken. The structure of the IEA is as follows:

Section 2: Description of the London Effluent Reuse SRO schemes

Section 3: Options appraisal

Section 4: Design evolution

Section 5: Approach to the IEA

Section 6: Regulatory report conclusions

Section 7: Impact Risk Assessment: Beckton water recycling

- Introduction
- Baseline, existing evidence base and receptors
    - Water, biodiversity, historic environment, landscape and visual amenity, soil and contaminated land, transport, navigation, noise, air quality, people and communities.
- Assessment
    - Water, biodiversity, historic environment, landscape and visual amenity, soil and contaminated land, transport, navigation, noise, air quality, people and communities.
- Summary and Gate 3 Lookahead

Section 8: Impact Risk Assessment: Mogden water recycling

[sub-headings as for Beckton water recycling]

Section 9: Impact Risk Assessment: Teddington DRA

[sub-headings as for Beckton water recycling]

Section 10: Assessment of cumulative effects

Section 11: Conclusions and next steps

---

[10] RAPID (2022) Strategic regional water resource solutions guidance for Gate 2

[11] Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment ("SEA Directive")

[12] Directive 97/11/EC amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment ("EIA Directive")

2 DESCRIPTION OF THE LONDON EFFLUENT REUSE SRO SCHEMES

Refer to ***Annex A Conceptual Design Reports*** for full details available at Gate 2.

The key assets to be constructed as part of each London Effluent Reuse SRO scheme, based on the conceptual design developed for Gate 2, are summarised in **Table 2-1**.

Table 2-1 Summary of key assets for each London Effluent Reuse SRO scheme

Scheme Name	Key Assets
Beckton water recycling scheme	• Beckton STW final effluent abstraction (pumping station and pipeline located within Beckton STW) • Beckon Advanced Water Recycling Plant (AWRP) (50 – 300 Ml/d) located within Beckton STW • Recycled water conveyance o 3.5m-dia. transfer tunnel (AWRP – Lockwood Reservoir Pumping Station) o 3.5m-dia. transfer tunnel / TLT extension (Lockwood Reservoir PS - KGV) • Recycled water discharge outfall at Enfield Island Loop of River Lee Diversion Channel • Waste stream collection and discharge (pumping station and pipeline located within Beckton STW)
Mogden water recycling scheme	• Mogden STW final effluent abstraction (pumping station located in Mogden STW) • Final effluent transfer tunnel (Mogden STW – AWRP) • AWRP located on TWUL owned land near Kempton WTW (50 – 200 Ml/d, site selection in progress) • Recycled water transfer pipeline (AWRP - River Thames) • Recycled water discharge outfall to the River Thames • Waste stream collection and discharge (pumping station and pipeline, AWRP – Mogden STW)
Teddington DRA scheme	• Mogden STW final effluent abstraction (pumping station located in Mogden STW) • Tertiary Treatment Plant (TTP) located at Mogden STW (up to 150 Ml/d) • Treated effluent transfer tunnel (Mogden STW – Teddington) • Treated effluent discharge outfall to the River Thames o Teddington river abstraction o Intake from the River Thames • Abstracted raw water transfer (pumping station and pipeline, intake - TLT) • Waste stream collection and discharge (pumping station and pipeline located within Mogden STW) • If a TLT extension is not developed as part of a Beckton water recycling scheme, it would form part of a Teddington DRA scheme (For the purposes of this IEA, the assessment of the TLT extension is provided in the Beckton water recycling scheme only)

2.1 BECKTON WATER RECYCLING SCHEME

2.1.1 Concept design

The final effluent (FE) abstracted from the existing FE channels at Beckton STW will be treated in a new AWRP. To ensure WFD compliance, the standard of treatment will be Indirect Potable Reuse (IPR) which will undergo Full Advanced Treatment (FAT) through a RO and UV Advanced Oxidation Process (UVAOP). The option reduces the final effluent at the extant Beckton STW outfall to the estuarine Thames Tideway.

The recycled water will then be conveyed in two new tunnel sections. The first consisting of a tunnel from Beckton AWRP to the primary shaft site at Lockwood Reservoir Pumping Station. The second section of the conveyance route will involve an extension to the TLT from the secondary shaft site at Lockwood Reservoir Pumping Station to a proposed new outfall located on a side channel of the freshwater Lee Diversion Channel, known as the Enfield Island Loop, upstream of the existing Thames Water Enfield intake to the KGV Reservoir. Both sections of conveyance are designed for a transfer capacity of the maximum scheme sizing; 300 Ml/d.

Additional abstraction for public water supply on a put/take basis will be through existing intakes in the lower River Lee, to supplement the raw water supply to the Lee Valley Reservoirs.

2.1.2 Construction and indicative programme

The proposed AWRP site can accommodate the 150 Ml/d single-phase plant development with all process buildings and tanks in above-grade and single-storey configurations, however the two-phase 150 Ml/d capacity AWRP will be both above and below grade due to space constraints. The 300 Ml/d capacity AWRP will also be both above and below-grade due to site space constraints. The current maximum height would be approximately 22m (x2 buildings).

The transfer tunnel would be constructed using a Tunnel Boring Machine (TBM) which is lowered to the base of the drive shaft, and excavates the ground whilst automatically installing pre-cast concrete segments to form the tunnel lining.

The outfall structure on the River Lee Diversion will be constructed from cast-in-situ reinforced concrete, although consideration may be given to pre-casting some elements off site, transporting to the site and installing in position by crane. A short channel between the outfall structure and a culvert under the riverbank footpath will be lined with a geotextile and gabion mattress.

A summary of the scheme components and indication of construction periods is provided in **Table 2-2**.

Table 2-2 Summary of Beckton water recycling scheme components and indicative construction periods

Component	Component Description	Indicative Construction Period[13]
Beckton STW effluent abstraction	Effluent will be obtained from the final effluent outfall of Beckton STW, near the Barking Creek Barrier at the confluence of River Roding. The water will be abstracted via wet wells connected onto the side of the final effluent conduits, to capture the full volume, and pumped via screens to the new advanced water reclamation facility to the north of the Beckton STW.	
Effluent treatment at Beckton STW	RO based process.	44 months
Waste stream treatment and discharge	Waste streams will be produced from the ultrafiltration membranes, the RO membranes and the neutralized chemical cleaning wastewater. These will be collected at a wastewater return pumping station and may be pumped to the inlet of the Beckton STW (in the case of backwash, UF and neutralised CIP wastewaters) or may be combined with final effluent outfall (in the case of RO concentrate). Work on waste management requirements and options is ongoing.	
Treated effluent transfer tunnel from Beckton STW to Lockwood Reservoir **7 shaft locations**	Remineralisation will be required to prevent corrosion of the treated water conveyance by the demineralised water produced by the RO. The tunnel will have an internal diameter (ID) of 3.5m. Based upon the requirements to drive a Tunnel Boring Machine (TBM), drive shafts would require to be 12.5m ID with a construction site area of 5,000 m^2.	33.5 months
Thames-Lee Tunnel extension from Lockwood Reservoir to King George V		24.5 months

[13] Based on 100 Ml/d sized option, not including enabling or commissioning phases. Construction phases may overlap.

Component	Component Description	Indicative Construction Period[13]
reservoir (with pumping station at Lockwood) **5 shaft locations**	The route has been chosen to limit tunnelling under buildings, especially buildings likely to be piled, follow highways to limit wayleaves and passing under greenfield sites to limit issues of settlement.	
Discharge into River Lee Diversion	A new discharge arrangement will be required on the River Lee Diversion Channel; within Thames Water's operational area. It will consist of a housing and a chamber with pipes that feed into a stilling arrangement discharging the treated reuse water into the River Lee Diversion Channel.	7 months

2.2 MOGDEN WATER RECYCLING SCHEME

2.2.1 Concept design

The FE abstracted from the existing FE channels at Mogden STW will be treated in a new AWRP located near to Kempton Water Treatment Works (WTW). To ensure WFD compliance, the standard of treatment will be IPR which will undergo FAT through a RO and UVAOP. The option reduces the final effluent at the Mogden STW outfall to the upper Thames Tideway.

The conveyance routes, one from Mogden STW a new AWRP located near the Kempton WTW, and a second taking treated water from the AWRP to the outfall at Walton Bridge, will be installed using a mixture of trenchless and sections of open-cut.

2.2.2 Construction and indicative programme

It is assumed that construction elements for AWRP will be above ground, single storey and will either be reinforced concrete or steel-clad buildings which will house equipment. Underground tanks and multi-storey buildings may need to be considered if land availability is limited.

Pipe-jacking will be used to construct the conveyance route between Mogden STW and a new AWRP located near the Kempton WTW. Drive and reception shafts will be needed, at depths varying between 14m and 25m, and TBMs will be used.

The recycled water conveyance between the new AWRP located near the Kempton WTW and the outfall at Walton Bridge on the River Thames would be constructed using open-cut trenching methods. This pipeline will be 5.9km in length. There are two short sections that would require trenchless methods (e.g., River Ash crossing). Construction within highways and the local road network will be for approximately 1.4km with the working width in highways and urban areas to be reduced to reduce construction impacts.

The outfall will be mostly buried into the riverbank to ensure a discrete design, however a large open excavation will be required during construction. The structure foundations will be below the river level and will need to be built out from the riverbank 2-3m into the river. The new outfall structure will be made from reinforced concrete and the pipeline will be cast into the wall of the structure. The riverbank profile on either side of the structure will be reinstated, as will the route of the footpath along the river and over the outfall opening to the river.

A summary of the scheme components and indication of construction periods is provided in **Table 2-3**.

Table 2-3 Summary of Mogden water recycling scheme components and indicative construction periods

Component	Component Description	Indicative Construction Period[14]
Mogden STW effluent abstraction	There is a 3m wide, 2m deep final effluent channel that runs along the edge of Mogden STW from the southwest side of the works to the northeast corner to the penstock station and effluent culverts. There are 8no. storm tanks which discharge directly into the effluent channel. It is necessary that the effluent is abstracted upstream of the storm tank discharge to prevent untreated storm water	9 months

[14] Based on 100 Ml/d sized option, not including enabling or commissioning phases. Construction phases may overlap.

Component	Component Description	Indicative Construction Period[14]
	overflow being transferred to the new AWRP. There, proposed connection is upstream of the storm water overflow weir. Abstracted final effluent will be pumped to the new AWRP located near the Kempton WTW for treatment.	
Effluent transfer from Mogden STW to AWRP **11 shaft locations**	A 1600mm-diameter pipeline is to transfer the final effluent from Mogden STW to the new AWRP located near the Kempton WTW. The length of the pipeline will be approximately 8.9km. A single pipeline is the only option. The route will include trenchless crossings of railway lines, watercourses and A roads. Assumption that trenchless crossings are with 2m dia pipejacks.	29 months
AWRP located near the Kempton WTW	Proposed treatment process is being reviewed and currently comprises the following elements; Fine screening, Pre-formed chloramine dosing, Ferric coagulation, Ultrafiltration membrane treatment, Anti-scalant and sodium bisulphite dosing, Reverse osmosis membranes, Advanced oxidation process consisting of UV irridation and hydrogen peroxide addition and Remineralisation with line and CO_2.	27 months
Treated waste stream return pipeline from AWRP to Mogden STW	A 1000mm-diameter pipeline is to transfer the treated waste stream from the new AWRP located near the Kempton WTW to the Inlet Works at the Mogden STW. The length of the pipeline will be approximately 8.9km.	29 months
Treated effluent transfer pipeline from AWRP to upstream of Walton	A circa 1400mm or 1600mm diameter pipeline is to transfer the final effluent from the new AWRP located near the Kempton WTW to the Walton intake. The length of the pipeline will be approximately 6km. The new AWRP site is at an approximate elevation of 16mAoD and the proposed outfall location is at 10MAoD. This gives 6m of head that could be used to gravitate the flow to the outfall without the need for pumping, hence the 100mm diameter.	21.5 months
Discharge to River Thames at upstream of Walton Intake		7 months
Pumping Stations requirement	Pumping stations (wet or dry) are required for the effluent abstraction, the wastewater stream return (from the new AWRP) and treated effluent conveyance. The possibility of gravitating the treated effluent to the outfall is being explored and if feasible	Within above

2.3 TEDDINGTON DRA SCHEME

2.3.1 Concept design

FE from Mogden STW will be subject to further treatment at a new Tertiary Treatment Plan (TTP) at Mogden STW. The treatment design is focused on achieving a compliant discharge, and the proposed process comprises tertiary nitrification for ammonia compliance and chemical dosing and tertiary filtration for phosphate compliance and Biological Oxygen Demand (BOD) compliance.

The conveyance route has been selected to limit tunnelling under buildings where feasible and pass under greenfield sites to limit issues of potential settlement. Intermediate shafts along the tunnel route between the reception shafts will be located within private and public land. Drive shafts require a larger land requirement than reception shafts given their purpose as TBM launch sites, material transportation and storage and plant logistics.

Treated effluent will discharge into the River Thames upstream of the Teddington Weir which will then blend with the river flow downstream towards Ham, and compensate for the abstraction being made at the new intake upstream to the TLT.

The river intake is to be located immediately upstream of the proposed new outfall and is intended to draw up to 150 Ml/d of water from the River Thames. The intake would comprise of course screens, mechanical fine screens and a settling chamber to remove sand or silts that may be drawn in. A low velocity intake with eel screen (self-cleaning band screen) with circa 1mm screen spacing is proposed at this stage.

2.3.2 Construction and indicative construction programme

The new TTP will be constructed at Mogden STW. As there is no vacant land available on site, some of the eight existing storm tanks at Mogden STW will be deepened, freeing up space on the site to construct a new TTP. The new TTP would be built where storm tanks 7 and 8 currently sit. Upgrades of the existing storm return pumps and re-installation of the associated pipework may be required for the deepened storm tanks.

The tunnel between Mogden STW and Teddington discharge site is to be excavated using a TBM and the tunnel lining will be pushed in by pipe-jacking.

The outfall structure will mainly be buried in the riverbank with the outfall discharging into the River Thames below the footpath. A large excavation will be required during construction, so the footpath will be temporarily closed. The excavation will be approximately 10m wide, 30m long and 4m deep. The new outfall will be constructed from reinforced concrete whilst the top cover slabs are likely to be pre-cast concrete craned into position. The riverbank profile on either side of the structure will be reinstated, as will the route of the footpath along the river and over the outfall opening to the river.

The intake structure will require a similar construction process to the outfall, and again require a temporary footpath closure. The foundations will be below the river level and a temporary steel sheet pile caisson will be installed around the excavation area. The caisson will extend into the River Thames 10m from the riverbank. The excavation area will be 20m wide, 40m long and 9m below the river level. The structure will be constructed from reinforced concrete. Temporary sheet piles will be removed post-construction with the riverbank profile reinstated. Re-routing of the footpath will be required over the intake behind new screens.

A summary of the scheme components and indication of construction periods is provided in **Table 2-4**.

Table 2-4 Summary of Teddington DRA scheme components and indicative construction periods

Component	Component Description	Indicative Construction Period[15]
Mogden STW effluent abstraction (with pumping station)	There is a 3m wide 2m deep final effluent channel that runs along the edge of Mogden STW from the southwest side of the works to the northeast corner. The proposed location for connection is upstream of the storm water overflow weir. The internal size of the pumping station is 8.5m by 10m. The pumping station will include pumps, delivery manifold and isolation wall and the pumps are assumed to be 3m by 1.5m. Infrastructure here would range in dimensions, with the largest structure being 8m high, 75m long and 47m wide.	27.5 months
Effluent tertiary treatment at Mogden STW	Abstracted final effluent will be pumped to new tertiary treatment facilities to be built in the location of the existing storm tanks. The existing storm tanks will be demolished and new deeper storm tanks will be installed next to the new tertiary treatment facilities.	
Waste stream treatment and discharge	Waste streams will be produced from the Nitrifying Filter and Mechanical Filter. These will be collected and pumped to the inlet of the Mogden STW	
Treated effluent transfer tunnel/pipeline from Mogden STW to Teddington Weir (with pumping station) **8 shaft locations**	Pipejacked route between shaft locations. A treated effluent pumping station will be required at Mogden STW. The total land space required for the pumping station and substation is 30.0m by 27.5m. This will be located in the vicinity of the tertiary treatment plant.	25.5 months

[15] Based on 75 Ml/d sized option, not including enabling or commissioning phases. Construction phases may overlap.

Component	Component Description	Indicative Construction Period[15]
Discharge to River Thames at Teddington Weir	The outfall, for 150 Ml/d of treated effluent, from the Teddington shaft will be conveyed to the river via a 110m long, 1.5m diameter concrete culvert. The velocity of the flow in the culvert will be 2m/s. The outfall will require screens and a dissipation structure to prevent fish and debris from getting into the tunnel and minimise the discharge velocity.	10 months
Abstraction from the River Thames (with pumping station)	The source of the raw water is the River Thames and the proposed abstraction location is on the north east side of the river in the Burnell Avenue Open Space. The intake is required to be a low velocity intake with eel screens with 2mm screen spacing.	15 months

2.4 LONDON EFFLUENT REUSE OPERATING PATTERN

To support the environmental assessments at Gate 2, an indicative operating pattern has been developed. The approach uses the 19,200-year stochastic flow series developed for the River Thames catchment for the WRSE group. The stochastic flow series represent contemporary climate conditions and provide information on the return frequency, or regularity, of both the likely river flow conditions and London Effluent Reuse SRO operation. The stochastic years have been made available as 48-year continuous periods, and one of these has been selected as having representative flow characteristics to inform the environmental assessments. The selected 48-year series[16] includes a suitable range of regular low and moderate low flow periods. It does not include extreme low flows that are considered to be less regular than once every fifty years. It should be noted that this operating pattern is for the London Effluent Reuse SRO used on its own for Thames Water, without conjunctive use with other Thames Water SROs (such as South East Strategic Reservoir Option). It also uses the controlling triggers developed by Thames Water for current SROs (such as Thames Gateway Water Treatment Plant) based on lower River Thames flows and Thames Water’s total London Reservoir storage. The indicative pattern is shown in **Figure 2-1**, noting that outside the normal operating pattern the Gate 2 engineering design includes a plant and conveyance maintenance flow at all times, with the recycled / treated water being discharged at the reuse outfall but not re-abstracted. The rate of the maintenance flow discharge varies with London Effluent Reuse SRO.

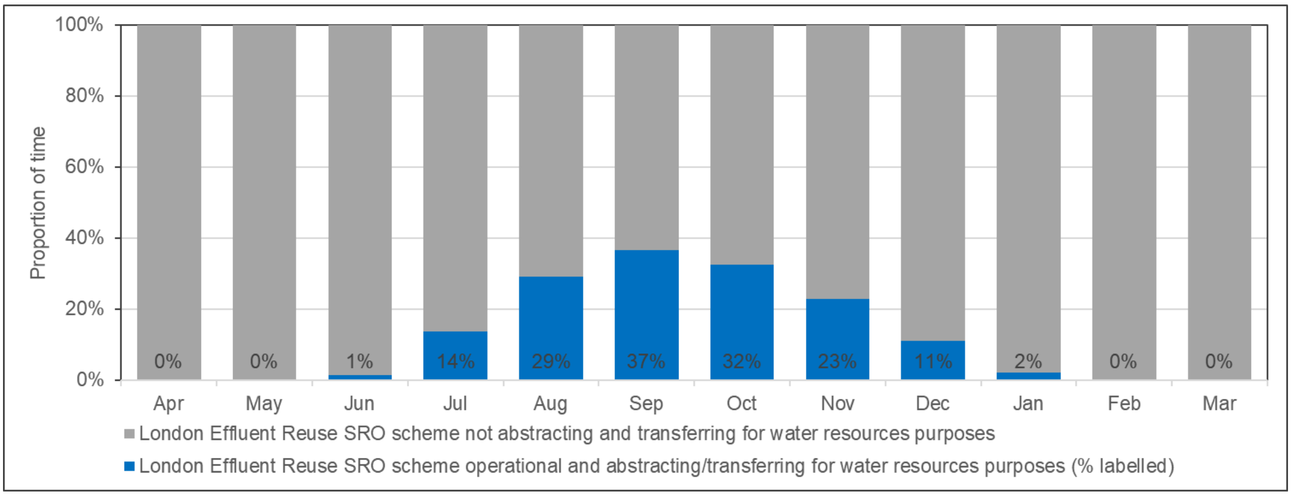
[16] Note these are 48 calendar years. The environmental assessment period has been selected as a water resources year (1 April to 31 March) and as such the selected period includes 47 water resources years from the 48 calendar years.

Figure 2-1 Representation of the operational pattern of London Effluent Reuse SRO as used in the Gate 2 environmental assessments

Within these patterns, selected return frequencies have been selected for the detailed assessment including modelling used extensively in the assessments presented for Gate 2. These are a 1.5 return frequency year with moderate-low flows in the River Thames at Teddington with a 1.5 return frequency operating pattern in terms of duration and season (model reference A82). Also, a 1:20 return frequency year with very low flow years in the River Thames at Teddington with a 1:20 return frequency operating pattern in terms of duration and season (model reference M96). Noting the scheme would only be used on a 1:2 return frequency, these capture a suitable range of circumstances and have been discussed and reviewed with the regulators during Gate 2. In addition, a 1:50 return frequency year of extremely low flows in the River Thames at Teddington and with a 1:50 return frequency operating pattern in terms of duration and season (model reference N17), has been prepared and reviewed for consideration of scheme resilience. Such a low return frequency is outside the regularity of occurrence included in WFD assessments and is not described further in this report.

As shown on **Figure 2-2** expected London Effluent Reuse SRO usage would typically be in the months August to November, peaking at 375 of days in September. Outside this period, there would be less regular usage in July and December, with usage very rare in June and January and not anticipated in February, March April or May.

Figure 2-2 Representation of the per calendar month operational pattern of London Effluent Reuse SRO as used in the Gate 2 environmental assessments



3 OPTIONS APPRAISAL

3.1 APPRAISALS COMPLETED

Two elements of option appraisal work have been undertaken since Gate 1:

- Scheme sizing
- Site and conveyance routes

The latter followed a methodology adopted from Thames to Southern Transfer SRO used at Gate 1 and adapted to reflect the urban setting of London. The process utilised professional judgment and expertise of a multi-disciplinary team comprised of engineers, environmental assessors, town planners and land experts and followed a systematic process of appraisal. Further work is ongoing to refine the options selected with local level data and consultations with Local Planning Authorities, and other regulators (e.g. Natural England) helping to inform decisions to secure a consentable site and conveyance route.

As such, the locations of infrastructure and conveyance routes are indicative only at this stage, and will be subject to refinement through the options appraisal process and detailed design ahead of Gate 3.

3.1.1 Scheme sizing

3.1.1.1 Beckton water recycling

Spreadsheet based stochastic modelling has been undertaken of the freshwater Enfield Island Loop and 3D hydraulic modelling of the estuarine Thames Tideway to understand the risk of breaching any environment thresholds, WFD status or Environment Agency guidance for different scheme sizes[17]. The results show only negligible impacts to the River Lee Diversion Channel and middle Thames Tideway from a 300 Ml/d sized Beckton water recycling scheme.

Early site appraisal work examined the footprint of multiple sizes of AWRPs, and it was concluded that sufficient space was available in the boundary of the existing Beckton STW to accommodate, including a capacity of up to 300 Ml/d.

3.1.1.2 Mogden water recycling

As part of the environmental investigations, 1D fluvial water quality modelling of the River Thames was undertaken, and 3D hydraulic modelling of the outfall locations and weir pools in the fluvial Thames and 3D hydraulic modelling of the Thames Tideway to understand the risk of breaching any environmental thresholds, WFD status or Environment Agency guidance for different scheme capacities[17]. The results show a significant risk from a 200 Ml/d scheme breaching Environment Agency thermal plume characteristics. At a 150 Ml/d capacity, breaches occur in only extreme scenarios whereas at 100 Ml/d the modelling shows no risk of breaching guidance. The constraint on maximum scheme size for Mogden is therefore driven by the potential environmental impacts rather than the available final effluent. For future scheme investigations into Gate 3 the maximum capacity of a Mogden water recycling scheme would be capped at 100 Ml/d.

3.1.1.3 Teddington DRA

As part of the environmental investigations, 1D fluvial water quality modelling of the River Thames was undertaken, 3D hydraulic modelling of the intake and outfall locations in the fluvial Thames and 3D hydraulic modelling of the Thames Tideway to understand the risk of breaching any environmental thresholds, WFD status or Environment Agency guidance for different scheme capacities[17].

Within Thames Water's draft WRMP24, the scheme sizes of 50 and 75 Ml/d, have been assessed. As part of the Gate 2 process for the SRO, 100 and 150 Ml/d sized options have also been tested to refine the upper limit of a promotable Teddington scheme. The 100 Ml/d sized scheme is being recommended for inclusion in Gate 3, and this will be updated in the subsequent iterations between draft and final WRMP and regional modelling to inform WRSE.

[17] Ricardo (2022) London Effluent Reuse SRO Water Quality Assessment Report.

3.1.2 Site and conveyance route locations

Pipeline route corridors have been modified between Gate 1 and Gate 2, informed by feedback from site visits completed by the teams (engineering, planning and ecology). Shaft locations have been moved to reduce likely planning and environmental constraints where possible. An options appraisal process is still ongoing, therefore the infrastructure locations and conveyance routes are indicative only and will be subject to further refinement.

The Beckton water recycling scheme conveyance route has changed very little, with only a couple of shafts moving on the Beckton STW to Lockwood Reservoir section to reduce impacts to recreational facilities and utilise existing areas of hardstanding within open space environments.

The Mogden water recycling scheme has changed very little along the section from AWRP site near Kempton WTW to the Walton Bridge discharge; this remains a trenched pipeline along the boundary of Kempton Racecourse and utilising the road network where possible in Sunbury on Thames. More substantial changes in routing have occurred along the trenchless section between Mogden STW and AWRP site near Kempton WTW. The whole of this pipeline section is now trenchless, and shaft/compound locations have been moved to avoid common land and golf course complexes.

The Teddington DRA scheme has changed with regards the outfall location moving to the opposite bank and shaft/compound locations being refined to avoid open areas within school property boundaries, and reducing impacts to recreational facilities and open space by utilising existing areas of hardstanding, or being in proximity to boundaries, within these environs. The move of the discharge location to the north bank was driven by planning consideration for both the conveyance and discharge construction. 3D hydraulic modelling of the north bank arrangement identified no additional in river constraints compared to the south bank location.

3.2 APPRAISAL RESULTS

3.2.1 Beckton water recycling

A combination of the two tunnel sub-options (Beckton – Lockwood tunnel and Lockwood – KGV tunnel) for the Beckton water recycling scheme was appraised and confirmed as representing a preferred conveyance option, with ongoing progression to be informed by regional modelling outcomes.

3.2.2 Mogden water recycling

Appraisal of the conveyance options identified that the general alignment for the conveyance route was considered to be acceptable, subject to adjustments to avoid interfacing with special category land.

With regards to the AWRP site, a series of locations owned by Thames Water near Kempton WTW were appraised. The AWRP site near Kempton WTW has currently been selected for assessment at Gate 2, however review of the remaining two suitable alternatives will progress into Gate 3 to confirm the most suitable location.

3.2.3 Teddington DRA

The sites and conveyance route appraisal identified that the majority of Gate 1 conveyance route alignment for Teddington DRA scheme remained acceptable, subject to the adjustment of possible site areas for intermediate shafts, and relocation of the discharge outfall location and river abstraction intake to take account of environmental modelling, land use and ownership. The river abstraction intake was identified as requiring further detailed design review and stakeholder engagement with its interface with the public realm setting and its connection to TLT.

4 DESIGN EVOLUTION FROM GATE 1

4.1 DEVELOPMENT OF PREFERRED SCHEME

Table 4-1 provides a summary how the design and construction techniques to be used on the London Effluent Reuse SRO scheme are being developed now that the infrastructure and conveyance routes are more defined. This work will continue to Gate 3 as the most effective way of 'designing-out' adverse impacts to the environment.

Table 4-1 Indication of design evolution at Gate 2

Beckton water recycling	Mogden water recycling	Teddington DRA
Area of land-take at Lockwood Reservoir minimised to reduce potential for adverse effects to Lee Valley SPA and Ramsar.	Layout on AWRP site adapted to minimise use of north west corner closest to South West London Waterbodies SPA and Ramsar, and area with woodland cover	Location of intake has been revised to reduce impacts to the SINCs and minimise loss of trees and woodland habitat.
Beckton STW and KGV sites are to be used to transport soil and waste arisings from tunnels, to minimise transport movements at intermediate shaft sites.	Locations for shaft sites have maximised the use of existing hard standing, and existing visual screens (e.g., recreational facilities). Have also been sited where potential enhancements to those recreational facilities could be afforded.	Locations for shaft sites have maximised the use of existing hard standing, and existing visual screens (e.g., recreational facilities). Have also been sited where potential enhancements to those recreational facilities could be afforded.
Use of barges to transport materials to be explored further.		
Locations for shaft sites have maximised the use of existing hard standing, and existing visual screens (e.g., recreational facilities). Have also been sited where potential enhancements to those recreational facilities could be afforded.		

4.2 EMBEDDED MITIGATION

Embedded mitigation measures were identified for a number of topic areas during Gate 1 and during the completion of the Strategic Environmental Assessment (SEA), which are provided in **Appendix 1**. Those additional mitigation measures required to reduce adverse impacts are identified where relevant for each environmental topic assessment for the London Effluent Reuse SRO schemes in Sections 7, 8 and 9.

The mitigation measures are indicative only at this stage, consistent with the feasibility testing and level of conceptual design completed as required for Gate 2. The mitigation measures will be added to and refined as further assessment work is undertaken to Gate 3.

5 APPROACH TO THE IEA

5.1 INTRODUCTION

5.2 STUDY AREA

The construction study area for the London Effluent Reuse SRO has typically used a 1km buffer[18], measured either side of the conveyance routes and the outer perimeter boundary of infrastructure sites (e.g., AWRP, outfalls). Where specific topic assessments have used a different study area, this is clearly identified in the baseline and assessment sections.

The operational study area for the London Effluent Reuse SRO has been divided into the following water courses to reflect the positioning of the intakes and outfalls for the different schemes:

- The freshwater River Thames from Shepperton Weir to the tidal limit at Teddington Weir, noting the 1D river model boundary is Cricklade in the upper catchment of the River Thames.
- Channels of the freshwater Lee from Newman's Weir on the Enfield Island Loop to the tidal limit at Three Mills Lock.
- The estuarine Thames Tideway from the tidal limit at Teddington Weir, including the Richmond Pound, to 3km seawards of Beckton STW outfall, noting the estuarine model boundary is at Southend-on-Sea.
- The estuarine Bow Creek (tidal Lee) from Three Mills Lock to the Thames Tideway.

5.3 ASSESSMENT METHODOLOGY

In April 2022, RAPID produced final guidance as to the expectations of the regulators for solution submission at Gate 2[10]. This guidance indicated a change in approach from the original Gate 2 guidance and the ACWG methodology, which both envisaged a SEA approach, to an IEA report. As a result, a proposed scope of the London Effluent Reuse SRO IEA was developed in early 2022 (referred to as the IEA Methodology[19]) which had regard to the Gate 2 guidance. The London Effluent Reuse SRO IEA has also reflected on comments made by the regulators on the Gate 1 submission, plus RAPID's recommendations and actions contained in its Gate 1 final decision on the London Effluent Reuse schemes[20].

As mentioned in Section 1.4, the IEA is intended as a summary of the various London Effluent Reuse scheme workstreams and environmental assessments undertaken. Section 5.3.2 signposts where in this IEA the various requirements of the Gate 2 guidance are covered.

The Gate 2 submission does not form a statutory plan or programme and therefore there is no statutory requirement for SEA. However, as with Gate 1, it is recognised that the SEA approach can assist in the identification of potential environmental effects (positive and negative) as well as mitigation and enhancement measures and aid option refinement and selection. These outputs help identify potential environmental risks and opportunities, mitigation measures as well as data gaps and uncertainties. To facilitate the environmental appraisal of the London Effluent Reuse scheme being developed to a level suitable for submitting into final regional plans or final WRMPs, the SEA output tables produced in Gate 1 have been updated for the Gate 2 design using the same methodology, objectives and presentational format.

The structure and scope of the IEA has regard to the environmental topic areas as identified in both the SEA and EIA regime and Gate 2 RAPID guidance. In line with the IEA Methodology, the IEA undertaken in Gate 2 comprises an initial high-level appraisal but is cognisant of the likely EIA requirements at Gate 3. Therefore, further topic areas associated with the land-based infrastructure have been included for high level appraisal.

Each London Effluent Reuse SRO scheme has been considered in separate environmental assessment sections; Section 7 (Beckton), 8 (Mogden) and 9 (Teddington). A summary of the baseline environment is provided in sub-section 2 (Baseline, Existing Evidence Base and Receptors) of each London Effluent Reuse

---

[18] This is consistent with the distances agreed with the NAU via the Gate 2 Environmental Appraisal: Cumulative Effects Methodology in April 2022. The 1km buffer incorporates the distances typically applied under other relevant guidance for environmental topic e.g. Institute of Air Quality Management, or best practice e.g. Preliminary Ecological Appraisal. Larger zones of influence may be required, for example 10km for Habitats Regulations Assessment, again reflecting guidance and best practice.

[19] Ricardo Energy and Environment, June 2022, London Effluent Reuse SRO Gate 2 Methodology Report: Initial Environmental Appraisal

[20] Regulators' Alliance for Progressing Infrastructure Development, December 2021, Strategic regional water resource solutions: Standard gate one final decision for London Effluent Reuse.

scheme section, with reference to relevant work completed during Gate 2 and the additional evidence base available across each London Effluent Reuse SRO scheme. The sensitive receptors across each SEA/EIA topic are defined at the end of each environmental topic section.

Within sub-section 3 (Assessment) the effects identified from the SEA output tables have been reviewed, alongside consideration of activities and pathways for impact. This has been supplemented with further appraisal work completed by technical leads for each environmental topic, to provide consideration of local level designations, and further professional judgement on the types of impacts and severity. Following the review of potential effects and existing uncertainty around the proposed additional mitigation measures, an overall risk rating has been applied to each effect. The risk assessment uses a "traffic light" red / amber / green (RAG) system to display the findings of the assessment. The risk scoring used is provided in **Table 5-1**.

Table 5-1 Risk RAG Scores

Risk Score	Description
Red	Effect is a major/moderate environmental constraint and is likely to be challenging to overcome; significant additional mitigation required; there is significant current uncertainty surrounding understanding of effect and/or scope/effectiveness of additional mitigation measures, will require extensive further investigations to improve understanding.
Amber	Effect is a major/moderate environmental constraint, but with known or commonly applied mitigation measures effect will be overcome; mitigation will potentially be extensive; likely to require further studies and investigations to improve understanding of effect and refine mitigation measures.
Green	Effect is a negligible or minor constraint, or is easily mitigatable with best practice measures and currently defined mitigation or minor additional mitigation requirements.

Within sub-section 3, areas where design refinements and optimisation are to be considered further, and to help develop further mitigation and enhancement measures to be embedded within the detailed design as the schemes progress to Gate 3 are summarised. Where additional work is required to further develop these mitigation measures, the necessary investigations and studies have also been identified.

Sub-section 4 in each London Effluent Reuse scheme assessment provides a summary of the proposed plan of work for Gate 3 required to address remaining data gaps and uncertainties. The proposed scope has been developed to address the likely requirements for planning consent.

5.3.1 Information informing the IEA

The Gate 1 London Effluent Reuse SRO SEA assessment recognised that there were still a number of uncertainties and risks that need to be managed, and that further iterations of the assessment are required as more detailed information and assessment work becomes available during the gated process. The Gate 1 SEA assessment recommended that the Gate 2 work should include the consideration of the recommended *further* mitigation measures as well as confirming the effectiveness of the embedded mitigation measures identified within the Gate 1 matrices.

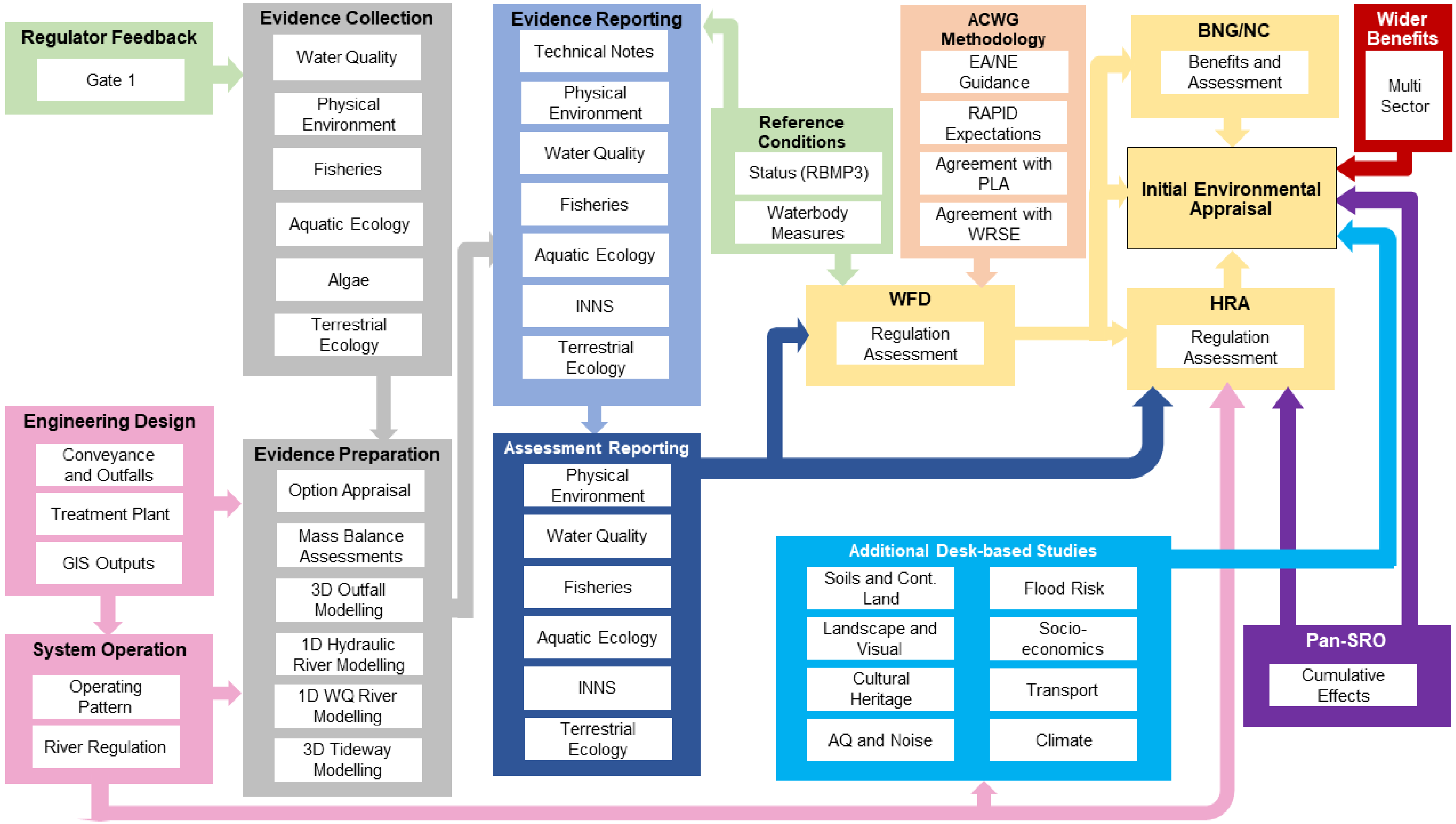
In this context, the environmental appraisals have been updated in Gate 2 as more detailed design and mitigation information is now available. These appraisals cover the physical environment, water quality, fish, invasive species, protected species, protected habitats, macroinvertebrates and other ecology. In addition, updated HRA, WFD, NCA, and BNG assessments have been undertaken and have fed into this IEA.

Figure 5-1 illustrates how the further survey work, studies and assessments help inform the development of the concept designs, mitigation measures and the IEA.

The assessment uses qualitative and / or quantitative information where this is available (such as identified by the HRA or WFD assessment process, conceptual design information, and / or public domain datasets including GIS datasets). The appraisal is at a strategic level and makes use of spatial analysis, professional judgement and applicable assessment guidelines relating to that topic/objective. It should be noted however that the Gate 2 submission is still to support "*detailed feasibility, concept design and multi-solution decision making".* As such, a number of assumptions have been made to provide an initial appraisal of likely impacts and the severity, with further refinement of the conveyance routes and infrastructure sites required through the ongoing options appraisal process, and construction techniques, methods and programmes to be developed.

The operational assessments also need to be developed as the design and understanding of the infrastructure components is developed. As such, the results in this report should be considered as preliminary with an indication of the types of mitigation measures required where impacts are considered to effect a receptor.

Figure 5-1 Interaction between surveys, design, mitigation and assessments[21]



21 "Regulation assessment" referring to adopting *the principles of* these process, albeit not in a statutory context.

5.3.2 Specific requirements of the Gate 2 Guidance

The Gate 2 guidance states that the submission should be supported by an annexed IEA report that addresses the following:

- An update of the Gate 1 work where relevant
- The environmental appraisal work undertaken to date – likely to be at a strategic scale.
- Baseline and analysis – this might include results of monitoring, modelling, environmental surveys, etc.
- Options assessment, with sufficient detail to allow comparison of options within the solution and identify potential effects (positive and negative) and opportunities.
- Assessment of the effects of the solution, an evaluation of their significance and any cumulative or in-combination effects.
- Clear justification as to options within the solution discounted, those taken forward, and the preferred option selected. Where the preferred option is identified, potential environmental effects and opportunities should be discussed.
- The appraisal work should include consideration of resilience (e.g., climate change,)
- A description of the connection to other assessments (e.g., biodiversity net gain, WFD, natural capital, carbon) and demonstrate how they have been considered within this initial appraisal work.
- Development of mitigation and enhancement opportunities.
- Any future monitoring requirements of the identified environmental effects and efficacy of any included mitigation measures.
- A plan to address uncertainties and data gaps.

As stated in the guidance, and at the request of the regulators, these items are summarised within the IEA as shown in **Table 5-2**. A number of elements identified in the Gate 2 guidance document are assessed in detail through other London Effluent Reuse SRO workstreams outside the environmental assessment work and **Table 5-2** signposts where in this IEA report these items are covered.

Table 5-2 Gate 2 IEA requirements

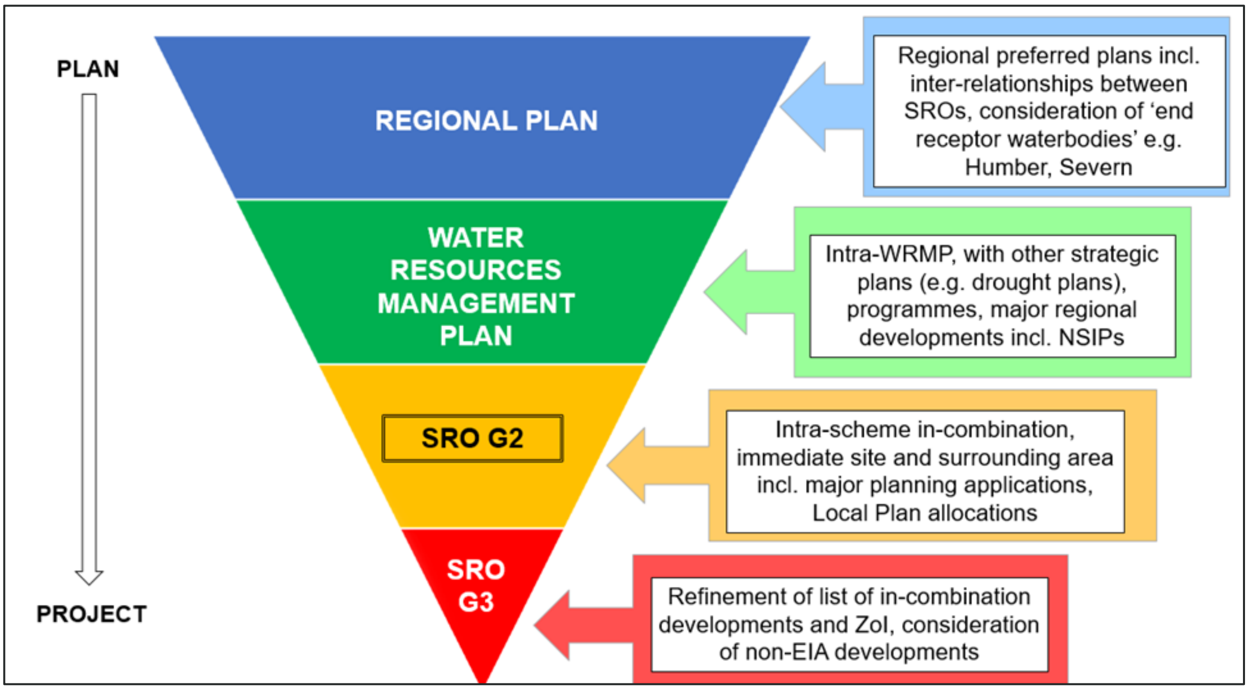
Gate 2 Guidance Requirements	Compliance Check List
An update of the Gate 1 work	Detailed throughout.
The environmental appraisal work undertaken to date	Section 3: Options Appraisals, Section 6 Regulatory Report Conclusions, and Sections 7-10.
Baseline and analysis	Section 7.2 Beckton water recycling - environmental baseline, Section 8.2 Mogden water recycling – environmental baseline and Section 9.2 Teddington DRA – environmental baseline.
Options assessment	Section 3: Options Appraisals
Assessment of the effects of the solution	Section 7: Impact Risk Assessment: Beckton water recycling Section 8: Impact Risk Assessment: Mogden water recycling Section 9: Impact Risk Assessment: Teddington DRA
Preferred options selection	Section 3: Options Appraisals and Section 4: Design Evolution
Consideration of resilience	Section 2.4 explains the approach to modelling for future climate scenarios.
Description of the connection to other assessments	See relevant sections of individual scheme assessment sections
Development of mitigation and enhancement opportunities	Section 6.4 Biodiversity Net Gain and Natural Capital assessment summary
Future monitoring requirements	• Beckton water recycling – Section 7.4 • Mogden water recycling – Section 8.4 • Teddington DRA – Section 9.4
Plan to address uncertainties and gaps	• Beckton water recycling – Section 7.4 • Mogden water recycling – Section 8.4

Gate 2 Guidance Requirements	Compliance Check List
	• Teddington DRA – Section 9.4

5.4 CUMULATIVE EFFECTS ASSESSMENT

Whilst the Gate 2 environmental appraisal is not a regulatory assessment, the requirement to assess cumulative effects is set out in the Rapid Gate 2 guidance[22]. The cumulative effects and in-combination assessment draws on the proposed approach outlined in the Gate 2 Environmental Appraisal - Cumulative effects methodology (December 2021) (referred to as the Cumulative effects methodology)[23], originally presented to the NAU for comment by the Thames Water SRO team in February 2022[24]. **Figure 5-2** presents a high-level overview of the approach taken.

Figure 5-2 The proposed responsibility for completion of in-combination effects assessment: Regional Plans, WRMPs and SROs



In terms of SROs, the Cumulative effects methodology states that these will report the outcomes of the regional plan and WRMP24 in-combination and cumulative effects assessments (relevant to their SRO), where timing permits, and will not undertake any further assessment of the in-combination and cumulative effects of the SRO with the other SROs, plans or programmes identified in these assessments. It will be assumed that the Regional Plan and WRMP24 assessments have concluded no significant in-combination and cumulative effects at a plan level, enabling the SRO to progress. The SRO specific cumulative effects assessment will then look in further detail at the site and surrounding area in terms of local and site-specific information including large development allocations within Local Plans and larger applications such as Development Consent Orders (DCO), Transport and Works Act and Hybrid Bills.

At Gate 2, the SROs are at a conceptual design stage and, therefore, the level of design information is much less detailed than that available at the EIA stage. Furthermore, the appraisal that is presented in the IEA does not report on likely significant effects but rather potential environmental effects in terms of risks and opportunities and likely required mitigation. Therefore, a full cumulative effects assessment, as would be reported in an EIA, is not appropriate for Gate 2, but rather the focus is on identification of risks due to potential

[22] Rapid (Feb 2022) Strategic regional water resource solutions guidance.

[23] Mott Macdonald (April 2022), Gate 2 Environmental Appraisal, Cumulative effects methodology.

[24] The latest version of the note was circulated on 5 April 2022, with a subsequent meeting with the NAU Leads to formally agree its adoption for the SRO process.

cumulative effects of SROs with other plans and projects that will need to be addressed at future gates and for which additional mitigation may be required.

As per the hierarchy shown in **Figure 5-2**, the SRO cumulative effects assessment at Gate 2 focuses on the larger and longer-term developments that could combine with the SRO to cause an additional or different effects on receptors and will be undertaken for the whole of an SRO scheme regardless of consenting route.

The first step is to identify the other plans and developments to be considered by establishing a zone of influence (ZOI) for each topic, using GIS, to determine the maximum area within which other developments and plans will need to be identified. **Table 5-3** provides indicative ZOIs per topic[23].

Table 5-3 Environmental topics and zone of influence[25]

Environmental topic	Zone of influence explanation
Air quality	**Construction:** 350m ZoI from anticipated construction activities for effects relating to construction dust and emissions. **Operation:** 1km ZoI for construction and operational traffic effects.
Biodiversity, flora and fauna	2km ZoI for both construction and operational effects on national statutory designated sites. 1km ZoI for both construction and operational effects on habitat and non-statutory designated sites. Habitats Regulations Assessment to define ZoI for internationally designated sites.
Historic environment	500m ZoI for both construction and operational effects on the significance of designated heritage assets. 200m ZoI for both construction and operational effects on the significance of non-statutory heritage assets.
Landscape	**Construction and operation:** 1km ZoI for both construction and operational effects on landscape.
Material assets	**Construction and operation:** 200m ZoI for both construction and operational effects.
Noise	**Construction and operation:** 600m ZoI from anticipated construction activities as a worst case.
Population and human health	**Construction and operation:** 500m ZOI for assessing impacts on community assets with considering to effects outside of the 500m area where these are likely to occur.
Soils	**Construction and operation:** A 200m ZoI for both construction and operational effects.
Transport and access	**Construction and operation:** A 1km ZoI for both construction and operational effects which will be extended where impacts extend beyond this.
Water	**Construction and operation:** 1km ZoI for flood risk which will be extended where impacts extend beyond this. Water Framework Directive Assessment to define ZoI for water resource (flow and quality) for construction and operational effect.

5.4.1 Intra-SRO cumulative effects assessment

There is no standard approach to the assessment of interrelationships between effects, which will be adopted to assess the intra-SRO cumulative effects. Effects are very rarely additive, but rather a collection of impacts on a receptor that need to be drawn together. Consideration also needs to be given to the potential for 'synergistic' effects whereby different types of impact affecting a receptor may interact together and increase their effect.

A receptor-based approach to the assessment of interrelationships between effects is set out below.

- Step 1: Identify receptor types (e.g., community, ecological habitat or species, a heritage asset, landscape feature or natural feature, waterbody or watercourse) and geographical locations.
- Step 2: Identify receptors and their geographical location.

[25] The 1km buffer incorporates the distances typically applied under other relevant guidance for environmental topic e.g. Institute of Air Quality Management, or best practice e.g. Preliminary Ecological Appraisal. Larger zones of influence may be required, for example 10km for Habitats Regulations Assessment, again reflecting guidance and best practice.

- Step 3: Screen out receptors where there is no potential for interrelationships between effects or temporal overlap of impacts, or where impacts are anticipated to be negligible.
- Step 4: Assess interrelationships between effects at remaining receptors and report on a receptor basis (within geographical areas) appropriate to the effects identified.

It is considered that climate change can be scoped out of the assessment of interrelationships between effects as topic-specific climate change effects will be considered through topic assessments (and be carried through to the cumulative assessment if appropriate), with no separate input to the cumulative assessment required for the climate change topic. Carbon effects are not location specific within the anticipated ZOI for the SROs and do not interact with other environmental effects therefore will be scoped out of the assessment of interrelationships between effects.

5.4.2 Cumulative effects assessment with other plans and developments

As per the Cumulative effects methodology, it is assumed that the Regional Plan will have been subject to an in-combination effects assessment with SROs, and that the WRMPs will be subject to a cumulative effects assessment with adopted and emerging Development Plans, therefore, these have been excluded from the SRO-specific cumulative effects assessment at Gate 2 with the exception of large existing and emerging site allocations. Other confirmed investments by water companies at sites that form part of the SRO options are also considered.

Therefore, the list of other developments and plans considered for this IEA are:

- Large existing and emerging Local Plan allocations e.g., 500 or more dwellings.
- Projects on the Planning Inspectorate's Programme of Projects.
- Hybrid Bills e.g., HS2 Phase One.
- Transport and Works Act Orders for large-scale transport infrastructure.
- Minerals and waste applications, including for landfill and energy from waste.
- Large Town and Country Planning applications where an EIA is required.

Initially, the list of other plans and developments, and a schedule has been developed providing information for each development including location information, planning status, and programme for construction / operation to determine if there is an overlap in temporal scope and which receptors have potential to experience effects from both the SRO and the other development. This allows the potential for cumulative effects of two or more developments to be identified by virtue of overlaps in temporal or geographical scope or due to the scale and nature of the 'other development' / receiving environment, and whether these could require additional mitigation. The intention is to identify interactions of construction and/ or operational effects between developments. This information has not been collected to inform route and/or site selection decisions. Therefore, developments that are likely to be completed prior to construction commencing on the SRO will be excluded from a cumulative effects assessment, as they will instead become part of local, environmental baselines against which broader environmental assessment will be undertaken.

Potential SRO-specific cumulative effects are reported within this IEA together with any proposed mitigation measures (including how the mitigation could be secured and delivered).

It is noted that as the RAPID process progresses and the scheme is refined at Gates 3 and 4, the topic ZOIs will need to be reviewed and updated as necessary. As the ZOIs change, data collection on 'other developments' will therefore also be reviewed and updated ahead of a future EIA Scoping Opinion request. The list of developments for the EIA-stage cumulative effects assessment will also need to be reviewed and updated, for example, consideration given to applications for National Significant Infrastructure Projects (NSIPs) under the Planning Act (2008) and for major developments under The Town and Country Planning Act (TCPA) (1990).

5.5 ASSUMPTIONS AND LIMITATIONS

The principal limitation with the land-based appraisals, and cause of uncertainties at this stage in determining exact risks from the London Effluent Reuse SRO schemes, is a lack of baseline survey data at the specific receptor sites, relative to a final scheme design.

Given Gate 2 is still feasibility and conceptual design, the detail around construction methods, types of plant, HGV movements and programme, is also limited. Therefore, assessments have been undertaken on the best evidence and data at this stage, but will require review and update approaching Gate 3. As such they should be treated as initial risk appraisals only, which is considered sufficient for the requirements of Gate 2.

Operational effects are also less well defined at this stage, in terms of final infrastructure, with a greater focus of Gate 2 being on the effects to the operational effects on the watercourses and construction effects of the land-based infrastructure. Again, the assessments will require review and update approach Gate 3.

6 REGULATORY REPORT CONCLUSIONS

6.1 STRATEGIC ENVIRONMENTAL ASSESSMENT

The purpose of Gate 2 is to refine the Gate 1 activities to improve the detail and breadth of feasibility studies and to develop concept solution designs with reduced uncertainty in costs and benefits. With respect to environmental assessment, SRO schemes are to be developed to a standard suitable for submitting into final Regional Plans and / or final WRMPs.

With elements of the London Effluent Reuse scheme having been refined from those considered in Gate 1, a re-assessment of these amended elements has been undertaken for the Water Resources South East (WRSE) Regional Plan, including the development of updated environmental metrics. The SEA tables, updated to reflect changes in scheme design, completed in February 2022, are available in **Appendix 2** of this report. These follow the same assessment framework as those completed in Gate 1 and therefore do not include the additional information, such as consideration of local level designations, presented within this IEA.

It should be noted, however, that there will be a difference in the point at which the WRMPs and the Gate 2 report are submitted and, therefore, the SEA output tables will likely not be identical.

6.2 HABITATS REGULATIONS ASSESSMENT

Refer to ***Annex B.3 Habitats Regulations Assessment*** for full details.

An *informal* Habitats Regulations Assessment (HRA) was produced to support Thames Water's Gate 1 submission in June 2021 and included early consultation with Natural England. The *informal* HRA for the Gate 2 submission, builds on the work of the Gate 1 assessment and, as per the ACWG guidelines[26], aims to improve the detail and breadth of studies. This has been completed alongside the further development of the concept solution designs, helping to identify risks to feasibility and deliverability of the elements and reduce uncertainty in terms of environmental impact for a key decision point for strategic solutions.

Therefore, the Gate 2 HRA Stage 1 screening assessment has revisited the three remaining options, informed by a more detailed conceptual design produced by the team engineers; notably the refinement of the conveyance routes and associated infrastructure (e.g., shaft locations), to identify if any of the elements could lead to Likely Significant Effects (LSEs) on European sites.

The *informal* HRA Stage 1 Screening assessment concluded that Beckton water recycling scheme, Mogden water recycling scheme and Teddington DRA scheme have the potential to cause LSEs on European sites alone. This was due to LSEs on qualifying habitats and species of the Lee Valley Special Protection Area (SPA) and Ramsar site, Thames Estuary and Marshes SPA and Ramsar site, South West London Waterbodies SPA and Ramsar site and Richmond Park Special Area of Conservation (SAC).

Therefore, *informal* HRA Stage 2 Appropriate Assessments were required to determine whether Beckton water recycling scheme, Mogden water recycling scheme and Teddington DRA scheme would result in an adverse effect on the integrity of European sites, in light of conservation objectives. It was concluded, that with implementation of <u>additional</u> mitigation measures the majority of impact pathways could be suitably controlled such that the schemes would not result in an adverse effect on the integrity of European sites alone.

Further work is required to determine species presence in a number of locations (e.g., use of Barking Creek by Thames Estuary and Marshes SPA and Ramsar bird species) and both the noise and air quality assessments refined, with specific modelling of traffic and plant emissions to be undertaken for the latter at Gate 3.

An in-combination assessment was also undertaken to determine if the London Effluent Reuse SRO schemes from west London had low level residual effects that could lead to an in-combination effect with the east London Beckton water recycling scheme. No in-combination effects were identified. In-combination effects of the London Effluent Reuse SRO with local plans and projects was also considered, and no likely significant effects on European sites were identified. This assessment is based on information available at the time of writing.

[26] Environment Agency, Drinking Water Inspectorate & Ofwat (2022). Strategic regional water resource solutions guidance for gate two. RAPID, 1 – 35.

Table 6-1 Summary of Gate 2 *Informal* Habitats Regulations Assessment (HRA) Stage 1 Screening and Stage 2 Appropriate Assessments of the London Effluent Reuse SRO

Schemes	Is scheme likely to have a significant effect on European site(s) alone in the absence of mitigation?	Appropriate assessment required?	Adverse effect on integrity of European site(s) alone?	Effect in-combination with other plans and projects?
Teddington DRA	Yes – Richmond Park SAC	Yes	No – with mitigation measures	No – with mitigation measures
Beckton water recycling	Yes – Lee Valley SPA/ Ramsar and Thames Estuary and Marshes SPA/ Ramsar	Yes	No – with mitigation measures	No – with mitigation measures
Mogden water recycling	Yes – South West London Waterbodies SPA/ Ramsar	Yes	No – with mitigation measures	No – with mitigation measures

6.3 WATER FRAMEWORK DIRECTIVE

Refer to ***Annex B.4 Water Framework Directive*** for full details.

The WFD Gate 1 submission has been re-evaluated with the inclusion of extra data and evidence to form the Gate 2 submission. The WFD is a strategic assessment, undertaken in line with the ACWG methodology for WFD compliance assessments of SROs.

An assessment has been undertaken of the WFD compliance for the following London Effluent Reuse SRO:

- Beckton water recycling scheme – sizes 100 Ml/d, 200 Ml/d and 300 Ml/d.
- Mogden water recycling scheme – sizes 50 Ml/d, 100 Ml/d, 150 Ml/d and 200 Ml/d.
- Teddington DRA scheme – sizes 50 Ml/d,75 Ml/d, 100 Ml/d and 150 Ml/d.

6.3.1 Beckton water recycling scheme

The effects on the Enfield Island Loop of the Lee Diversion Channel from flow augmentation from a Beckton water recycling scheme outfall are deemed to be WFD compliant with respect to physico-chemical, WFD chemical water quality while potential changes in velocity and depth are not considered to be of a magnitude to result in impacts on aquatic ecology. The affected water course is ~100m of a larger water body Lee (Tottenham Locks to Bow Locks/Three Mills Locks) (GB106038077852) and any effects in the reach are not significant at a water body scale.

No expected potential for status deterioration or introducing impediments to target status were identified in the Thames Middle (GB530603911402) transitional water body from effluent flow reductions.

This assessment has been supported by bespoke modelled and measured data on pathways of impact and have a medium to high confidence.

6.3.2 Mogden water recycling scheme

Minor changes to physico-chemical water quality were noted in the River Thames (GB106039023232), while the parameters currently less than good, e.g. phosphate, receive benefit across all scenarios and do not impede achieving the objective. Minor localised impacts may also occur around a Mogden water recycling outfall.

No potential for status deterioration or introducing impediments to target status were identified in the Thames Upper (GB530603911403) water body for any Mogden water recycling scheme size.

This assessment has been supported by bespoke modelled and measured data on pathways of impact and have a medium to high confidence.

6.3.3 Teddington DRA scheme

No potential for status deterioration or introducing impediments to target status were identified in the Thames (Egham to Teddington) (GB106039023232). However, minor changes to physico-chemical water quality were noted at the 150, 100 and 75 Ml/d scheme size (temperature and dissolved). It must be noted that WFD water body status is assigned by the Environment Agency and that the impact on WFD chemicals informs modelled risk to possible non-compliance from scheme only and that there are other factors including regularity of scheme operation and zone of influence compared with water body scale that are important factors in assessing deterioration risk and risk of impeding targets.

No potential for status deterioration or introducing impediments to target status were identified in the Thames Upper (GB530603911403) water body for any Teddington DRA size.

This assessment has been supported by bespoke modelled and measured data on pathways of impact and have a medium to high confidence.

In Gate 3, as the London Effluent Reuse schemes move away from strategic assessment towards planning, the WFD compliance assessment will move towards that suitable for accompanying an application.

6.4 BIODIVERSITY NET GAIN AND NATURAL CAPITAL ASSESSMENT

Refer to ***Annex B.6 and B.7 Biodiversity Net Gain and Natural Capital Assessment*** for full details.

The BNG and Natural Capital (NC) assessment of the London Effluent Reuse SRO schemes, assesses BNG and NC losses and benefits for the London Effluent Reuse SRO, for reporting as part of the Gate 2 submission and to enable a comparison of the SROs.

An assessment of habitat loss (both temporary and permanent loss) was completed, as was a high-level assessment of habitat reinstatement required on-site and where necessary consideration given to additional off-site mitigation to offset any habitat loss. An assessment of 'uplift' necessary to achieve a minimum of 10% net gain was also undertaken. An associated NCA was completed that accounts for temporary and permanent losses and additional benefits related to on-site and off-site mitigation required to obtain a minimum of 10% net gain.

6.4.1 Biodiversity Net Gain (BNG) terrestrial assessment

The mitigation required to achieve a minimum of 10% BNG was calculated for each of the three London Effluent Reuse SRO schemes. Between the three options, mitigation for Mogden water recycling scheme will provide the greatest BNG, resulting in a net increase of 14.9 units. Implementing the Beckton water recycling option will create a net increase of 7.92 units, and Teddington DRA will provide a net increase of 2.37 units.

Areas of land which may be suitable for mitigation have been identified using scoring criteria with the highest scoring sites potentially offering more effective, functioning mitigation. Due to the relative closeness of the three options, the areas identified can be used regardless of which option is chosen, however due to the differing sizes of habitat loss, Mogden water recycling scheme will require the top five of the identified areas for full mitigation and BNG whereas Beckton water recycling scheme will require the top three and Teddington DRA require only the topmost identified area. Subject to planning and wider stakeholder engagement, details of timelines for implementation will strengthen the confidence of the assessment at future stages.

6.4.2 Biodiversity Net Gain (BNG) rivers assessment

The overall unit changes are displayed in Table 6-2. A total of -0.04 river units losses were estimated for the installation of permanent infrastructure such as pumping stations and abstraction and outfall locations associated with Beckton water recycling scheme option, with operational impacts of increased water flow creating a further loss of -0.23 river units within the Lea Navigation Enfield Lock to Tottenham Locks Water Body. Mogden water recycling scheme also results in a permanent loss of -0.04 river units, but has negligible effect on water flow, so no operational impacts are expected. The Teddington DRA will create a loss of -0.12 river units through the creation of permanent structures, but has no temporary or operational disbenefits.

Mitigation measures to enhance off-site sections of rivers would be required to deliver a minimum of 10% net gain. Permanent construction impacts from Mogden water recycling scheme and Teddington DRA will require respectively the enhancement of 0.6km and 1.8km of 'other river and stream' located outside the catchment. With regards to the Beckton water recycling scheme option, operational impacts have not been considered to impact the river condition at this stage and therefore, mitigation would be required only to compensate the permanent construction impacts. In that case, 1km of 'other river and stream' is recommended to be enhanced off-site and outside the catchment. Enhancement may include the removal of structures within the watercourse to reduce the encroachment, planting, removal of INNS or restoration measures. Further MoRPh survey will inform the encroachment measures required to enhance the river from 'poor to moderate condition'. Subject to planning and wider stakeholder engagement, details of timelines for implementation will strengthen the confidence of the assessment at future stages.

Table 6-2 Summary of the BNG benefits for the Strategic Resource Options

London Effluent Reuse Schemes	BNG - Terrestrial	BNG – Rivers*
Beckton water recycling scheme	7.92 units	-0.04 units
Mogden water recycling scheme	14.9 units	-0.04 units
Teddington DRA scheme	2.37 units	-0.12 units

*Mitigation measures to enhance off-site sections of rivers will be assessed at Gate 3

6.4.3 Natural Capital assessment

The overall environmental benefits in relation to climate regulation, natural hazard regulation and agriculture ecosystem services over the 30 and 80 years for the London Effluent Reuse scheme are summarised in Table 6-3Table 6-3. As the larger schemes have been assessed, there will be more land and associated management costs as it is not accounted in the NC methodology. The current buffer area for the assessed components extends to just the assumed construction zones. Whilst acceptable for a high-level approach, greater detail will be necessary following stakeholder engagement, agreed engineering specification etc as part of further scheme development.

Table 6-3 Summary of the NPV benefits for the Strategic Resource Options

London Effluent Reuse Schemes	30-year NPV benefits	80-year NPV benefits
Beckton water recycling scheme	£20,743	£40,883
Mogden water recycling scheme	£496,421	£1,082,155
Teddington DRA scheme	£219,311	£485,268

6.5 MARINE CONSERVATION ZONE ASSESSMENT

A Marine Conservation Zone (MCZ) assessment (Annex B.7.) was completed following the guidance published by the Marine Management Organisation[27]. A Stage 1 Screening assessment was completed for the Beckton water recycling scheme with regards potential impacts to the Swanscombe MCZ during operation of the AWRP plant.

The Swanscombe MCZ is designated for intertidal mud (seabed habitat) and tentacled lagoon worm (*Alkmaria romijni*) (protected species).

The Annex B.2.1. Physical Environment Report and Annex B.2.2. Water Quality reports, including the modelling of operational scenarios, were used as the basis to understand the potential pathways for impact to the Swanscombe MCZ and changes to physico-chemical properties (e.g. pH, salinity, temperature), sediment movement and hydrodynamic regime, and water quality (dissolved oxygen).

The proposed activities associated with the Beckton water recycling scheme, including the operation of the AWRP, are not deemed to be capable of affecting either the protected features of the MCZ or any ecological or geomorphological process on which the conservation of any protected feature of the Swanscombe MCZ is dependent.

[27] Marine Management Organisation (2013). Marine conservation zones and marine licensing.

6.6 OTHER ENVIRONMENTAL CONSIDERATIONS

6.6.1 Climate and resilience

Water resource schemes have the potential to create beneficial effects on climatic factors through the provision of additional water resource which reduces vulnerability to water supply risks attributed to climate change. Adverse effects are also possible as the operation of the schemes rely on energy usage for treatment and pumping processes. Water companies have commitments to achieve net zero in line with government targets.

Climate monitoring and risk assessments have improved significantly over the last two decades but there are still limits to the understanding of future climate change impacts. Whatever happens to future 'greenhouse gas' emissions, there is already a certain amount of global warming "locked in" due to historic emissions due to the inertia and lags in the global climate system. Mitigation through reduction in greenhouse gas emissions will contribute to risk reduction over the long term (100 years). Adaptation is however needing to start now, in order to reduce the costs and damages of potential impacts and to take advantage of opportunities that result from a changing climate.

The 2018 UK Climate Projections (UKCP18) to 2100 estimate that there will be:

- More intense rainfall events;
- Hotter, drier summers;
- More flooding of low-lying coastal areas;
- Milder and wetter winters;
- Less snowfall and frost;
- Lower groundwater levels.

Climate resilience has been considered for the London Effluent Reuse SRO schemes as requested by regulators. For the Physical Environment assessment, which determines the level of operational impact from the schemes on the watercourses, modelling has been completed for future climate change scenarios, considering different patterns of river flow and STW final effluent flow: a 1:5 return frequency moderate-low flow year (A82); and a 1:20 return frequency very low flow year (M96)[28]. For the water quality assessment, a range of reference condition and SRO operation model runs were established and reviewed during Gate 2. These tested, amongst other things, the extent of environmental change from SRO operation under scenarios such as climate change. As the design of the infrastructure is progressed to Gate 3, climate change resilience due to flood risk for example, will need to be incorporated into the design.

6.6.2 Carbon

Local authority (LA) scale carbon dioxide (CO_2) emissions are produced and estimated each year for the Department for Business, Energy & Industrial Strategy (BEIS). Using data from the UK National Atmospheric Emissions Inventory and the BEIS National Statistics of energy consumption for each local authority, a reliable and consistent breakdown of CO2 emissions across the UK has been published. Using this dataset and carbon emissions estimated during construction and operation (available from the CDRs), percentage increases for each London Effluent Reuse SRO scheme have been estimated.

6.6.2.1 Beckton water recycling scheme

Table 6-4 and **Table 6-5** outline the percentage increase of carbon emissions in each LA across the construction and operational phases. During construction of the Beckton to Lockwood Reservoir Tunnel, Waltham Forest is to experience the highest % increase in total carbon emissions per year compared to other LA with an increase of 1.61%, compared to Redbridge – 0.88%, and Newham – 0.68%. Whilst the Lockwood to KGV Tunnel is under construction, Enfield will see the highest increase in carbon emissions per year with 1.7%, approximately 1% higher than Waltham Forest.

All three AWRP iterations will only impact upon Newham during construction, with the smallest (50 Ml/d) size producing the smallest % increase in carbon emissions and the largest size producing the largest emissions

[28] Some selected reference conditions are specific to selected flow conditions.

per construction year. During operation, only Newham will see an increase in total carbon emissions per year with the total increase dependent on the size of the AWRP to be built.

6.6.2.2 Mogden water recycling scheme

Table 6-6 and **Table 6-7** outline the percentage increase of carbon emissions in each LA across the construction and operational phases. During the construction phase of the Mogden water recycling scheme, Spelthorne will experience highest percentage increase in carbon emissions; 3.01% per year of construction of the conveyance route. The 100 Ml/d option will result in a higher percentage increase to Spelthorne and Richmond upon Thames compared to the 50 Ml/d elements. During construction of the AWRP, Richmond upon Thames will see a higher percentage increase in authority-wide carbon emissions compared to Spelthorne, however during operation, Spelthorne will be marginally higher than Richmond upon Thames. During operation, the conveyance route will have negligible impacts across all LAs.

6.6.2.3 Teddington DRA scheme

Table 6-8 and **Table 6-9** outline the percentage increase of carbon emissions in each LA across the construction and operation phases. During construction of the transfer tunnel, there will be a minor increase to total carbon emissions for Hounslow and Richmond upon Thames. The highest increase in authority wide emissions will be seen in Hounslow during construction of the 100 Ml/d TTP element of the Teddington DRA scheme. Construction of the 100 Ml/d TTP will emit 0.23% more emissions per year compared to the 50 Ml/d option. Only one element is to be constructed in the authority of Kingston upon Thames (River Abstraction and TLT connection) which will create a small increase of 0.77% in carbon emissions per year of construction.

During operation there will be minor increases to Hounslow's annual total carbon emissions. The 50 Ml/d and 100 Ml/d TTPs will bring an increase of 0.027% and 0.041% per year respectively.

6.6.2.4 Significance of the carbon emissions of each scheme

Carbon emissions for any individual scheme are difficult to assess the significance of. In isolation, the carbon emissions would not be significant for any of the schemes considered in this IEA. This is due to the global nature of greenhouse gas emissions and their effect also being global. As a result, it is considered that all schemes that are carbon positive are significant in terms of carbon emissions. All carbon emissions should be prevented or minimised, if possible.

Table 6-4 Beckton water recycling scheme: estimated construction carbon impact to Local Authorities

		Beckton to Lockwood Recycled Water Transfer Tunnel			Lockwood to KGV Recycled Water Transfer Tunnel			50 Ml/d AWRP		100 Ml/d AWRP		150 Ml/d AWRP	
Beckton water recycling	LA Grand Total (t CO2)	Total Carbon (t CO2)	LA Impact (% increase)	LA Impact per construction year (% increase / year)	Total Carbon (t CO2)	LA Impact (% increase)	LA Impact per construction year (% increase / year)	Total Carbon (t CO2)	LA Impact per construction year (% increase / year)	Total Carbon (t CO2)	LA Impact per construction year (% increase / year)	Total Carbon (t CO2)	LA Impact per construction year (% increase / year)
Scheme Embodied Carbon		62,230			46,090			32,713	12,936	55,176	21,819	70,361	27,824
Epping Forest	**929,366**												
Barking and Dagenham	**563,577**												
Enfield	**111,206**				36,872	3.32%	1.77%						
Haringey	**657,614**												
Newham	**1,021,020**	17,780	1.74%	0.68%				3.20%	1.27%	5.40%	2.14%	6.89%	2.73%
Redbridge	**790,432**	17,780	2.25%	0.88%									
Waltham Forest	**644,809**	26,670	4.14%	1.61%	9,218	1.43%	0.76%						

Table 6-5 Beckton water recycling scheme: estimated operational carbon impact to Local Authorities

		50 Ml/d AWRP		100 Ml/d AWRP		150 Ml/d AWRP	
Beckton water recycling	LA Grand Total (t CO2)	Lifetime Operational Carbon (t CO_{2e})	LA Impact per construction year (% increase / year)	Lifetime Operational Carbon (t CO_{2e})	LA Impact per construction year (% increase / year)	Lifetime Operational Carbon (t CO_{2e})	LA Impact per construction year (% increase / year)
Scheme Embodied Carbon		80,307	1,004	160,614	2,008	240,922	3,012
Newham	**1,021,020**		0.098%		0.197%		0.295%

Table 6-6 Mogden water recycling scheme: estimated construction carbon impact to Local Authorities

		Conveyance Route			50 Ml/d AWRP			100 Ml/d AWRP		
Mogden water recycling	LA Grand Total (t CO2)	Total Carbon (t CO2)	LA Impact (% increase)	LA Impact per construction year (% increase / year)	Total Carbon (t CO2)	LA Impact (% increase)	LA Impact per construction year (% increase / year)	Total Carbon (t CO2)	LA Impact (% increase)	LA per construction year (% increase / year)
Scheme Embodied Carbon		57,795			37,006			49,475		
Hounslow	**982,993**	4,901	0.50%	0.22%						
Richmond upon Thames	**612,761**	26,802	4.37%	1.97%	27,231	4.44%	2.15%	36,407	5.94%	2.87%
Spelthorne	**390,137**	26,090	6.69%	3.01%	9,774	2.51%	1.21%	13,067	3.35%	1.62%

Table 6-7 Mogden water recycling scheme: operational carbon impact to Local Authorities

		50 Ml/d AWRP			100 Ml/d AWRP		
Mogden water recycling	LA Grand Total (t CO2)	Lifetime Operational Carbon (t CO_{2e})	Lifetime Operational Carbon per year (t CO_{2e}/year)	LA Impact per construction year (% increase / year)	Lifetime Operational Carbon (t CO_{2e})	Lifetime Operational Carbon per year (t CO_{2e}/year)	LA Impact per construction year (% increase / year)
Scheme Embodied Carbon		80,307		1,004	160,722		2,009
Richmond upon Thames	**612,761**	59,095	738	0.12%	118,271	1,478	0.24%
Spelthorne	**390,137**	21,211	265	0.19%	42,450	530	0.38%

Table 6-8 Teddington DRA scheme: construction carbon impact to Local Authorities

		Treated Effluent Transfer Tunnel			50 Ml/d AWRP		100 Ml/d AWRP		River Abstraction and TLT Connection	
Teddington DRA	LA Grand Total (t CO2)	Total Carbon (t CO2)	LA Impact (% increase)	LA Impact per construction year (% increase / year)	LA Impact (% increase)	LA Impact per construction year (% increase / year)	LA Impact (% increase)	LA Impact per construction year (% increase / year)	LA Impact (% increase)	LA Impact per construction year (% increase / year)
Scheme Embodied Carbon		13,723			39,320	17,396	44,409	19,648	5,432	4,486
Hounslow	**982,993**	3,430	0.35%	0.17%	4.00%	1.77%	4.52%	2.00%		
Kingston upon Thames	**582,884**								0.93%	0.77%
Richmond upon Thames	**612,761**	10,292	1.68%	0.81%						

Table 6-9 Teddington DRA scheme: operational carbon impact to Local Authorities

		50 Ml/d Tertiary Treatment Plant			100 Ml/d Tertiary Treatment Plant		
Teddington DRA	LA Grand Total (t CO2)	Lifetime Operational Carbon (t CO_{2e})	Lifetime Operational Carbon per year (t CO_{2e}/year)	LA Impact per construction year (% increase / year)	Lifetime Operational Carbon (t CO_{2e})	Lifetime Operational Carbon per year (t CO_{2e}/year)	LA Impact per construction year (% increase / year)
Scheme Embodied Carbon		21,509	269		32,245	403	
Hounslow	**982,993**			0.027%			0.041%

7 IMPACT RISK ASSESSMENT: BECKTON WATER RECYCLING

7.1 INTRODUCTION

Using a RAG based approach (see Section 5.3 for further information), the key risks of the Beckton water recycling scheme have been identified under each environmental topic. The approach seeks to understand the mechanisms (activities and pathways) by which activities arising from the scheme might affect the identified receptors, and the likely significance of the impact. Where amber or red risks have been identified, additional mitigation that could be implemented is stated. An introduction to the scheme is provided in Section 2.1.

7.2 BASELINE, EXISTING EVIDENCE BASE AND RECEPTORS

7.2.1 Water

Refer to ***Annex B.2.1. Physical Environment Assessment Report*** and ***Annex B2.2. Water Quality Assessment Report*** for full details.

7.2.1.1 Physical environment

A catalogue of evidence has been compiled for the physical environment topic, which covers river flow, hydraulics, level, bathymetry, STW flow, estuary water level, Richmond Half-tide sluice operation, and designs of existing Environment Agency fish passes and the proposed London Effluent Reuse SRO scheme discharge outfalls. The watercourses of the study area for the Beckton water recycling scheme includes:

- Channels of the freshwater Lee from Newman's Weir on the Enfield Island Loop to the tidal limit at Three Mills Lock
- The estuarine Thames Tideway from the tidal limit at Teddington Weir to 3km seawards of Beckton STW outfall, noting the estuarine model boundary is at Southend-on-Sea.
- The estuarine Bow Creek (tidal Lee) from Three Mills Lock to the Thames Tideway.

Bespoke numeric models have been developed, and model scenarios have been undertaken for both reference conditions without London Effluent Reuse SRO schemes and correspondingly with London Effluent Reuse SRO schemes. These reference conditions are different patterns of river flow and STW final effluent flow: a 1:5 return frequency moderate-low flow year (A82); and a 1:20 return frequency very low flow year (M96)[29].

7.2.1.2 Water quality

7.2.1.2.1 Baseline for modelling input

Water quality data were collated for the period covering 1 January 2010 to 16 December 2021, for the same reaches identified for the physical environment. Water quality data for these watercourses were sourced from the Environment Agency and Thames Water. In addition, water quality data pertaining to the STW discharging to these water courses were sourced from Thames Water.

Two types of water quality data are available. Data from water quality monitoring sondes and data from spot sampling. The spot sampling analysis includes Thames Water's pan-SRO water quality monitoring programme for the following analytical suites:

- WFD suite: All chemicals listed in Schedule 3 of The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
- EQSD suite: All hazardous chemicals and elements listed by the Environment Agency as relevant to discharge permitting[30]
- Olfaction suite: A suite of potential fish olfaction inhibiting chemicals identified from literature review.

[29] Some selected reference conditions are specific to selected flow conditions.

[30] https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit

7.2.1.2.2 Effluent temperature

For Beckton STW final effluent the minimum effluent temperatures recorded were 11.7°C with a maximum of 25.6°C. Mean temperatures measured 19.0°C.

7.2.1.2.3 STW final effluent general physico-chemicals water quality

From a dataset that spans 7th Jan 2022 to 7th Jul 2022 the average dissolved oxygen percentage of 58% and a max value of 96.36% in and a minimum value of 29.22%. The Dissolved Oxygen (DO) generally stays between 50-65% with a few outlying data points.

Through the dataset there are spikes in ammonia concentrations during the periods of 2010 and 2012-13. The mean value is 0.5mg/l, and the median value is 0.1mg/l. The minimum value is <0.002mg/l and the maximum value is 7.5mg/l.

Within the dataset there is a reduction in suspended solids variability from 2013 onwards. The mean value is 19mg/l, and the median value is 10mg/l. The minimum value is 1.9mg/l, and the maximum value is 193.3mg/l.

Within the dataset there are two spikes in Biological Oxygen Demand (BOD) concentration during 2010 and 2013. Following this, the variability decreases for the rest of the sampling period. The mean value is 5.5mg/l, and the median value is 3.6mg/l. The minimum value is 1.0mg/, and the maximum value is 45.6mg/l.

Of the 81 chemical determinands within the WFD suite for Beckton STW, 36 were consistently below the LOD in final effluent, leaving 45 determinands for analysis. Of these, dissolved copper, dissolved zinc, Perfluorooctane sulfonic acid and its derivatives and permethrin frequently exceeded their LOD. C10-13 chloroalkanes, cybutyne, cyanide, dicofol, Chlorothalonil and trichlorobenzenes occasionally exceeded their Limits of Detection (LOD).

7.2.1.3 Flood risk

7.2.1.3.1 Baseline

The baseline data to assess the flood risk impacts were obtained from multiple sources. The flood zone location was obtained from the Environment Agency Flood Map for Planning, while the risk of surface water flooding at the sites are based on the Environment Agency surface water flood maps.

The groundwater and sewer flood risks were based on the relevant maps and text contained in the Local Authorities Strategic Flood Risk Assessments (SFRAs). The information provided in the SFRAs varies for different Local Authorities so the most relevant information from each SFRA was used. For groundwater, the maps include the British Geological Survey Susceptibility to Groundwater Flooding, Environment Agency Susceptibility to Groundwater Flooding, Areas Susceptible to Groundwater Flooding, and Aquifer Designations. The sewer flood risk assessments were based on Thames Water Sewer Flooding Records maps and text.

The Critical Drainage Areas were obtained from a range of sources depending on the Local Authority, such as SFRAs and Surface Water Management Plans. It is recommended that the Critical Drainage Areas are confirmed by liaising with the Local Authority during Gate 3.

The National River Flow Archive (NRFA)[31] was used to obtain the flow statistics for gauges located on the rivers at the locations where effluent is proposed to be discharged.

7.2.1.3.2 Summary of receptors

There are several sources of flood risk. These sources are:

- Rivers (fluvial).
- Sea/coastal.
- Surface water (pluvial).
- Sewers.
- Artificial (reservoirs and canals)

The receptors of interest considered in the appraisal are primarily human receptors, such as buildings, roads, farms, etc. While the receptors could be categorised according to flood risk vulnerability categories, it is considered more appropriate to minimise all flood risks offsite, since any increase in flood risk may adversely affect multiple land types and flood risk vulnerability classifications downstream.

[31] National River Flow Archive. *Data I National River Flow Archive*. Available from: https://nrfa.ceh.ac.uk/data.

The sites and the proposed infrastructure are receptors of flood risk. The flood risks to site users linked to the London Effluent Reuse SRO should also be minimised so that they are not adversely affected by flooding. The flood risks to the London Effluent Reuse SRO should be managed so that the infrastructure remains operational in the event of a flood, and any disruption is minimised. The London Effluent Reuse SROs are expected to be categorised as "*water transmission infrastructure and pumping stations*" which is classified as being a "water compatible" developmental use[32].

Any structures located underground, such as pipes, have been screened out. Underground structures are not expected to affect flood risk and therefore no FRA would be required. However, underground structures may have an impact on groundwater flood risk and this should be assessed through a Ground Investigation, and used to determine construction method.

7.2.2 Biodiversity

Refer to ***Annex B.2.3. Fish Assessment Report***, ***Annex B2.4. Aquatic Ecology Assessment Report***, ***Annex B2.5 INNS Report*** and ***B2.6. Terrestrial Ecology Assessment Report*** for full details.

7.2.2.1 Fisheries

A catalogue of the evidence base for the fish topic has been compiled which covers freshwater and estuarine fish species, weir pool and marginal habitat assessment, migratory fish species, olfactory cues and inhibitors and an assessment of European smelt. The baseline data collected is provided in **Table 7-1**.

[32] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government. *Flood risk and coastal change*. Available from: https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification

Table 7-1 Beckton water recycling scheme: summary of fisheries baseline

Reach	Receptor					
	Freshwater Fish	Weir Pool and Marginal Habitat (including Sunbury Creek)	Estuarine Fish (including European Eel)	Migratory Fish (including European Eel)	European Smelt	Olfactory Inhibitors
Estuarine Thames Tideway						
F – Tower Bridge to 3km seawards of Beckton STW	The fish community within the reach was highly diverse and dominated by estuarine/marine species. At the furthest upstream site (i.e., Greenwich), species typical of freshwater are present, accounting for ~23% of catch abundance, and dominated by species with a high- (e.g., perch, roach, 3-spined stickleback) and mid-range (e.g., dace, pike) tolerance for environmental disturbance. Further downriver (i.e., Woolwich), high-tolerant freshwater species accounted for <0.1% of total catch abundance	x – no Weir Pool/ no River Condition Assessment completed	Data was obtained from EA TraC monitoring records (2010–2021). Baseline data from 71 fisheries surveys across 2 sites indicates that under present conditions, the fish community is diverse and demonstrates the transitional nature of the reach within the middle of the Thames Tideway. Upstream (i.e., Greenwich), catch abundance is dominated by species indicative of estuaries (~73%), with a transition in dominance to >99% of estuarine/marine species at the downriver site (i.e., Woolwich), including flounder, pouting, dover sole, herring, and cod.	Data obtained from EA TraC monitoring records (2010–2021) indicated presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009) across differing life-stages recorded at both sites. Anecdotal historical datasets, obtained from a systematic review of open-source data, also note low number presence of adult and juvenile twaite shad (section 5, Wildlife and Countryside Act, 1981; UK BAP Priority species); Atlantic salmon (Habitats Regulations, 2017; UK BAP Priority species), sea lamprey (Habitats Regulations, 2017; UK BAP Priority species); and river lamprey (Habitats Regulations, 2017; UK BAP Priority species) within the tideway.	Data obtained from EA TraC monitoring records (2010–2021) indicated presence of European smelt (UK BAP Priority species) recorded at both sites.	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 1 site between 2021-2022. Of 53 determinands, 29 were consistently below the LOD, with 2 having no available, and 24 still requiring analysis.
Channels of the freshwater Lee						
G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions	Data was obtained through project-specific fisheries monitoring completed in 2021. Baseline data from 1 fisheries survey at 1 site indicates that under present conditions, the fish community is moderately diverse, and representative of the dominant habitats associated with a typical moderately-flowing run, and characteristic of a lowland river tributary. The tolerable range of disturbance-sensitivity taxa within the reach is broad.	The result of the assessment found this section of the River Lee to be 'H' type and in Fairly Poor condition.	N/A	Presence and reliability of records for Sea Lamprey in the upper Lee are subject to ongoing discussion owing to the difficulties associated with identifying the amoecete life stage. The use of eDNA is suggested to confirm species presence. Presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009), as per comms (Steve Coates, 2022; see also Colclough *et al*., 2000[33]).	N/A	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 1 site between 2021-2022.
H – Chingford Abstractions to Three Mills Lock	EA monitoring programme data records (2010–2021) were supplemented by project-specific fisheries monitoring completed in 2021. Baseline data from 9 fisheries surveys across 4 sites indicates that under present conditions, the fish community is diverse, and representative of the dominant habitats associated with a typical moderately-flowing run, and characteristic of a lowland river tributary. The tolerable range of disturbance-sensitivity taxa within the reach is broad.	x – no River Condition Assessment completed	N/A	Presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009) across differing life-stages recorded.	N/A	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 1 site between 2021-2022.
Estuarine Bow Creek (tidal Lee)						
I - Three Mills Lock to Thames Tideway	x - No monitoring programme data available from 2010–2021 to allow for baseline assessment. NRA data available from 1992/3 Thames tideway survey at Vauxhall site,	x – no River Condition Assessment completed	x - No baseline assessment. NRA data available from 1992/3 at Vauxhall site, provisioning presence/absence indications.	x - No baseline assessment. NRA data available from 1992/3 at Vauxhall site, provisioning presence/absence indications.	NRA lower River Lee report (1992) noted, historical presence of European smelt (UK BAP Priority species) recorded on 25th Sept 1991.	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 1 site between 2021-2022.

[33] Colclough, S., Dutton, C., Cousins, T., and Martin, A. A fish population Survey of the tidal Thames 1994-1996, pp. 28, 2000.

Reach	Receptor					
	Freshwater Fish	Weir Pool and Marginal Habitat (including Sunbury Creek)	Estuarine Fish (including European Eel)	Migratory Fish (including European Eel)	European Smelt	Olfactory Inhibitors
	provisioning presence/absence indications. Historical presence of 9 high-medium tolerant disturbance-sensitivity taxa.		Historical presence of 4 estuarine species, including mullet, sand smelt, and flounder.	Historical presence of European eel (IUCN red listed: “critically endangered”; Eels Regulations, 2009 recorded.		

7.2.2.2 Aquatic ecology

The following baseline data has been updated between Gates 1 and 2, and is summarised in **Table 7-2**:

- Aquatic macroinvertebrates freshwater and estuarine.
- Marginal habitat assessment.
- Plants/diatoms.
- Macroalgae, angiosperm and phytoplankton.
- Designated and protected sites and species.

The relevant reaches for the Beckton water recycling scheme are Reach F on the Thames Tideway, Reaches G and H on the River Lee, and Reach **I** on the estuarine Bow Creek. These are shown in **Figure 7-1**.

Figure 7-1 London Effluent Reuse SRO: locations of schemes and reaches

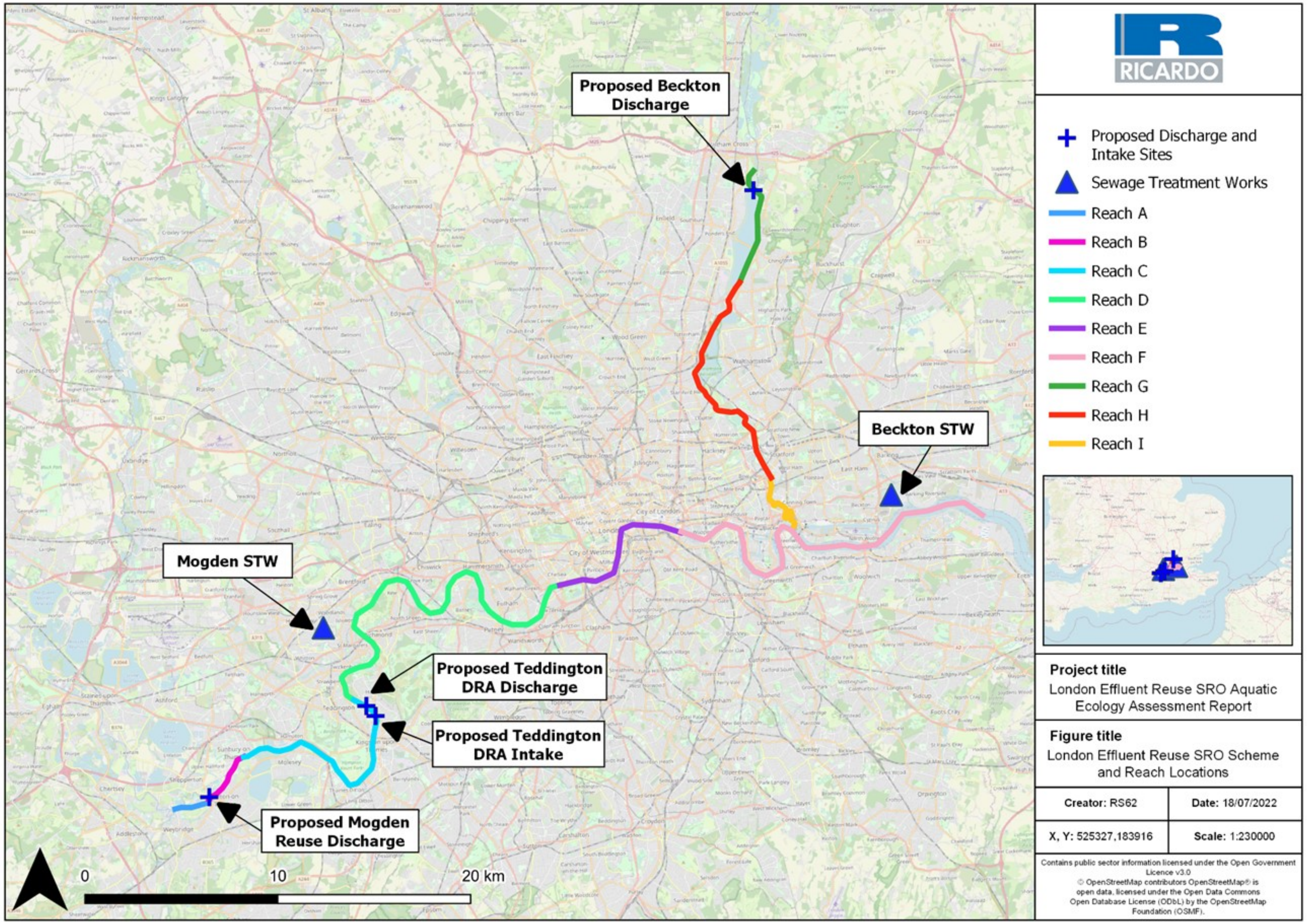


Table 7-2 Beckton water recycling scheme: summary of aquatic ecology baseline

Reach	Receptor					
	Aquatic/estuarine invertebrates	Marginal habitat	Macrophytes	Diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
Estuarine Thames Tideway						
D – Teddington Weir to Battersea Park	Baseline LIFE data indicates that under present conditions, the invertebrate community in the impacted reaches are not sensitive to reduced flows. The baseline data suggest that the invertebrate community within the reach from the Teddington Weir to Battersea Park is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slow flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). No other invertebrates of interest were recorded in the estuarine Thames Tideway Teddington Weir to Battersea Park.	N/A - Modular River (Physical) Survey being completed	N/A	x – no data available	Only algal taxon recorded in Reach D (at Isleworth Ait) was Vaucheria which is a genus of yellow-green algae. Vaucheria species are mostly found in freshwater or low salinity estuarine waters while a small number are fully marine. Vaucheria spp. Was noted to be patchily distributed and the percent coverage of the AIH across the survey sites in Reach D was 8.5%. Baseline data indicates that within this reach, the biological status of the macroalgal community is considered Bad, based on the calculated EQR values (<0). This suggests that the macrophyte community within this reach is in an impacted state. See Table 2 22 for guidance in interpreting EQR scores.	Sixteen designated sites within 2km; 1 Special Area Conservation (SAC). 4 Sites of Special Scientific Interest (SSSIs), 1 National Nature Reserve (NNR) and 10 Local Nature Reserves (LNRs). The following were considered to be hydrologically connected (therefore pathway for impact): • Ham Lands LNR • Isleworth Ait LRN • Syon Park SSSI • Barn Elms Wetland Centre SSSI • Duke's Hollow LNR • Chiswick Eyot LNR • Leg of Mutton Reservoir LNR • Battersea Park Nature Areas LNR
E – Battersea Park to Tower Bridge	x – no data available	N/A - Modular River (Physical) Survey being completed	N/A	Data shows a general low saline tolerance across all sample dates, with only one recording a saline tolerant score, with that being sampled in 2007. This therefore suggests there has been little influence of saline waters in this reach. Diatoms were classed as being either tolerant to moderate or no organic pollution.	x – no data available	One designated site, Battersea Park Nature Areas LNR was identified within 2 km of the reach.
F – Tower Bridge to 3km seawards of Beckton STW	x – no data available	N/A - Modular River (Physical) Survey being completed	N/A	x – no data available	No opportunistic algae were recorded on soft sediment at either site in in Reach F. Ulva spp. was recorded on hard substrates, along with Fucus vesiculosus on riprap on the upper shore at the estuarine Thames Tideway survey area.	Thirteen designated sites were identified within 2 km; 1 SSSI and 12 LNRs. None were considered to be hydrologically connected, therefore no pathway for impact.
Channels of the freshwater Lee						
G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions	Baseline LIFE data indicates that under present conditions, the invertebrate community in the impacted reaches are sensitive to reduced flows The baseline data suggest that the invertebrate, macrophyte and phytobenthos community within the reach from EIL to Chingford abstractions is not sensitive to water quality and flow changes.	The result of the assessment found this section of the River Lee to be 'H' type and in Fairly Poor condition.	No EA Macrophyte data available between 2010 and 2022. Two surveys at two locations were completed in 2020 by the London Effluent Reuse SRO monitoring programme. Biological status of the macrophyte community is poor, based on the calculated EQR values. Mean RMNI scores suggests that the community within this reach is associated with higher nutrient enriched rivers.	A low percentage of diatoms that are tolerant of slightly saline waters. This therefore suggests there has been little influence of saline waters in this reach percentage of the motile diatoms at the site also recorded low scores diatoms in this reach have a low tolerance to organic pollution.	N/A	Four designated sites were identified within 2 km; 1 SAC< 2 SSSIs and 1 LNR. The following were considered to be hydrologically connected (therefore pathway for impact): • Chingford Reservoirs SSSI
H – Chingford Abstractions to Three Mills Lock	Baseline LIFE data indicates that under present conditions, the invertebrate	x – no River Corridor Assessment completed	Eight surveys conducted by the EA within Reach H between 2010 and 2022.	Low percentage of diatoms that are tolerant of slightly saline waters	N/A	Eight designated sites were identified within 2 km; 1 SPA and Ramsar, 2 SSSIs, 1 NNR and 3

Reach	Receptor					
	Aquatic/estuarine invertebrates	Marginal habitat	Macrophytes	Diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
	community in the impacted reaches are not sensitive to reduced flows. The baseline data suggests that the invertebrate community within the reach is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slow flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). Invertebrates of interest: *Musculium lacustre*		Baseline data indicates that within this reach, the biological status of the macrophyte community is rated from as Poor, based on the calculated EQR values. Mean RMNI scores suggests that the community within this reach is associated with highly nutrient enriched rivers. Site 102092 had much lower algal taxa present than the other site, and site 34160 had a much higher percentage cover of green filamentous algae.	percentage of the motile diatoms across the sites vary along the reach. Although most sites are generally low in motility, site 154086, in the upper most of this reach was found in baseline data to have a highly motile percentage of diatoms over the sampled dates. General trend of no organic pollution.		LNRs. The following were considered to be hydrologically connected (therefore pathway for impact): • Lee Valley SPA and Ramsar • Walthamstow Reservoirs SSSI • Walthamstow Marshes SSSI • Walthamstow Marshes NNR
Estuarine Bow Creek (tidal Lee)						
I – Three Mills Lock to Thames Tideway	x – no data	N/A - Modular River (Physical) Survey being completed	N/A	x – no data available	x – no data	No pathway for impact identified.

7.2.2.3 Invasive Non-Native Species

The baseline data / evidence review considered INNS occurrence records stored within the NBN Atlas[34] covering a period of 20 years (1 January 2002 – 10 May 2022) of data. INNS species listed under; Schedule 9 of the Wildlife and Countryside Act, WFD UKTAG Aquatic Alien Species, EU Invasive and Alien Species Regulation, MSFD – UK priority species, WFD UKTAG alarm species, GB Non-Native Species Secretariat (NNSS) Alert species have been identified from the datasets for consideration.

For the Beckton water recycling scheme, Reaches F to I are considered as the relevant zone of influence. This includes the Thames Tideway from Tower Bridge to 3km seawards of Beckton STW, Newmans Weir on the Enfield Island Loop to Three Mills Lock and the Estuarine Bow Creek (tidal River Lee).

- **Reach F – Tower Bridge to 3km seawards of Beckton STW:** A total of 20 INNS species of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring survey. The most frequently recorded species were aquatic invertebrates, with the most abundant being New Zealand mudsnail, followed by Chinese mitten crab and red-gilled mudworms *Marenzelleria viridis*.
- **Reach G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions:** A total of 26 INNS species of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The species that was recorded most frequently was the terrestrial plant Himalayan Balsam. Other frequently recoded species includes aquatic invertebrate species such as New Zealand mudsnail and Demon shrimp.
- **Reach H – Chingford Abstractions to Three Mills Lock:** A total of 32 INNS species of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most commonly recorded species was the terrestrial plant species giant hogweed. Other abundant species includes the aquatic plant species floating pennywort and aquatic invertebrate species such as zebra mussel and quagga mussel.
- **Reach I – Estuarine Bow Creek (tidal River Lee):** A total of five INNS species of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most frequently recorded species were the terrestrial plant species Japanese Knotweed and False acacia. Only one record for aquatic invertebrate species was returned within this reach, which was for Chinese mitten crab.

7.2.2.4 Terrestrial

7.2.2.4.1 Baseline

7.2.2.4.1.1 Designated sites

Statutory and non-statutory designated sites were identified within a 2 km radius from each Beckton water recycling scheme component in the Preliminary Ecological Appraisals (PEA) undertaken for the main AWRP site and conveyance route. The desk study returned no non-statutory designated sites located within 500 m of the shaft locations[35]. A total of four Sites of Special Scientific Interest (SSSI), one Local Nature Reserve (LNR) and six Site of Importance for Nature Conservation (SINC) have been identified within 2km (see Section 7.3 for the scoped-in receptors).

7.2.2.4.1.2 Priority habitats

UK Habitat Classification (UKHab) surveys have been undertaken to inform the Gate 2 assessment, with the exception of Shafts 0, 5 and 6.

The UKHab surveys undertaken identified that the habitats were typically dominated by lower distinctiveness habitats such as other neutral grassland, modified grassland, scrub, and urban habitats (e.g., developed land sealed surface). However, priority habitats were present in two of the shaft compounds; the priority habitats wet woodland and reedbeds at Shaft 4 and priority river habitat at Lockwood Reservoir Pumping Station.

7.2.2.4.1.3 Other protected, notable, and/or invasive species

Local environmental records centres' (Greenspace Information for Greater London (GiGL) and Essex Field Club (EFC)) data was obtained, with the following recorded within 2km of the infrastructure; bats, stag beetle

---

[34] https://nbnatlas.org/

[35] Jacobs (2022). Beckton Tunnel Conveyance Route: Preliminary Ecological Appraisal. Report for Thames Water Utilities, 1 – 85. B22849BM/REP/PEA/002.

Lucanus cervus and other notable terrestrial invertebrates, reptiles, water vole *Arvicola amphibius*, European hedgehog *Erinaceus europaeus*, and protected/notable amphibians (see Section 7.3 for the scoped-in receptors).

Preliminary Ecological Appraisals (PEA) were completed to assess the construction sites' ecological potential. The habitats at the Beckton STW site were found to be suitable for protected and notable species including bats, badger *Meles*, barn owl *Tyto alba*, common and Schedule 1 birds, common mammals, riparian mammals, reptiles and priority invertebrate species. The habitats at the Beckton Tunnel Conveyance Route site were found to be suitable to support protected and notable species including great crested newts *Triturus cristatus*, bats, birds (including Schedule 1 species), badger, European hedgehog, riparian mammals (Eurasian otter and water vole) and common species of reptiles.

A total of 10 protected or notable plant species were identified within 2km of the conveyance route including two species listed under the Wildlife and Countryside act Schedule 8: bluebell (*Hyacinthoides non-scripta)* and Jersey cudweed (*Gnaphalium luteoalbum*.)

7.2.2.4.1.4 Birds

A total of 236 bird species have been recorded within 2 km of Beckton water recycling scheme by Essex Field Club from 2000 – 2021 with the latest record in 2020. Of the 236 species recorded, 88 are 'notable' species and the remaining are protected under local plans and local species of conservation concern or invasive species. A total of 72 bird species have been recorded within 2 km of Beckton water recycling scheme by Herts Environmental Records Centre from 2000 – 2022, with the latest record submitted in 2018. Herts Environmental Records Centre covers the Lee Valley SPA. Of those 72 species recorded, 22 were 'notable' species and the remaining 50 were protected under local plans and local species of conservation concern.

Additional data were requested from the Wetland Bird Survey (WeBS) core count data where impact pathways have been identified at reservoirs associated with the Lee Valley SPA and Ramsar site. The sites include King George V Reservoirs (24152), Banbury Reservoir (24108), Walthamstow Reservoirs excluding Banbury (24107), William Girling Reservoir (24151) and Wanstead Flats (24077).

7.2.2.5 Summary of receptors

Receptors identified at this initial stage are listed in **Table 7-3**.

Table 7-3 Beckton water recycling scheme: summary of ecological receptors

Scheme component	Topic area	Receptor
Beckton STW AWRP site and shaft	Terrestrial ecology	Designated sites Beckton STW northern settling lagoon SINC River Thames and tidal tributaries SINC Gascoigne Road Pumping Station Rough SINC Priority habitats Rivers, coastal saltmarsh and mudflats Protected and/or notable species Records: Notable invertebrate species, reptiles (common lizard), hedgehog PEA: bat, badger, breeding birds, riparian mammals, great crested newt (GCN).
Shaft 1	Terrestrial ecology	Protected and/or notable species Records: reptiles (grass snake, common lizard), water vole, hedgehog, amphibians (common toad). PEA: bat, badger, breeding birds.
Shaft 2	Terrestrial ecology	Protected and/or notable species Records: stag beetle, reptiles (grass snake, slow worm), amphibians (common toad, GCN). PEA: bats.
Shaft 3	Terrestrial ecology	Epping Forest SSSI Protected and/or notable species

Scheme component	Topic area	Receptor
		Records: stag beetle, reptiles (grass snake), amphibians (GCN). PEA: bats.
Shaft 4	Terrestrial ecology	Priority habitats: Wet woodland and reedbed priority habitats present at the site. Protected and/or notable species Records: reptiles (grass snake), amphibians. PEA: bats.
Shaft 5	Terrestrial ecology	Protected and/or notable species Records: reptiles (grass snake).
Lockwood Primary and Secondary Shaft site	Terrestrial ecology	Designated sites Lee Valley SPA and Ramsar Walthamstow Reservoirs SSSI Priority habitats One priority habitat identified: rivers.
Shaft 7	Terrestrial ecology	Protected and/or notable species Records: amphibians (common toad).
Shaft 8	Terrestrial ecology	No ecological receptors present
Shaft 9	Terrestrial ecology	No ecological receptors present
Shaft 10 and outfall at King George V reservoir into River Lea	Terrestrial ecology	Chingford Reservoirs SSSI Protected and/or notable species Records: reptiles (grass snake), water vole. PEA: badger, bats.
Watercourses	Aquatic ecology and INNS	Freshwater Lee Channel Estuarine Bow Creek Estuarine Thames Tideway

7.2.3 Historic environment

7.2.3.1 Baseline

A 1km study area around key infrastructure and a 200m corridor along the line of proposed conveyances (hereafter the 'study area') have been used to identify designated and non-designated heritage asset receptors that could be affected by the proposed London Effluent Reuse SRO.

The following sources were consulted to inform the assessment:

- Greater London Historic Environment Record as held by Historic England Greater London Archaeological Advisory Service;
- Details of Archaeological Priority Areas (APAs) and Areas of High Archaeological Potential (AHAP) as held by Historic England Greater London Archaeological Advisory Service and Surrey Historic Environment Record (SHER);
- Information upon nationally designated sites from Historic England's National Heritage List for England;
- Information upon locally or regionally designated sites as available from respective London Boroughs;
- Aerial photographs as available on on-line sources (Google Earth, Britain from Above, etc.);
- Cropmark plots as held by the National Mapping Programme (where available);
- LiDAR data as held by the Environment Agency;
- Historic OS maps reviewed online from an open-source digital map resource;
- Relevant geotechnical or topographical data held by the British Geological Survey and the Client.

Figures showing the locations of the receptors discussed in the following sections and their proximity to the conveyance and infrastructure are provided in **Appendix 3**.

7.2.3.1.1 National designations

There is one Scheduled Monument, Barking Abbey, located within the southern part of Beckton water recycling study area, north of Beckton STW. The abbey is listed on Historic England's Heritage at Risk register.

Within the study area there are 26 listed buildings, all of which are Grade II listed. These buildings are concentrated mainly in the north of the study area at Enfield Island Village and at Durham Road, Manor Road Conservation Area and near Barking Abbey in the south of the scheme. Two listed buildings are recorded on Historic England's Heritage at Risk register. There are five conservation areas located within the study area, evenly distributed along the southern half of the scheme between the Lockwood Primary Shaft 6 site and Beckton STW.

The Grade II* registered park and garden, Wanstead Park, is located within the southern part of the Beckton water recycling study area. Wanstead Park is listed on Historic England's Heritage at Risk register.

7.2.3.1.2 Regional and local designations

Five conservation areas are located within the Beckton water recycling study area, all of which are located within the southern half of the scheme.

There are 25 APAs located within the scheme study area. The APAs are numerous and cover almost the entirety of the study area.

7.2.3.1.3 Known non-designated heritage assets

There have been 235 previous archaeological events undertaken within the Beckton water recycling scheme study area. These are generally evenly distributed along the route with concentrations of events to the south of the site, north of Beckton STW, and near Edmonton in the northern half of the pipeline route.

There are a total of 378 known non-designated heritage assets regularly located along the study area. There are dense clusters of known heritage asset receptors in the southern part of the site, in particular to the north of Beckton STW and in the vicinity of Hackney Marsh. There is also a concentration of assets around the Lockwood Primary Shaft 6 site in the centre of the scheme.

7.2.3.2 Summary of receptors

Table 7-4 provides a summary of designated receptors identified along the route of the Beckton water recycling scheme. Receptors are defined as any designated heritage asset located within 100m, or non-designated heritage asset located within 50m, of proposed new infrastructure, or shaft site (including the associated temporary site compound). A proximity of 0m indicates that the scheme site is located directly within or on a receptor location, or that the receptor is contained within the site area.

Table 7-4 Beckton water recycling scheme: summary of historic environment receptors

Scheme Component	OA[36]	Name and description	Proximity (m)
Beckton STW AWRP 150 Ml/d site and Shaft 0	–	Beckton APA	<50
	–	Barking Level and Dagenham Marsh APA	50-100
	89	Jenkins Lane [Beckton Sewage Treatment Works]; UK's largest sewage treatment works	<50
	90	Barking Creek E6; possible Roman dock	50-100
Shaft 1	–	River Roding APA	<50
	91	Watson Avenue, East Ham, Newham; 20th-century gas holder	<50
Shaft 2	–	Wanstead Flats APA	<50
	92	Avenue Road/Cranmer Road [Hamfrith Farm]; site of 16th-century farm	<50
Shaft 3	–	Wanstead Flats APA	<50

[36] See Appendix 2 for gazetteer of heritage assets and corresponding figures.

Scheme Component	OA[36]	Name and description	Proximity (m)
	1	Wanstead Park; registered park and garden	<50
	93	Possible Roman road from London to Chelmsford; conjectured route	<50
	94	Northumberland Avenue [Wanstead Park]; 18th-century gardens/public park	<50
Shaft 4	–	River Lea APA	<50
	123	Lower Lea Valley; site of 20th-century pylons	<50
Shaft 5	2	The Coppermills (Waterboard Stores); listed building	<50
	–	Coppermills APA	<50
	–	River Lea APA	<50
Lockwood Primary Shaft 6 site and Pylon	–	River Lea APA	<50
	–	The Lea Valley APA	<50
	–	Tottenham Mills APA	50-100
	95	Ferry LA; post-medieval oyster beds	<50
Shaft 7	–	Lea Valley West Bank APA	<50
	96	Glover Drive N18; prehistoric flint find spot	<50
Shaft 8	–	Lea Valley West Bank APA	<50
Shaft 9	–	Lea Valley West Bank APA	<50
Shaft 10 and King George V reservoir Outfall	4	Retort House and King George Pumping Station; listed building	50-100
	–	Lea Valley West Bank APA	<50
	97	Government Row [Former Royal Ordnance Factory]; 19th-century small arms factory	<50

7.2.4 Landscape and visual amenity

7.2.4.1 Baseline

A study area of 500m to either side of the Beckton water recycling scheme was applied for the initial appraisal. The study area was informed by desk review and an initial site visit. Field survey work was carried out on Wednesday 6 June 2022 under clear weather conditions. This included visits to the sites and study areas to consider the likely effects of the proposed developments on landscape/townscape character and on views and visual amenity.

The study area has also been informed by an understanding of the topography, vegetation and built development in the surrounding landscape/townscape.

7.2.4.1.1 National designations

Nationally important landscapes (National Parks and Areas of Outstanding Natural Beauty) have protection through law. There are no nationally important landscapes in the study areas for this assessment.

7.2.4.1.2 Local designations

The proposed Beckton AWRP is within the site boundary of the existing Beckton STW. The site is overgrown with scrub and vegetation, and is managed as the Beckton Sewage Treatment Works northern settling lagoon SINC. The site also lies within Metropolitan Open Land (MOL). There is no public access within the site, although the Northern Lagoon Walkway runs along the perimeter of the existing Beckton STW, and the Beckton Creekside Nature Reserve lies to the east.

The proposed Beckton water recycling discharge to River Lee Diversion Channel is on the riverside to the north of the George V Reservoir, and consists of grassland, crossed by rights of way including the Thames Path. The site lies within Green Belt and the Lee Valley SINC. It is also within the Lea Valley Rivers and Reservoirs Enfield Area of Special Character.

The pipeline route and shaft sites cross the landscape/townscape between Beckton and Lockwood, and from Lockwood to the George V Reservoir. The pipeline route and shaft sites cross a number of parks and public open spaces, SINCs, and shaft site 6 is within the Lee Valley SPA and Ramsar and the Walthamstow Reservoirs SSSI.

Photo 1 Typical view along the Northern Lagoon Walkway adjacent to Beckton STW

7.2.4.2 *Summary of receptors*

This section identifies the landscape/townscape and visual receptors likely to be affected by the Beckton water recycling scheme. Desk studies and a site visit have helped to refine an understanding of potential receptors. As such, only those receptors which are likely to be impacted to a significant degree have been considered below.

7.2.4.2.1 Landscape/Townscape Receptors

Landscape/townscape receptors which are likely to be impacted by the proposed development are:

<u>Beckton STW</u>

- Local landscape character of the site with reference to Newham Character Study Area 7: Beckton, east of Royal Docks Road including Beckton Sewage Treatment Plant, former Gasworks, industry and Gallions Reach out of centre retail park.

<u>Pipeline and shaft sites</u>

- Local landscape character of the area proposed for the tunnelled pipeline and shaft locations.

<u>Discharge into River Lee Diversion Channel</u>

- Local landscape character of the site with reference to Enfield Landscape Character Area 4 River Valley and Floodplain, and the Lea Valley Rivers and Reservoirs Area of Special Character.

7.2.4.2.2 Visual Receptors

Visual receptors (people) likely to be impacted by the proposed development are:

Beckton STW

- Recreational users of Northern Lagoon Walkway to the north and east and Beckton Creekside Nature Reserve to the east.
- Visitors to and employees at Jenkins Way industrial estate to the north and west.

Pipeline and shaft sites

- Local community, recreational users, pedestrians and motorists.

Discharge into River Lee Diversion

- Recreational users of the London Loop and public rights of way through the site and close to the site.
- Residents/employees in properties adjacent to the west of the site.
- Local community north of the site on Enfield Island Village.

7.2.5 Soils and contaminated land

7.2.5.1 Baseline

Contaminated land is defined as land where substances could cause significant harm to people or protected species; or significant pollution of surface waters or groundwaters. Some types of contaminated land can be designated as special sites for a variety of reasons, including land that seriously affects drinking water, surface waters (e.g., lakes and rivers) and important groundwater sites.

The geology of the shaft locations and conveyance route was analysed through British Geological Survey Geology (BGS)[37]. The identified superficial and bedrock geology are listed in **Table 7-5**.

Historic landfill sites can pose an ongoing threat to the environment and have the potential to pollute surface and groundwaters. In general, the majority of these sites can be dated between 1800 and 1990, when approaches to control contamination were not as stringent. Historic landfills within close proximity to the Beckton water recycling scheme were identified using Catchment Based Approach Historic Landfills database[38]. The historic landfills within 1.5km of the conveyance route and which are intersected by the proposed route are noted in **Table 7-5**.

Table 7-5 Beckton water recycling scheme: contaminated land baseline

Location	Close to waste?	Historic landfill / type of waste	Geology	Potential pathway
Shaft 10	No. Closest 300-350m East	-	Superficial: Alluvium – clay, silt, sand and peat Bedrock: London Clay Formation – clay, silt and sand	None
Shaft 9	Yes. Shaft on western boundary of historic landfill.	Brimsdown. Licence holder: Johnson Matthey Chemicals Limited. Licence surrender 1980. EAHLD11392.	Superficial: Kempton Park gravel member - sand and gravel Bedrock: London Clay Formation – clay, silt and sand	Yes via excavation through waste
Shaft 8	No. Closest 100-150m South West.	-	Superficial: Kempton Park gravel member - sand and gravel Bedrock: London Clay Formation – clay, silt and sand	None

[37] BGS Geology Viewer BGS Geology Viewer (BETA)
[38] Historic Landfill Sites Historic Landfill Sites | Historic Landfill Sites | Catchment Based Approach

Location	Close to waste?	Historic landfill / type of waste	Geology	Potential pathway
Shaft 7	No. Closest 700-750m North.	-	Superficial: Enfield Silt Member – Clay and Silt. Bedrock: London Clay Formation – clay, silt and sand	None
Shaft 6	No. Closest 500-550m North.	-	Superficial: Alluvium – clay, silt, sand and peat Bedrock: London Clay Formation – clay, silt and sand	None
Shaft 5	No. Closes 100-150m South.	-	Superficial: Alluvium – clay, silt, sand and peat Bedrock: London Clay Formation – clay, silt and sand	None
Shaft 4	Yes. Shaft on western boundary of historic landfill.	Marsh Lane Playing Field (Waste Recovery Site?)	Superficial: Alluvium – clay, silt, sand and peat Bedrock: London Clay Formation- clay, sand and silt	Yes via excavation through waste
Shaft 3	No. Closest 1300-1350m West.	-	Superficial: Hackney Gravel Member – sand and gravel Bedrock: London Clay Formation – clay, silt and sand	None
Shaft 2	No. Closest 1350-1400m North East.	-	Superficial: Hackney Gravel Member – sand and gravel Bedrock: London Clay Formation – clay, silt and sand	None
Shaft 1	No. Closest 550-600m North East.	-	Superficial: Alluvium – clay, silt, sand and peat Bedrock: London Clay Formation	None
Shaft 0	No. Closest 1300-1350m South East.	-	Superficial: Alluvium – clay, silt, sand and peat Bedrock: London Clay Formation- clay, sand and silt	None
Tunnel between Shaft 7 and Tunnel 6	Yes. Tunnel lies along landfill.	Tottenham Marshes. Last Input 1962. Inert Waste. Licence surrender 1980. EAHLD11366.	Superficial: Alluvium – clay, silt, sand and peat Bedrock: London Clay Formation- clay, sand and silt	Yes via excavation through waste
Tunnel between Shaft 4 and Tunnel 3	Yes. Tunnel crosses landfill.	Land at Oliver Close. Last input 1050. Inert Waste. EAHLD11403.	Superficial: Taplow Gravel Member – sand and gravel Bedrock: London Clay Formation – clay, sand and silt	Yes via excavation through waste

Further work will be required for Gate 3 to establish what baseline evidence local planning authorities hold, complete the necessary Envirocheck requests and understand the likelihood of needing preliminary site investigations.

7.2.5.2 Receptors

The hydrogeological properties of the main geological strata are listed below based on the Defra MAGIC aquifer designation map[39]. Secondary A and Secondary Undifferentiated Aquifers are vulnerable to leaching of ground contamination as they may be important in supporting local abstractions or providing baseflow to rivers and streams. Groundwater sampling should be undertaken during ground investigation to confirm the risk.

[39] Defra MAGIC Map [Magic Map Application (defra.gov.uk)](https://magic.defra.gov.uk)

Geology:

Superficial deposits:

- Alluvium – Secondary Undifferentiated
- Taplow Gravel Member – Secondary A Aquifer
- Hackney Gravel Member – Secondary A Aquifer
- Enfield Silt Member – Unproductive Strata
- Kempton Park gravel member – Secondary A Aquifer

Bedrock geology:

London Clay Formation is an unproductive stratum which acts as a natural sealant preventing leaching of ground contaminants to groundwater. There is a covering of about 12m of London Clay Formation which will prevent downward migration of contamination and protect the Chalk stratum. Should the proposed conveyance penetrate the base of the London Clay Formation, groundwater sampling and detailed risk assessment should be undertaken to confirm the risk.

Excavating landfill areas as identified in **Table 7-5** will pose a significant ground gas risk and groundwater risk as the landfill condition and engineering is unknown. Therefore, construction workers, nearby occupants and groundwater will be impacted.

7.2.6 Transport

7.2.6.1 Baseline

There are different categories of road, and types of environs (residential, industrial) immediately surrounding the Beckton water recycling scheme site compounds. This will mean that HGV increases will impact upon roads, and their users, to different extents. An *absolute* increase of HGVs on a large multi-lane A-road would, for example, constitute a far smaller *relative* increase than the same *absolute* increase on an otherwise quiet residential road.

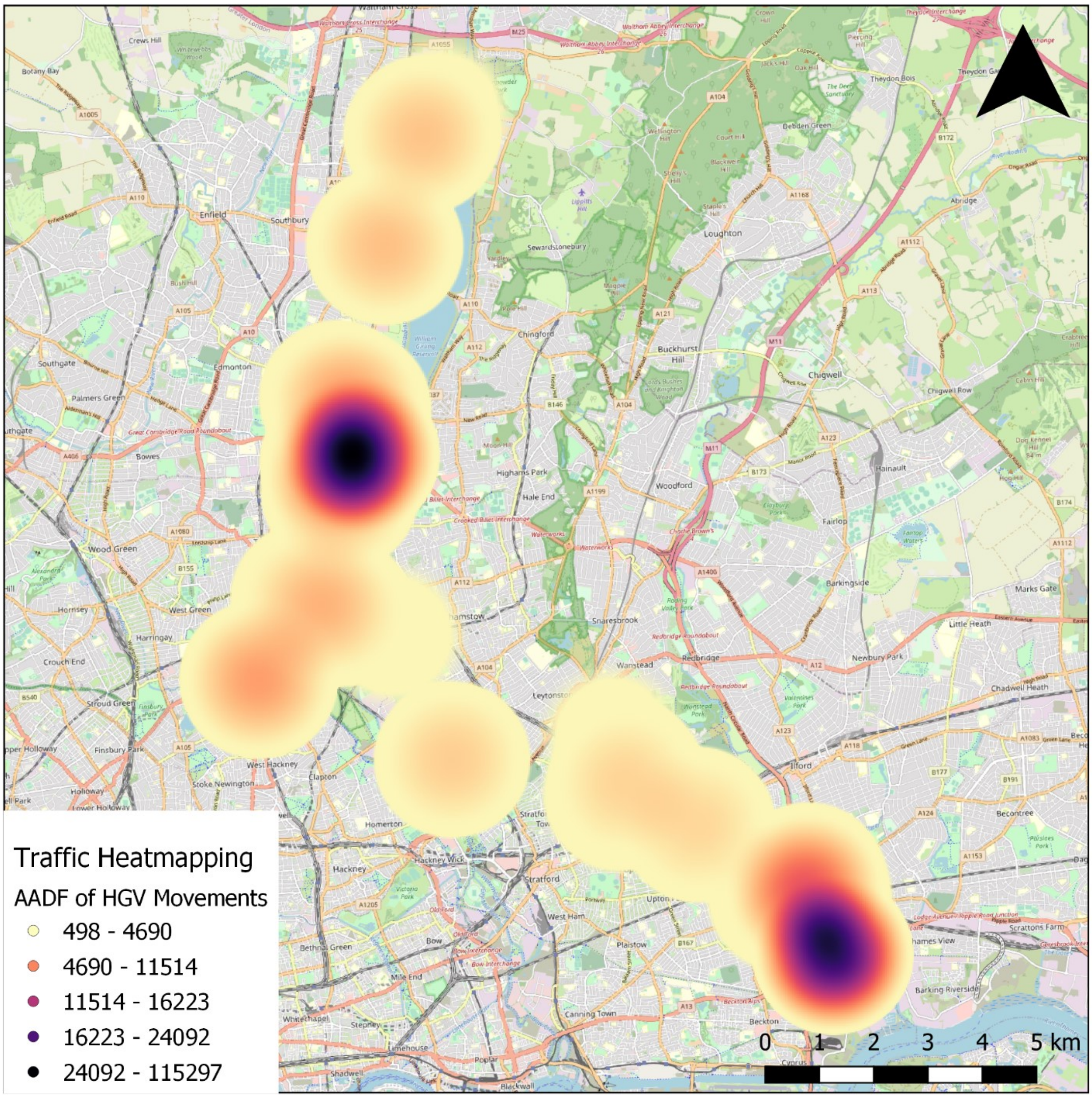
In order to obtain an indication of the baseline conditions, traffic counts from the Department for Transport were used. Road traffic open data provides street-level data on Great Britain's roads, including every junction-to-junction link on the motorway and 'A' road network, and for many minor roads in Great Britain. A map of traffic count points used to determine relative increases in traffic flows because of the construction of the Beckton water recycling scheme is shown in **Figure 7-2**.

Figure 7-2 Beckton water recycling scheme: traffic count points

As these traffic count points are located on roads of different categories, they have very different traffic compositions. A heatmap, showing the relative numbers of HGV movements currently past each of these points, is shown in **Figure 7-3**. **Figure 7-3** clearly shows that whilst the majority of the study area's road network currently experiences relatively low HGV movements, there are hotspots around the Beckton STW and the A406/A1020 junction, and in the area between the Banbury Reservoir and the William Girling Reservoir (the Lea Valley Viaduct, part of the North Circular Road, runs through the land between these two reservoirs).

The distribution seen in **Figure 7-3** shows that increases in HGV movements are most likely to be noticeable in areas such as Wanstead Flats, the Lockwood Reservoirs, and the Hackney Marshes area.

Figure 7-3 Beckton water recycling scheme: heatmap showing current Average Annual Daily Flow (AADF) of HGV movements in construction area



7.2.7 Navigation

No specific baseline survey work has been undertaken at Gate 2 to complete the assessment. Information on the pathway for impacts has been drawn from the B.2.1. Physical Environment assessment and modelling the change in flows under the worst-case scenarios, to determine where there would be any limitation on the ability of vessels of various draughts, to navigate in the upper Tideway around low water when the London Water Recycling scheme is in operation. The approach and findings have been consulted on with the PLA.

The scope of the Annex B.2.7. Navigation Assessment at Gate 2 has focussed on the operation impacts only in agreement with the PLA. If barges are to be used during the construction phase, further assessment of the types and numbers of barges to be used, berthing requirements, and the impacts of these movements on users of navigable waters will be required.

7.2.8 Noise

7.2.8.1 Baseline

Noise and vibration resulting from demolition and construction activities has the potential to cause temporary disturbance to surrounding sensitive receptors, particularly during the course of below ground excavation and general construction works. Baseline noise levels at the sites of the proposed shafts, structures and trenching, vary considerably, from locations in semi-rural settings to those on busy urban roads.

Baseline vibration levels are not likely to be significant as there are no apparent sources of vibration at receptor locations throughout the proposed pipeline routes. However, vibration from construction and tunnelling activities will be considered at a later stage of the impact assessment when more plant information becomes available.

Existing baseline noise data for approximately 40 construction site locations is clearly not available; brief site visits were therefore undertaken to each of the pipeline routes to assess typical daytime ambient noise levels and the proximity of the nearest noise sensitive receptors, both human and ornithological.

Based on site observation and mapping, the following descriptions of receptor locations were assigned with a typical ambient noise level. The ambient noise levels are based on short term spot noise measurements at selected positions during the site visits and, together with professional judgement, can be regarded as an indication of the likely range of baseline noise levels at receptors.

Table 7-6 Receptor description based on typical ambient noise levels

Descriptor	Ambient LAeq,T	Description
Rural	< 45dB	Applies to some of the ornithological receptors, (SSSI, WeBS sites, Priority Habitats)
Semi-Rural	45-49dB	Sensitive receptors, away from major traffic routes and industry
Suburban	50-54dB	Sensitive receptors close to major traffic routes and industry
Urban	55-59dB	Sensitive receptors located on major traffic routes
Industrial	60-64dB	Sensitive receptors located within or on the boundary of industrial activity

An estimated ambient noise level was assigned to the sensitive receptors nearest to each of the proposed shaft and structure construction sites and to receptors along the sections of trenched pipeline.

At this initial stage of technical studies, baseline night time noise levels have not been considered but may be required at a later stage if night time construction works are likely to be needed.

Receptors identified at this initial appraisal stage are those nearest to each of the construction site locations, and comprise of residential areas. Mapping has been used to identify the nearest receptors and to determine the distance from the construction sites.

7.2.8.2 Summary of receptors

Receptors identified at this initial stage are those nearest to each of the construction site locations. Mapping has been used to identify the nearest receptors and to determine the distance from the construction sites, as listed in **Table 7-7**.

Table 7-7 Beckton water recycling scheme: noise receptors and distance from construction sites

Construction sites	Nearest Receptors	Distance from works m
AWRP	Westminster Gardens	400-450

Construction sites	Nearest Receptors	Distance from works m
Shaft 1	Watson Avenue	50-100
Shaft 2	Capell Road	100-150
Shaft 3	Harrow Road, Dames Road	100-150
Shaft 4	Walnut Road	100-150
Shaft 5	Watermint Quay, Elmfield Road	600-650
Lockwood Reservoir	Mill Mead Road	250-300
Shaft 7	Willoughby Lane, Kimberley Road	250-300
Shaft 8	Pickets Lock Lane, Hudson Way	100-150
Shaft 9	Alma Road	300-350
KGV Shaft/Lee Outfall	Miller Avenue, Mayall Close, Lloyd Mews	50-100

7.2.9 Air quality

7.2.9.1 Baseline

The London Effluent Reuse SRO schemes are located across several boroughs mostly within London, all of which have declared the entire borough an Air Quality Management Areas (AQMA) for NO_2 and/or PM_{10} due to road traffic emissions. Parts of the schemes are located in close proximity to a mixture of sensitive ecological land uses (i.e., Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Ramsar etc), residential areas, watercourses and agricultural land bordered by hedgerows.

Baseline air quality data is available from London Air Quality Monitoring Network, relevant Local Authorities' monitoring campaigns and Department for Environment, Food and Rural Affairs (Defra) 'Background Mapping data for local authorities'.

All the local authorities within the boundary of the Beckton water recycling scheme employ the use of NO_2 diffusion tubes (DT) at a range of locations across their authority and some also employ the use of automatic monitoring (AM) stations which measure (NO_2, PM_{10} and $PM_{2.5}$)[40].

Details of the closest monitoring sites (within 1km for DT and within 3km for AM) which monitor annual mean NO_2, hourly mean NO_2, annual mean PM_{10}, daily mean PM_{10} and annual mean $PM_{2.5}$ are presented in the tables within **Appendix 4**. The findings of the data review are as follows:

- **Annual mean NO_2 concentrations** at the monitoring sites have reduced with each year. Using the pre-covid year of 2019, the annual mean NO2 concentrations still remain mostly below the National Air Quality Objective (NAQO) of 40 µg/m3 except at two sites (E17 and A18 within 1km of the SRO) in the London Borough of Waltham Forest[41].
- **NO2 hourly mean National Air Quality Objectives (NAQO)** was achieved at all the nearby automatic monitors, and there were no hourly exceedances of 200µg/m^3 from 2018 to 2020. The annual mean NO2 concentrations at the monitoring sites are less than 60 µg/m^3 at all the diffusion tubes, and as such it is expected that the hourly mean objective would also be achieved.
- **Annual mean PM_{10} concentrations** at the automatic monitoring sites are within the NAQO of 40 µg/m^3 at all nearby sites with a maximum concentration of 29 µg/m^3 at Crooked Billet Roundabout in 2019.
- **PM_{10} daily mean NAQO** was achieved at all the nearby automatic monitors with a maximum number of daily exceedances of 50µg/m^3 experienced for 19 days at Dawlish Rd and Ruckholt Close in 2019. This is lower than the 35 times a year stipulated in the NAQO.

[40] NO_2 nitrogen dioxide, PM_{10} Particles, $PM_{2.5}$ Fine Particles, NO_x oxides of nitrogen.

[41] The year 2020 is unlikely to be representative of a typical yearly concentration due to the Covid lockdown restrictions

- **Annual mean $PM_{2.5}$ concentrations** at the nearby automatic monitoring sites are within the NAQO of 25 µg/m3 at all nearby sites with a maximum concentration of 12 µg/m^3 at Dawlish Rd in 2019. However, the annual mean $PM_{2.5}$ exceed the proposed Environment Act 2021 target of 10µg/m^3 at most of the nearby sites.
- **Background concentrations** are all well within the annual mean NAQOs for all pollutants in 2018 except for the vegetation protection guideline for NOx. $PM_{2.5}$ is within the NAQO of 25µg/m^3 but above the proposed Environment Act 2021 target of 10µg/m^3.

7.2.9.2 Summary of receptors

Table 7-8 below summarises the locations of the scheme, relevant LA and nearby sensitive ecological land uses (within 10km for international habitats (SAC, SPA and Ramsar) and 2km for all other habitat types (SSSIs)) and nearest receptors.

Table 7-8 Beckton water recycling scheme: air quality - relevant Local Authorities, human and ecological receptors

	Beckton water recycling
Nearby ecological receptors	**SPA sites** Lee Valley SPA **Ramsar sites** Lee Valley Ramsar **SAC sites** Epping Forest SAC Wormley-Hoddesdonpark Woods SAC **SSSI sites** Epping Forest SSSI Walthamstow Reservoirs SSSI Chingford Reservoirs SSSI Walthamstow Marshes SSSI
Indicative nearby human receptors	Properties in the Brimsdown area, Northumberland Park area, Ponders End area, Lower Edmonton area, Manor Park area including Green Street, Osborne Road, Mollison Avenue, Gilda Avenue, Charlton Road, First Avenue, Stacey Avenue, Park Avenue Road, Bream Close, Perth Road, Walnut Road, High Road Leyton, Warren Road, Grove Green Road, Cobden Road, Lincoln Street, Harrow Road, Lake House Road, Capel Road, Shakespeare Crescent etc Schools – Brimsdown School, Avenue Primary School
Local Authority	London Borough of Enfield London Borough of Haringey London Borough of Waltham Forest Adjacent to London Borough of Hackney Main Beckon AWRP site is located in London Borough of Newham; and London Borough of Barking and Dagenham

The number of human receptors and ecological receptors within distances specified in the methodology for assessing the dust and traffic impacts are detailed in **Table 7-9** and **Table 7-10**. This information is then used to undertake the risk assessment.

Table 7-9 Beckton water recycling scheme: number of human receptors within 350m

Human receptors	Number
Number of receptors within 20m	1,561
Number of receptors within 50m	3,100
Number of receptors within 100m	5,908
Number of receptors within 350m	28,893

Table 7-10 Beckton water recycling scheme: number of ecological receptors within 50m

Ecological receptors	Number of SPA	ID – SPA name	Number of Ramsar	ID – Ramsar name	Number of SSSI	ID – SSSI name
Number of receptors within 20m	2	557 - Lee Valley 559 - Lee Valley	2	657 - Lee Valley 655 - Lee Valley	4	8463 – Walthamstow Reservoirs 9075 – Walthamstow Reservoirs 24046 – Walthamstow Reservoirs 24076 – Walthamstow Reservoirs
Number of receptors within 50m	2	557 - Lee Valley 559 - Lee Valley	2	657 - Lee Valley 655 Lee Valley	6	8463 – Walthamstow Reservoirs 9075 – Walthamstow Reservoirs 17222 – Epping Forest 24046 – Walthamstow Reservoirs 24061 – Walthamstow Reservoirs 24076 – Walthamstow Reservoirs

7.2.10 People and communities

7.2.10.1 Socio-economics

The Beckton water recycling scheme covers seven Local Authorities in London and Essex; Epping Forest, Barking and Dagenham, Enfield, Haringey, Newham, Redbridge and Waltham Forest

Current populations estimates in these authorities, London and England from the 2021 census are highlighted in **Table 7-11**.

Table 7-11 Beckton water recycling scheme: total population by area[42]

Area	Population
Newham	351,100
Epping Forest	135,000
Barking & Dagenham	218,900
Enfield	330,000
Haringey	264,200
Redbridge	310,300
Waltham Forest	278,400
London	8,799,800
England	56,489,800

Table 7-12 shows further baseline data on the demographic distribution of population by age and gender (initial results) in the reaches that will be impacted by the Beckton water recycling scheme.

Table 7-12 Beckton water recycling scheme: population distribution by age and gender[43]

Area	Female Population	Male Population	Ages 0-19	Ages 20+
Newham	175,600	175,500	92,600	258,400
Epping Forest	69,400	65,600	30,500	104,600
Barking & Dagenham	112,400	106,500	68,800	149,800

[42] Office for National Statistics (2021) Census 2021. P01. Available at: https://census.gov.uk/census-2021-results
[43] Office for National Statistics (2021) Census 2021. P02. Available at: https://census.gov.uk/census-2021-results

Area	Female Population	Male Population	Ages 0-19	Ages 20+
Enfield	172,500	157,500	89,500	240,700
Haringey	137,000	127,200	59,800	204,400
Redbridge	156,900	153,300	83,600	226,500
Waltham Forest	141,900	136,600	68,100	210,200
London	4,531,500	4,268,300	2,085,300	6,714,500
England	28,833,500	27,656,300	13,057,600	43,432,100

Table 7-13 highlights the percentage proportion of ethnic diversity within the assessment area, London and England.

Table 7-13 Beckton water recycling scheme: ethnicity per area[44]

Area	White British	All White Other	Mixed Ethnic Groups	Asian/Asian British	Black/African/ Caribbean/ Black British	Other Ethnicity Group
Newham	15.36%	16.23%	1.74%	43.77%	14.49%	8.41%
Epping Forest	84.62%	4.62%	3.08%	3.85%	2.31%	1.54%
Barking & Dagenham	36.36%	12.44%	3.35%	18.18%	24.40%	5.26%
Enfield	39.88%	21.15%	3.93%	11.18%	18.13%	5.74%
Haringey	36.03%	25.00%	4.04%	8.82%	16.54%	9.56%
Redbridge	31.23%	11.96%	2.33%	44.19%	6.98%	3.32%
Waltham Forest	36.50%	18.25%	3.65%	20.44%	16.06%	5.11%
London	43.80%	15.57%	3.72%	18.37%	12.49%	6.06%
England	78.74%	6.16%	1.75%	7.95%	3.52%	1.87%

London is a heavily built-up area with a typically high population density. **Table 7-14** shows the population density of the local authorities within the Beckton water recycling scheme area compared with London and England.

Table 7-14 Beckton water recycling scheme: population density by area[45]

Area	Population Density (number of residents per km^2)	Households
Newham	9,700	115,500
Epping Forest	398	54,600
Barking & Dagenham	6,064	73,900
Enfield	4,083	120,900
Haringey	8,924	105,100
Redbridge	5,502	103,700

[44] Office for National Statistics (2021) Population estimates by ethnic group and religion, England and Wales: 2019. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/populationestimatesbyethnicgroupandreligionenglandandwales/2019

[45] Office for National Statistics (2021) Census 2021. P04. Available at: https://census.gov.uk/census-2021-results

Area	Population Density (number of residents per km^2)	Households
Waltham Forest	7,173	102,900
London	5,598	3,423,800
England	434	23,435,700

The economic profile of the local authorities that will be impacted during construction and operation of the Beckton water recycling scheme are highlighted in **Table 7-15**.

Table 7-15 Beckton water recycling scheme: economic profile[46][47][48]

Area	Percentage of people in employment (2020/2021)	Children in low-income families (under 16)	Mean Annual Gross Pay
Newham	76.9%	20.1%	£34,757
Epping Forest	75.2%	12.1%	£35,653
Barking & Dagenham	63.2%	22.5%	£29,128
Enfield	65.5%	22.2%	£32,156
Haringey	73.6%	21.3%	£34,882
Redbridge	71.4%	14.7%	£37,635
Waltham Forest	70.1%	19.4%	£36,662
London	74.5%	18.8%	£42,001
England	75.1%	17.0%	£32,049

7.2.10.2 Human health

Life expectancy at birth is one of the main indicators used to determine the status of health and economic development amongst a demographic. Under 75 mortality rate and percentage of physically active adults has the ability to measure the fitness and health of a local community profile. None of the areas in proximity to the Beckton water recycling scheme components has a significantly higher life expectancy than the national or regional average (**Table 7-16**). Barking and Dagenham is approximately two years below the national and regional average. Barking and Dagenham also has a significantly higher rate of under 75 mortality rates and a low percentage of physically active adults when compared to the national and regional figures.

[46] Office for National Statistics (2022) Labour Force Survey. Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/methodologies/labourforcesurveyuserguidance

[47] HMRC (2022) Personal Tax Credits: Child Poverty Statistics. Available at: https://www.gov.uk/government/collections/personal-tax-credits-statistics

[48] Office for National Statistics (2021) Earnings and hours worked, place of residence by local authority. Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/placeofresidencebylocalauthorityashetable8

Table 7-16 Beckton water recycling scheme: health and wellbeing[49][50][51]

Area	Life Expectancy at Birth (Male)	Life Expectancy at Birth (Female)	Under 75 mortality rates from all causes (per 100,000)	Percentage of Physically active adults (2020/2021)
Newham	79.0%	83.1%	385.2	59.1%
Epping Forest	80.4%	84.0%	296.3	67.8%
Barking & Dagenham	77.0%	81.7%	449.3	52.3%
Enfield	80.0%	84.2%	314.8	61.4%
Haringey	79.6%	84.4%	330.5	64.7%
Redbridge	80.5%	84.6%	298.0	57.4%
Waltham Forest	79.8%	84.5%	329.4	60.4%
London	80.3%	84.3%	316.1	64.9%
England	79.4%	83.1%	336.5	65.9%

7.2.10.3 Index of multiple deprivation

The Index of Multiple Deprivation[52] is the official measure of relative deprivation in England which combines information from the seven domains (Income Deprivation; Employment Deprivation; Education, Skills and Training Deprivation; Health Deprivation and Disability; Crime; Barriers to Housing and Services; and Living Environment Deprivation).

Where each local authority ranks nationally based on the average score achieved is highlighted in **Table 7-17**. The average score measure is calculated by averaging the LSOA ranks in each larger area after being weighted by population. A rank of 1 (out of 317) represents the highest average score equating to the highest area of deprivation. Both Newham and Barking and Dagenham rank significantly higher than the other local authorities which will be impacted by the Beckton water recycling scheme.

Also included in **Table 7-17** are the proportion of Lower Layer Super Output Areas (LSOAs) in the most deprived 10% nationally alongside their rank compared to all other LAs. Two LAs (Epping Forest and Redbridge) have no LSOAs in the most deprived 10% nationally. Haringey is one LA which ranks significantly higher than other LPAs impacted by the Beckton water recycling scheme.

Table 7-17 Beckton water recycling scheme: index of multiple deprivation

Area	IMD 2019 – Local Authority Rank	IMD 2019 – Proportion of LSOAs in most deprived 10% nationally
Newham	12	2.4%
Epping Forest	200	0.0%
Barking & Dagenham	5	3.6%
Enfield	59	5.4%
Haringey	37	9.6%

[49] ONS (2021) Life Expectancy Estimates. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/datasets/lifeexpectancyestimatesallagesuk

[50] Office for Health Improvement and Disparities (2021) Mortality Profiles. Available at: https://www.gov.uk/government/statistics/mortality-profile-december-2021

[51] Office for Health Improvement and Disparities (2022) Physical Activity. Available at: https://www.gov.uk/government/statistics/physical-activity-data-tool-january-2022-update

[52] Ministry of Housing, Communities & Local Government (2019) English Indices of Deprivation 2019. Available at: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019

Area	IMD 2019 – Local Authority Rank	IMD 2019 – Proportion of LSOAs in most deprived 10% nationally
Redbridge	160	0.0%
Waltham Forest	45	2.1%

7.2.10.4 Cultural infrastructure

Table 7-18 shows the cultural infrastructure, as defined within the London Cultural Infrastructure Plan, that is within 500m of a construction site associated with the Beckton water recycling scheme. These cultural assets are important for a number of reasons; they support local culture and identity, they support jobs and businesses and they help to maintain London's status as a global centre of culture.

These assets may be impacted by construction in a number of different ways;

- The setting of them could be impacted by construction work nearby, lowering their attractiveness to visitors and the community;
- They may become temporarily more difficult to access due to nearby construction work causing road closures, diversions, or by increasing traffic volume;
- An increase in land purchasing in an area may result in an increase in land value, meaning cultural assets may begin to be displaced;

Due to the urban, and in some cases, industrial nature of the land surrounding the proposed construction sites, the majority of the cultural assets identified in **Table 7-18** are not anticipated to experience adverse impacts. However, the assets surrounding Wanstead Flats (those in Cann Hall and Forest Gate North wards) may experience impacts as these are in a usually quiet residential area. The same is also true for those assets nearby Enfield Island Village (within Enfield Lock ward).

Table 7-18 Cultural infrastructure within 500m of Beckton water recycling construction sites[53]

Name	Type	Ward
Galleon Community Centre	Community Centre	Gascoigne
Abbey Community Hall	Community Centre	Abbey
Enfield Island Village Community Centre	Community Centre	Enfield Lock
Papertank Collective	Coworking Area	Tottenham Hale
Studio 3 Arts	Creative Workspace	Gascoigne
Mill Mead Rehearsal Studios	Dance Studio	Tottenham Hale
Enfield Island Village Library	Library	Enfield Lock
North London Darkroom	Makerspaces	Tottenham Hale
The Cave Studios	Music Recording Studio	Tottenham Hale
Signature Brewery Tap	Pub	Leyton
Leytonstone Tavern	Pub	Cann Hall
Wanstead Tap	Pub	Cann Hall
Holly Tree	Pub	Cann Hall
Forest Gate Hotel	Pub	Forest Gate North
Pretty Decent Beer Co	Pub	Cann Hall
Frankie & Benny's	Pub	Beckton

[53] The Greater London Authority (2019) Cultural Infrastructure Plan. Available at: https://www.london.gov.uk/sites/default/files/cultural_infrastructure_plan_online.pdf

Name	Type	Ward
Ferry Boat Inn	Pub	Tottenham Hale
Cann-Hall Park	Skate Park	Cann Hall
Just Jersey Ltd	Textile Design	Leyton

7.3 ASSESSMENT

7.3.1 Water

Refer to ***Annex B.2.1. Physical Environment Assessment Report*** and ***Annex B2.2. Water Quality Assessment Report*** for full details.

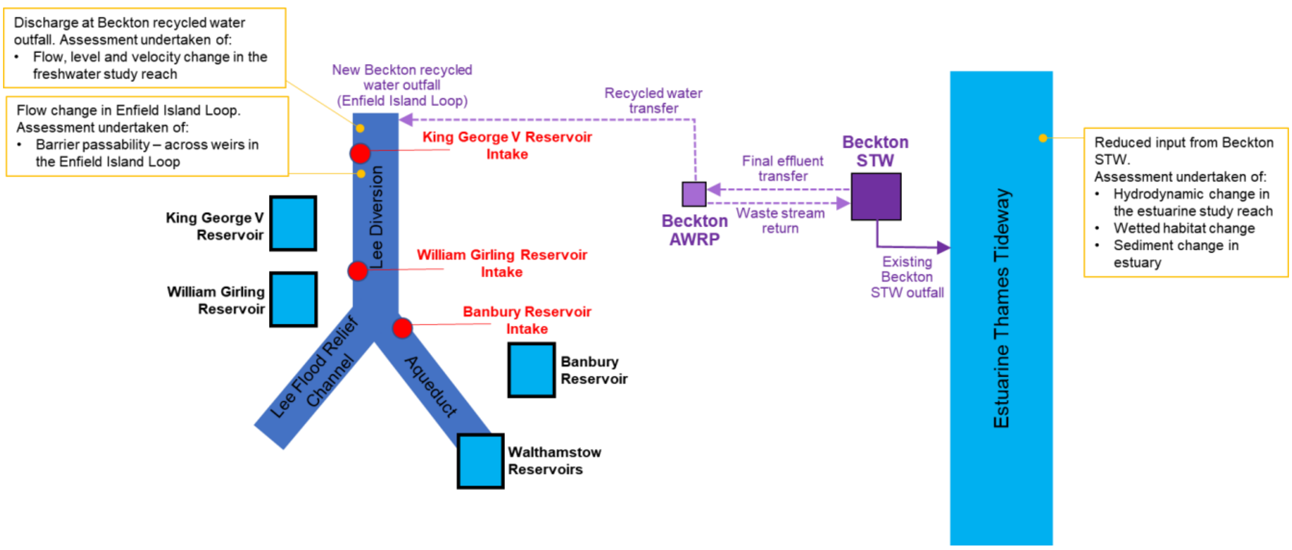
7.3.1.1 Physical environment

7.3.1.1.1 Activities and pathways for impact

The Physical Environment Assessment for the Beckton water recycling scheme considered the following operational impacts, and summarised in **Figure 7-4**:

- Flow changes from Beckton water recycling scheme;
- A review of Beckton water recycling outfall design;
- Wetted habitat change in freshwater channels of the River Lee, estuarine Bow Creek and estuarine Thames Tideway;
- Enfield Island Loop barrier passability; and
- Thames Tideway estuarine sediment assessment.

Figure 7-4 Representation of the Beckton water recycling scheme study area with conceptualisation of physical environment effects and listing of assessment undertaken for Gate 2



7.3.1.1.2 Impact risk and additional mitigation requirements

For the Beckton water recycling scheme, physical environment impacts are described in the ~100m reach of heavily modified channel of the Enfield Island Loop between a Beckton water recycling outfall and the existing intake to King George V Reservoir. There may also be impacts in the remaining ~500m heavily modified reach of the Enfield Island Loop downstream to the confluence with the Lee Diversion Channel but the effects cannot be quantified as they are entirely dependent on the abstraction regime operated for the Thames Water intakes. Based on the artificial nature of the channel, no adverse effects are considered likely from a physical environment perspective.

The Beckton water recycling scheme would not impact upon the Thames Tideway, associated with reductions in Beckton STW final effluent input into the middle Tideway. Hydrodynamic modelling has identified negligible changes in low water spring tide water levels and therefore negligible change in intertidal habitat exposure. The effects on modelled suspended sediment concentration within the Thames Tideway for Beckton water recycling scheme are indiscernible from reference conditions and therefore there would be no change in sediment deposition and mud habitats in the Thames Estuary.

Table 7-19 summarises the potential physical environment impacts for each of the sizes of a Beckton water recycling scheme.

Table 7-19 Beckton water recycling scheme: summary of potential physical environment impacts

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Flows	~100m reach of Enfield Island Loop	**100 Ml/d** 80% increase in very low flows (Q95)	G	Not required.
		200 Ml/d 160% increase in very low flows (Q95)	G	Not required.
		300 Ml/d 240% increase in very low flows (Q95)	G	Not required.
	~500m reach of Enfield Island Loop and downstream Lee Diversion	**100 Ml/d** 0-80% increase in flows downstream	G	Not required.
		200 Ml/d 0-160% increase in flows downstream	G	Not required.
		300 Ml/d 0-240% increase in flows downstream	G	Not required.
	Beyond Flanders weir	**100 Ml/d** No change.	G	Not required.
		200 Ml/d No change.	G	Not required.
		300 Ml/d No change.	G	Not required.
Outfall design	Enfield Island Loop	Negligible. Not set out in detail at Gate 2 but due to the extent of flow increase, a 0.3m/s exit velocity and the shallow channel depth would result in full dispersal of plume within metres of the outfall in a heavily modified channel.	G	Not required.
Wetted habitat	~100m reach of Enfield Island Loop	**100 Ml/d** No change in water width and 0.08m/s increase in mean flow velocity at very low flow conditions.	G	Not required.
		200 Ml/d No change in water width and 0.15m/s increase in mean flow velocity at very low flow conditions.	A	Not considered to be required given artificial channel
		300 Ml/d No change in water width and 0.23m/s increase in mean flow velocity at very low flow conditions.	A	Not considered to be required given artificial channel
	River Lee Diversion Channel	Unknown change downstream in a largely artificial channel without aquatic habitat at all sizes.	G	Not required.

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
	Estuarine Thames Tideway	Indiscernible change in intertidal exposure at all sizes.	G	Not required.
Barrier passability	Enfield Island Loop	Negligible. One low barrier, KGV North Weir, in the Enfield Island Loop with potential for increase in depth of water over crest and reduction in head difference both of which reduce any barrier effect.	G	Not required.
Estuarine sediment	Estuarine Thames Tideway	Negligible. Negligible changes in suspended sediment concentration within the Thames Tideway from final effluent flow reductions at Beckton STW.	G	Not required.

7.3.1.2 Water quality

7.3.1.2.1 Activities and pathways for impact

The Beckton water recycling schemes may have only negligible changes in the general physico-chemical environment compared to the baseline conditions of the freshwater Lee Diversion Channel. The 300 Ml/d, 200 Ml/d and 100 Ml/d schemes have a negligible impact on WFD chemicals, EQSD chemicals and olfactory water quality.

7.3.1.2.1 Impact risk and additional mitigation requirements

Table 7-20 summarises the potential water quality impacts for each of the sizes of a Beckton water recycling scheme.

Table 7-20 Beckton water recycling scheme: summary of potential water quality impacts

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Water temperature	Freshwater Lee Diversion	**100 Ml/d** Negligible change	G	None required.
		200 Ml/d Negligible change	G	
		300 Ml/d Negligible change	G	
	Estuarine Thames	**100 Ml/d** No change	G	None required
		200 Ml/d No change	G	
		300 Ml/d No change	G	
General physico-chemical	Freshwater Lee Diversion	**100 Ml/d** DO: No deterioration. No other data available (Gate 3)	G	None required.
		200 Ml/d DO: No deterioration. No other data available	G	None required.
		300 Ml/d DO: No deterioration. Ammonia: No deterioration. Phosphate: No deterioration.	G	None required.

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
		Langelier Saturation Index: Corrosive value not advisable.		
	Estuarine Thames	**100 Ml/d** DO: No data available. DIN: Reductions in DIN during times when the scheme is on. Salinity: Negligible salinity increases inferred from larger schemes modelling.	G	None required.
		200 Ml/d DO: No data available. DIN: Reductions in DIN during times when the scheme is on. Salinity: Negligible salinity increases inferred from larger schemes modelling.	G	None required.
		300 Ml/d DO: No data available. DIN: Reductions in DIN during times when the scheme is on. Salinity: Negligible salinity increases inferred from both scenarios modelled.	G	None required.
WFD chemicals	Freshwater Lee Diversion	**100 Ml/d** The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	G	None required.
		200 Ml/d The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	G	None required.
		300 Ml/d The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	G	None required.
	Estuarine Thames	**100 Ml/d** 15 WFD chemicals exceeded the standard in the baseline scenario. In the A82 and M96 scenarios, no further chemicals exceeded the standards.	G	None required.
		200 Ml/d 15 WFD chemicals exceeded the standard in the baseline scenario. In the A82 and M96 scenarios, no further chemicals exceeded the standards.	G	None required.
		300 Ml/d 15 WFD chemicals exceeded the standard under reference conditions. A further one chemical exceeded the standard under the A82 Under the M96 scenario no further chemicals exceeded standards.	G	None required.
		100 Ml/d	G	None required.

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
EQSD chemicals	Freshwater Lee Diversion	The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.		
		200 Ml/d The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	G	None required.
		300 Ml/d The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	G	None required.
	Estuarine Thames	**100 Ml/d** With the scheme in operation (A82), one further chemical exceeded the standard. Under the M96 scenario one further chemical exceeded the standard.	G	None required.
		200 Ml/d With the scheme in operation (A82), one further chemical exceeded the standard. Under the M96 scenario one further chemical exceeded the standard.	G	None required.
		300 Ml/d With the scheme in operation (A82), one further chemical exceeded the standard. Under the M96 scenario one further chemical exceeded the standard	G	None required.
Olfactory water quality	Freshwater Lee Diversion and Estuarine Thames	**100 Ml/d and 200 Ml/d** Negligible Olfactory water quality inferred from larger schemes modelling.	G	None required.
	Freshwater Lee Diversion	**300 Ml/d** The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	Uncertain - More data needed for assessment.	
	Estuarine Thames	**300 Ml/d** A82 has four exceedances which were also present at baseline, one improvement and one new pressure. M96 exhibits the same changes as for A82.	Uncertain - More data needed for assessment.	

7.3.1.3 Flood risk

7.3.1.3.1 Activities and pathways for impact

7.3.1.3.1.1 Construction

The construction phase has the potential to present flood risks to the site users, equipment, temporary compounds and machinery on-site, as well as having the potential to increase flood risks off-site. This is partly dependant on the site conditions. The potential flood risk impacts that could be presented by the construction phase could include:

- Damage to machinery, equipment and temporary compounds located in areas of flood risk from rivers, watercourse, tides and surface water.
- Storage of equipment and materials in areas vulnerable to flooding, which could offset flood storage and increase the flood risks in other areas.
- Impacts on groundwater flow and volumes as a result of sub-surface construction and excavation. This could cause groundwater flooding at the site, or displace groundwater flows and volumes causing flooding in other locations [54].
- Changing surface water runoff rates, flow paths and infiltration rates due to increasing the impermeable areas, altering the ground elevation, and compacting the ground through the use of heavy machinery on-site. This could increase the amount of surface water flowing downstream or into other locations, both on-site and off-site, which could increase surface water flooding.
- The heavy machinery used for construction could damage existing flood risk defences, water supply pipes, sewers and/or drainage infrastructure. This could cause flooding both onsite and elsewhere.

7.3.1.3.1.2 Operation

A risk assessment of each of the Beckton water recycling components and proposed operational pattern, has been completed, to determine whether there would be an increase in flood risk from:

- Development within flood zones.
- Increase in surface water runoff.
- Changes to other sources of flooding.
- Changes to river flows.

7.3.1.3.2 Impact risk and additional mitigation requirements

Further definition has been applied to the RAG criteria, relevant to each type flooding. This is provided in **Appendix 5**.

7.3.1.3.2.1 Construction

Without mitigation, the construction impacts have the potential to have an amber RAG rating at sites where there is a high flood risk or where the construction phase would displace floodwater elsewhere by increasing surface water runoff or taking up floodplain storage.

Best practice flood risk construction measures should be implemented to minimise the flood risks presented to site users and construction machinery and equipment, as well as to avoid increasing flood risks off-site. This can be set out in a site-specific Construction Environmental Management Plan (CEMP) that highlights the necessary mitigation measures that will be required to manage flood risks during construction. These measures may include:

- Planning the site layout so that machinery, equipment, chemicals and temporary compounds are located away from flood risk receptors such as rivers and watercourses, where feasible.
- Storage of machinery, equipment, chemicals, and construction materials should be located away from the floodplain and flood risk receptors.
- A surface water drainage system should be constructed in the first stage of the build to manage surface water runoff from the construction site. This should not release surface water at runoff rates or volumes that are greater than the existing runoff rates.
- Existing flood risk assets, water supply and sewer infrastructure should be identified and marked out, with care undertaken for any construction adjacent to these assets. Any damage to these assets should be repaired immediately.
- If there are potential flood risks that remain onsite, an emergency evacuation plan should be prepared with safe access and egress routes determined so that site users can safely leave the site in a flood event.

7.3.1.3.2.2 Operation

Flood Zones

[54] Groundwater flood risk would be picked up in a Ground Investigation

Out of the 16 sites, eight sites are classified as having a Red RAG rating and two sites are classified as having an Amber RAG rating. The sites with a red or amber rating are shown in **Table 7-21**.

For all sites located in Flood Zones 3 and 2 (Red/Amber RAG rating) an FRA will be required at the planning stage to manage the flood risks to the proposed development while not increasing flood risk elsewhere. This is applicable for all sites in **Table 7-21**. Environment Agency Product 4 data will be required to assess the modelled flood zone levels and extents onsite. This assumes that the Environment Agency can provide suitable hydraulic model outputs and that additional hydraulic modelling will not be required to determine the flood zone levels and extents. The modelled outputs will be used in the Flood Risk Assessment (FRA) to determine any additional mitigation that may be required to manage the flood risks. This mitigation may include:

- Using flood resistant and/or flood resilient techniques to enable the infrastructure to operate in the event of a flood;
- Providing Level for Level Floodplain Compensation to offset any loss of floodplain storage so that flood risks do not increase elsewhere;
- Providing mitigation to prevent flood flows from being impeded and diverted elsewhere;
- Providing a Flood Warning and Evacuation Plan to manage the flood risks to site users in the event of a flood.

Table 7-21 Beckton water recycling scheme: flood zone RAG results

Assessment	Sites
Red	FE Pumping Station (FEPS)
	River Lee Diversion outfall
	AWRP 300 Ml/d Capacity
	Beckton AWRP discharge structure
	Shaft 0
	Shaft 1
	Shaft 4
	Shaft 10
Amber	Shaft 6
	Shaft 6 Lockwood Secondary Shaft Compound

Surface Water

Out of the 16 sites, eight sites are classified as having a Red RAG rating and five sites are classified as having an Amber RAG rating. The sites with a red or amber rating are shown in **Table 7-22**.

For all sites located in a Critical Drainage Area (Red RAG rating), an FRA will be required at the planning stage to manage the flood risks to the proposed development and elsewhere. The Lead Local Flood Authority should be contacted to determine any additional mitigation requirements for sites located in Critical Drainage Areas.

For sites containing areas classified as having a high or medium surface water flood risk in the Environment Agency surface water flood maps (Red or Amber RAG rating), further assessment will be required to determine if this presents a significant risk to the site or proposed development. Mitigation should be provided if this presents a significant flood risk to the proposed development, or if the proposed development is likely to increase surface water flood risks elsewhere. This mitigation may include:

- Adapting the site layout so that proposed infrastructure is not located in areas at high or medium risk of surface water flooding.
- For any proposed development that need to be located in an area of high/medium surface water flood risk, the infrastructure should be set above the design surface water flood level so that a flood event does not affect the developments operation. Surface water should not be displaced to cause flooding elsewhere due to the proposed development. This can be managed by storing surface water elsewhere

on-site in a Sustainable Drainage System (SuDS). Flood resistant/resilient measures for can also be used to protect the infrastructure from flooding.

- Diverting or maintaining any high or medium risk surface water flow paths located on-site so that surface water flood risks are not increased elsewhere.

A Drainage Strategy will be required for any proposed developments introducing significant impermeable areas to the site that would increase surface water runoff (Red RAG rating). The Drainage Strategy should manage surface water runoff sustainably using SuDS where feasible, including managing water quantity and water quality. National and Local policies should be adhered to in the drainage strategy design alongside contact with the Lead Local Flood Authority.

For Amber RAG sites in **Table 7-22** where an increase in impermeable areas is proposed, a drainage strategy should be considered to manage surface water runoff if the proposed development would either be at risk of surface water flooding or present a surface water flood risk elsewhere. It may also be necessary to produce a drainage strategy for sites where no additional impermeable areas are introduced. This is dependent on the scale of the development and whether SuDS are feasible at the site. This should be determined through discussions with the Lead Local Flood Authority.

Table 7-22 Beckton water recycling scheme: surface water RAG results

Assessment	Sites	Reason
Red	FEPS	Proposed development introducing significant impermeable areas to the site (increase of more than 0.2ha). Site located in a critical drainage area.
	River Lee Diversion outfall	Proposed development introducing significant impermeable areas to the site (increase of more than 0.2ha).
	AWRP (300 Ml/d)	Proposed development introducing significant impermeable areas to the site (increase of more than 0.2ha). Site located in a critical drainage area
	Beckton AWRP discharge structure	Proposed development introducing significant impermeable areas to the site (increase of more than 0.2ha).
	Shaft 0	Proposed development introducing significant impermeable areas to the site (increase of more than 0.2ha). Site located in a critical drainage area.
	Shaft 1	Site containing areas classified as having a high surface water flood risk in the EA surface water maps. Site located in a critical drainage area.
	Shaft 2	Site located in a critical drainage area.
	Shaft 3	Site located in a critical drainage area.
Amber	Shaft 4	Site containing areas classified as having a medium surface water flood risk in the EA surface water maps.
	Shaft 5	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 6	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 10	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).

Assessment	Sites	Reason
	Shaft 6 Lockwood Secondary Shaft Compound	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).

Other Flood Sources

Out of the 16 sites, seven sites are classified as having a Red RAG rating and six sites are classified as having an Amber RAG rating. The red and amber ratings are all linked to groundwater flood risk. The sites with a red or amber rating are shown in **Table 7-23**.

For all sites that the SFRA maps have highlighted could be at a high risk of groundwater, consideration should be given to undertaking a Ground Investigation to assess this risk. If this indicates that the proposed development is at risk of groundwater flooding, or that the development would displace groundwater elsewhere which could result in flooding, additional groundwater mitigation should be implemented to manage this risk. This mitigation may include:

- Arranging the site layout so infrastructure is not located at high risk of groundwater flooding;
- If the infrastructure has to be located in areas at high groundwater flood risk, increasing the infrastructure levels above the estimated flood level or making the infrastructure flood resistant/resilient so the infrastructure is flood resilient;
- Minimising below ground structures in areas with a high water table.

Table 7-23 Beckton water recycling scheme: other flood sources RAG results

Assessment	Sites
Red	FEPS
	River Lee Diversion outfall
	Beckton AWRP discharge structure
	Shaft 1
	Shaft 8
	Shaft 9
	Shaft 10
Amber	AWRP 300 Ml/d Capacity
	Shaft 2
	Shaft 3
	Shaft 4
	Shaft 5
	Shaft 7

River Flows

The Beckton water recycling scheme will increase flows in the River Lee of up to 300 Ml/d (3.4m³/s) at the discharge location to the north of the King George V reservoir. These flow changes will only occur during periods of low flow.

The flows will only be increased in the River Lee for a short 150m section since the flows will be abstracted into the King George V reservoir. With good operational management, this will not significantly increase low or moderate flows downstream to present a flood risk.

During higher flows, a reduced sweetening flow will continue to be discharged. However, this will be suspended during high flow events so that this will not increase flood risk.

Therefore, the change in River Lee flows as a result of the Beckton water recycling scheme has a Green RAG rating for flood risk.

7.3.2 Biodiversity

Refer to ***Annex B.2.3. Fish Assessment Report***, ***Annex B2.4. Aquatic Ecology Assessment Report***, ***Annex B2.5 INNS Report*** and ***B2.6. Terrestrial Ecology Assessment Report*** for full details.

7.3.2.1 Fisheries

The purpose of fish assessment report is to identify the source of greatest potential magnitude of change that a London Effluent Reuse SRO might cause within that reach, and then assess the potential for change to the fish community present within that reach and also in relation to any migratory species present or moving through the reach.

7.3.2.1.1 Activities and pathways for impact

The fish assessment of the Beckton water recycling Scheme was conducted for the following topics, utilising the results of the Physical Environment and Water Quality assessment reports:

- Freshwater fish
- Weir pool / marginal habitat (including Sunbury creek)
- Estuarine fish (including European eel)
- Migratory fish (including European eel)
- European smelt
- Olfactory cues

7.3.2.1.2 Impact risk and additional mitigation requirements

It is evident that the potential changes in flow are not considered to be of a magnitude to affect the fish communities within the freshwater River Lee, Tidal River Lee or Thames Tideway, or result in changes to the use of the Estuarine Thames Tideway by migratory fish species.

The changes to flow are likely to result in temporary changes to species distribution and barriers to migratory European eel within the Enfield Island Loop to Chingford Abstraction.

The results of the water quality modelling indicate that temperature changes within the Enfield Island Loop of the Lee Diversion Channel upstream of King George V Reservoir Intake are unlikely to result in changes to the freshwater fish community. Impacts to temperature are not expected to lead to a reduction in WFD status or exceed the thermal tolerances of species present but may result in impacts to the behaviour of fish species particular at or close to the discharge location where temperatures are highest. Though, these impacts are likely to be dependent upon the ambient temperature in the River Lee. Temperature increases below the mixing zone may result in changes to metabolic rate, gonad development, embryonic development, hatch rate and overall survival of most species to a varying degree. Species and life-stages tolerant to a broader range of temperatures including warmer water, may show increased success compared to less thermally plastic species, this may lead to changes to the community structure downstream of the discharge outfall. There are no predicted impacts upon temperature within the Thames Tideway and thus no predicted impacts upon the estuarine fish community.

Impacts to ammonia concentrations are not likely to impact the freshwater and estuarine fish population. A number of WFD and EQSD priority substances have been identified as likely to exceed standards during the scheme, the extent to which these chemicals will impact the freshwater or estuarine fish community is not yet understood. However, several olfactory inhibitors have been highlighted including dissolved copper, cypermethrin, permethrin, pirimicarb and dissolved zinc which may impact olfaction in the estuarine Thames Tideway.

7.3.2.2 Aquatic ecology

The purpose of aquatic assessment report is to identify the source of greatest potential magnitude of change that a London Effluent Reuse SRO might cause within that reach, and then assess the potential for change to the aquatic flora and fauna present within that reach.

7.3.2.2.1 Activities and pathways for impact

7.3.2.2.1.1 Construction

An assessment of construction related impacts has not been completed at Gate 2, the focus has been around determining in which reaches the operational impacts are significant and confirming the size of the scheme to be progressed to Gate 3. Construction impacts are considered to be manageable with best practice construction techniques and a suite of standard mitigation measures which will be confirmed as part of the Gate 3 work.

7.3.2.2.1.2 Operation

The physical environment assessment has concluded negligible impacts for fish pass and barrier passability and estuarine sediment, therefore no further assessment has been undertaken for the aquatic ecology receptors. With limited details of the outfall design currently, in depth analysis of effects of the increased velocity from the outfall is not possible. This will be required at Gate 3.

Therefore the Gate 2 aquatic ecology assessment has focussed on the impacts from velocity and flow changes, and changes in wetted habitat, and the changes in water quality parameters as summarised in Section 7.3.1.2.1.

In summary, the aquatic ecology assessment has considered changes to:

- Macroinvertebrates across Reaches D, E, F, G and H.
- Marginal habitats across Reach G in the freshwater Lee Diversion Channel
- Macrophytes across Reaches G and H in the freshwater Lee Diversion Channel
- Diatoms across Reaches Reach E in the estuarine Thames Tideway and Reaches G and H in the freshwater Lee Diversion Channel
- Macroalgae, Angiosperm and Phytoplankton across Reaches D, E and F in the estuarine Thames Tideway
- Designated and protected sites and species across Reaches D, E and F in the estuarine Thames Tideway, Reaches G and H in the freshwater Lee Diversion Channel and Reach I in the estuarine River Lee.

7.3.2.2.2 Impact risk and additional mitigation requirements

No pathways for impact have been identified from the physical environment and water quality work, and therefore no impacts to aquatic and/or estuarine communities and/or designated sites, are anticipated for the following reaches:

- Reach F – Tower Bridge to 3km seawards of Beckton STW
- Reach I – Three Mills Lock to Thames Tideway

Table 7-24 includes a summary of the risks anticipated for the 300 Ml/d option.

Table 7-24 Beckton water recycling scheme (300 Ml/d): summary of potential aquatic and estuarine ecology impacts

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Reach D – Teddington Weir to Battersea Park				
Velocities and flows	Aquatic invertebrates, macroalgae, angiosperm and phytoplankton	No change to velocity for flow, temperature or oxygen saturation in the middle Thames Tideway is expected as a result of reduced discharge from Beckton STW discharge, as such there are no impacts to aquatic invertebrates.	G	None required.
Temperature				
Oxygen saturation				
Dissolved inorganic nitrogen		Significant decreases in DIN are predicted for the Thames Tideway, this is not expected to impact the invertebrate community as the community has been determined to be tolerant to a wide range of nutrient conditions.	G	None required.
Reach E – Battersea Park to Tower Bridge				
Velocities and flows	Diatoms	No impacts on flow or velocity are expected within this reach, as such there will be no impacts to the diatom community.	G	None required.
Temperature		Significant decreases in DIN are predicted for the Thames Tideway, this is not expected to impact the invertebrate community as the community has been determined to be tolerant to a wide range of nutrient conditions.	G	None required.
Oxygen saturation				
Dissolved inorganic nitrogen				
Reach G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions				
Velocities and flows	Aquatic invertebrates	Localised increases in flows immediately adjacent to the discharge outfall may exceed the tolerance range of several species found within the reach. Overall increased flows have the potential to increase the fitness and available habitat for species with a preference or tolerance to faster flows.	G	None required.
	Macrophytes	The likely increasing in velocities and flow as a result of the schemes may change the overall community structure with Reach G with an increase in taxa with a preference for faster flowing water.	G	None required as artificial channel.
	Diatoms	Major increases in very low flows are predicted in ~100m reach of Enfield Island Loop. This has the potential to have an adverse impact on those diatom communities with little motility. From the samples collected within this reach, the results showed that there was a low percentage of motile diatoms present.	A	Further assessment required with regards operational regime.
Wetted habitat	Marginal habitat	The assessed changes to the indictor scores were both positive (increased hydraulic feature richness) and negative (increased siltation and NNIPS extent). Overall, the preliminary condition score was reduced to -0.660, however this change does not meet the lower threshold and the condition category for Poor, and therefore remains Fairly Poor river condition category. Diatoms in this reach are likely to be affected in areas whereby there is an increase in flows.	G	None required.
Temperature	Aquatic invertebrates	The tolerable range of the species within the reach are broad, and negligible changes are not likely to exceed these.	G	None required.
	Macrophytes	Changes are expected to be minimal for temperature. Therefore, no significant impacts are anticipated on the macrophyte communities.	G	None required.
	Diatoms	There is a predicted increase of up to 1.7°C. An increase in temperature may potentially improve the fitness of individual diatom species. Conversely, an increase in temperature also may have negative impacts on diatom communities. It is possible that by increasing temperature, there will be a reduction in optimum conditions for diatom species. Increasing temperatures have also been found to slow or stop division rates within diatom species when upper tolerances have been reached. Therefore, those diatom species with a higher temperature tolerance may flourish.	A	Further assessment required with regards operational regime.
Oxygen saturation	Aquatic invertebrates	No negative impact on oxygen saturation is predicted under any scenario, therefore no adverse impacts on the invertebrate community, macrophytes or diatoms are expected.	G	None required.
	Macrophytes			
	Diatoms			
Phosphorous	Aquatic invertebrates	No significant negative changes in phosphorous are expected, therefore no adverse impacts on the invertebrate community, macrophytes or diatoms are expected.	G	None required.
	Macrophytes			
	Diatoms			
Reach H – Chingford Abstractions to Three Mills Lock				
Velocity and flows	Aquatic invertebrates	The flow impacts described above for Reach G are only expected to persist until Flanders weir, which is located at the very top of Reach H above Banbury Reservoir, beyond this there are no changes to flows in this reach.	G	None required.
	Macrophytes			
	Diatoms			
Temperature	Aquatic invertebrates	The tolerable range of the species within the reach are broad, and negligible changes are not likely to exceed these.	G	None required.
	Macrophytes			
	Diatoms			
Oxygen saturation	Aquatic invertebrates	No negative impact on oxygen saturation under any scenario, therefore no adverse impacts on the invertebrate community, macrophytes or diatoms are expected.	G	None required.
	Macrophytes			

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
	Diatoms			
Phosphorous	Aquatic invertebrates	No significant negative changes in phosphorous are expected, therefore no adverse impacts on the invertebrate community are expected as many species within the reach are able to tolerate a wide range of nutrient levels within the freshwater Lee Diversion Channel.	G	None required.
	Macrophytes			
	Diatoms			
Change in water quality and levels	Chingford Reservoirs SSSI	The existing operating regime and River Lee abstraction is designed to maintain water levels in the King George V and William Girling reservoirs, consequently there is no evidence to suggest that change in flow within the rivers would negatively affect the levels within the reservoirs.	G	None required.
	Walthamstow Reservoirs SSSI	There are no flow changes in the reach of the freshwater Lee Diversion Channel adjacent to the site associated with a Beckton water recycling scheme, as any discharges that would increase flow in the upstream Lee Diversion Channel would be abstracted upstream of Walthamstow Reservoirs. In addition, no water quality impacts are anticipated in Lee Diversion Channel due to operation of the Beckton water recycling scheme. Therefore, no impacts to the qualifying features of the SSSI are anticipated due to changes in hydrology or water quality.	G	None required.
	Walthamstow Marshes and NNR	There is likely to be hydrological connectivity between the Lee Diversion Channel and wetland habitats that form Walthamstow Marshes, however, as there will be no change in flow or water level within the reach adjacent to the Site, no adverse impacts to the qualifying features of the site are anticipated.	G	None required.

7.3.2.3 Invasive Non-Native Species

Major changes in flows, along with minor and moderate changes in wetted habitat are predicted, which has the potential to increase the distribution of INNS within the freshwater Lee Diversion Channel. The 300 Ml/d scheme has the greatest predicted effects when compared to the other option sizes.

Modelling predicts negligible effects on water quality within the Lee Diversion Channel, with slight increases in dissolved oxygen, and minor developments in phosphate. This suggests that there will be minimal effect on distribution of INNS within the river.

The Beckton water recycling scheme does not need to be assessed using the SAI-RAT tool. It is not likely that the introduction or transfer of INNS will occur during the operation of this option, as the effluent discharge is treated in several steps prior to discharge into the freshwater River Lee Diversion which eliminates all pathways that are likely to introduce or transfer INNS during normal operation.

7.3.2.4 Terrestrial ecology

7.3.2.4.1 Activities and pathways for impact

7.3.2.4.1.1 Construction

The construction activities associated with the 300 Ml/d Beckton water recycling scheme would include the following activities that have potential to result in biophysical changes to important terrestrial ecological features:

- Construction of AWRP at Beckton STW (north of existing site) which includes removal of vegetation, earthworks and associated drainage.
- Construction of temporary site compounds and permanent reception shafts at Beckton STW and permanent intermediate shafts along the conveyance route (including vegetation removal, earthworks, provision for compound drainage and Sustainable Urban Drainage Systems (SuDS), and creating areas of hardstanding to provide a working area for construction phase activities).
- Construction of temporary access routes (including vegetation removal, earthworks, and associated drainage)
- Construction of discharge/outfall location along the River Lee Diversion Channel.
- Fencing (comprising taller ‘Heras’ type around compounds and lay-down areas).

The activities listed above have the potential to result in the following effects:

- Habitat loss (both temporary and permanent) - It is assumed that all areas of temporary habitat loss will be re-instated to the current baseline condition following completion of the construction phase of the scheme.
- Habitat fragmentation (temporary)
- Management changes to habitats (leading to habitat degradation)
- Disturbance of individuals or groups of animals via noise, vibration and visual disturbance
- Direct injury or mortality of individual animals and plants
- Pollution e.g., sediment mobilisation, dust, hydrocarbons (habitat degradation and indirect injury/mortality to species).

7.3.2.4.1.2 Operation

The operational activities associated with the 300 Ml/d Beckton water recycling scheme would include the following activities that have potential to result in biophysical changes to important terrestrial ecological features:

- Operational changes to flow regime in the River Lee Diversion Channel.
- Operation and maintenance of new infrastructure including the conveyance route and within the existing Beckton STW site

The activities listed above have the potential to result in the following effects:

- Management changes to habitats (leading to habitat degradation)

- Disturbance of individuals or groups of animals via noise, vibration and visual disturbance
- Direct injury or mortality of individual animals and plants
- Impacts from water level changes (a cause of habitat loss, degradation and/or indirect injury/mortality to species).

7.3.2.5 Impact risk and additional mitigation requirements

The construction of the Beckton water recycling scheme including the AWRP at Beckton STW, conveyance route and discharge location will result in the direct loss of grassland, woodland and scrub habitat including lowland dry acid grassland, wet woodland and reedbed priority habitat at Shaft 3 and 4 respectively. This includes the permanent loss of other neutral grassland g3c within the boundary of Lee Valley SPA and Ramsar site, Walthamstow Reservoirs SSSI and Lea Valley SINC. Permanent loss of mixed/ dense scrub and other neutral grassland was identified in the boundaries of Beckton STW northern settling lagoon SINC and grassland within Epping Forest South SINC. Two SSSIs (Epping Forest SSSI and Chingford Reservoirs SSSI) were identified within 2 km of the scheme, plus seven additional non-statutory sites (SINCs). Species records received within 2 km of the Beckton water recycling scheme included bats, reptiles, breeding and wintering birds, amphibians, stag beetle and water vole. At Beckton STW, the expansion could result in the direct loss of supporting habitat for bats, breeding birds, amphibians, reptiles, protected and notable terrestrial invertebrates, otter, water vole, hedgehog, and badger. Additional surveys are recommended to determine presence of protected species and identification of compensation sites will need to be considered.

Where adjacent supporting habitat has been identified, indirect impacts from the scheme include noise, visual and vibration disturbance and pollution (e.g., via vehicle emissions, dust, and hydrocarbons). This includes at Beckton STW (due to the proximity to Barking Creek and associated saltmarsh and mudflat priority habitat), Shaft 3 (due to Epping Forest SSSI and stag beetle), Shaft 6 and Shaft 10 (due to proximity to Lee Valley SPA, Ramsar and Walthamstow Reservoirs SSSI and qualifying birds). Additional surveys are recommended to determine presence/ spatial distribution of protected species.

During operation of the Beckton water recycling scheme, no discernible impacts were identified on habitats present in estuarine Thames Tideway, the Lee Diversion Channel or adjacent habitats as a result of intermittent disturbance from anthropogenic activity at Beckton STW, shaft and the intake/ outfall sites.

Increase flow level and velocity in the Lee Diversion Channel has the potential to reduce the suitability for foraging and commuting otter through reduction in suitability for prey species and increased flow increasing effort required to travel up stream. However due to the large size of otter home range and limited length of affected reach, their ability to travel on land, and the presence of additional connecting water courses (e.g., Lee Navigation) the potential impacts to otter during operation of the Beckton water recycling scheme are considered to be negligible.

Table 7-25 includes a summary of the risks anticipated.

Table 7-25 Beckton water recycling scheme: Summary of potential terrestrial ecology impacts

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Habitat loss – temporary and permanent	Priority and local value habitats	Fencing of retained adjacent habitats to reduce the potential for works encroachment.	Permanent loss of habitats within site footprints: combined total of 6.143ha. No areas of priority habitats are within the areas of permanent loss associated with the Beckton water recycling. The temporary construction compounds will result in a total of 8.049 ha of temporary habitat loss including 0.03 ha of the priority habitat saltmarsh and saline reedbeds.	A	Compensation for loss of priority habitat area.
Disturbance to protected and notable species	Bat	Construction best practice relating to control of dust and pollution prevention. Avoidance of mature trees, woodland, and hedgerows through scheme design where possible to minimise potential impacts. Fencing of retained adjacent habitats to reduce the potential for works encroachment.	Direct impacts (Shafts 1, 2, 3, 4 and 10): • loss, damage and/or disturbance of potential bat roosts (Shafts 1, 2, 3, 4, and 10). • temporary and permanent loss of foraging or commuting habitats within site compound and permanent infrastructure. Indirect impacts: • disturbance of foraging bats through noise and/or lighting during construction activities.	Uncertain – more data needed[55]	Avoidance of night-time working adjacent to bat roosts (where identified through further surveys) and high value foraging habitats. Lighting of shaft compounds should be designed to minimise light spill on to adjacent high value habitats.
	Badger		Direct impacts (Shafts 1 and 10): • damage or disturbance of badger setts during construction works. • accidental injury or mortality due to presence of excavations and/or plant/ vehicle movements.	Uncertain – more data needed	Fencing of site compounds to prevent badger access to exposed excavations and encroachment of works into retained habitats
	Stag beetle		Direct impacts (Shafts 1, 2, 3, 4, and 10): • loss or disturbance of larval habitats which include rotting standing trees, stumps or logs. • injury or mortality of larvae and/or adults (May to September) during site clearance. • temporary and permanent loss of supporting habitats within site compound and permanent infrastructure footprint. Indirect impacts: • disturbance of populations through additional artificial lighting attracting night flying insects such as moths. • habitat degradation from pollution including accidental spills and dust.	Uncertain – more data needed	Deadwood suitable for priority invertebrate species should be translocated to retained habitats, and habitats within the areas of temporary loss re-instated on a like-for-like basis.
	Reptiles		Direct impacts Shafts 1, 2, 3, 4, 5, 9 and 10: • loss or disturbance of supporting habitats. • injury or mortality during site clearance and construction. Indirect impacts: • habitat degradation from pollution including accidental spills and dust.	Uncertain – more data needed	Site clearance in areas containing suitable reptile hibernation features should not be undertaken during the hibernation period (October to March inclusive). The clearance should be supervised by a suitably experienced ecologist following a precautionary working method statement (PWMS).
	Water vole		Direct impacts (Shafts 1, 4 and 10): • loss or disturbance of supporting habitats. • injury or mortality during site clearance. Indirect impacts: • habitat degradation from pollution including accidental spills.	Uncertain – more data needed	Site clearance should be undertaken under supervision of an Ecological clerk of Works (ECoW). In areas containing suitable hibernation features should not be undertaken during the hibernation period (October to March inclusive).
	European hedgehog		Direct impacts (Shafts 1, 2, 3, 4, 5 and 10): • loss or disturbance of supporting habitats (e.g. grassland, scrub, woodland, parkland). • injury or mortality during site clearance Indirect impacts: • habitat degradation from pollution including accidental spills and dust.	Uncertain – more data needed	Avoidance of scrub, woodland, and hedgerows through scheme design where possible to minimise potential impacts. Site clearance in areas containing suitable hibernation features should not be undertaken during the hibernation period (October to March inclusive).
	Amphibians		Direct impacts: • loss or disturbance of supporting terrestrial habitats. • injury or mortality during site clearance and construction. Indirect impacts: • habitat degradation from pollution including accidental spills and dust.	Uncertain – more data needed	Potential need for exclusion fencing and trapping programmes if great crested newt present. Sensitive clearance of vegetation.

[55] Insufficient baseline data to confirm whether species/group present or not.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Disturbance to birds	Birds	Screening and noise dampening equipment should be used to minimise noise disturbance and dust emissions. • Measures will be taken to protect any temporary exposure of bare soil from runoff during heavy rainfall events. • All vehicles and any chemical/ oil storage will be fully bunded to prevent any accidental pollution within supporting habitat.	Direct Permanent loss of supporting habitat within the footprint of the shaft. No habitat survey completed at proposed site due to access constraints. Potential impacts on riverbank stability on the River Lea and increased sediment input into the river potentially smothering supporting habitat for waterbirds (Beckton outfall) No impacts considered likely at Shaft Compounds 2, 3, 7-9. Indirect – Noise, vibration and visual disturbance and exposure to pollution (air, dust, lubricants, detergents, cement, fuel) if birds present.	R	Any vegetation clearance required should be undertaken outside of the breeding bird season (March –August inclusive). Outfall - Minimise removal of riparian vegetation to avoid damage to bank stability and sediment loading in the river. If necessary to remove, reinstate riparian vegetation. - Minimise duration of any necessary in-channel working to avoid compaction, disruption of flow processes and bank erosion.

7.3.3 Historic environment

7.3.3.1 Activities and pathways for impact

7.3.3.1.1 Construction

The setting of designated heritage assets is likely to be affected by construction works associated with the scheme. However, these effects are anticipated to be temporary, only affecting the asset settings for the duration of the construction phase of the project.

There is the potential for known and currently unknown archaeological deposits to be disturbed or removed by construction activities associated with the scheme. Intrusive groundworks may truncate or destroy any archaeological remains present within the footprint of temporary and permanent compounds, shaft sites, and in the location of any new infrastructure.

The proposed pipelines associated with the scheme are all anticipated to be tunnelled at a depth of c.20m. As tunnelled pipelines will be located at a much lower depth than any surviving archaeological deposits (based on professional experience), it is unlikely that these pipelines will have any affect upon archaeological deposits present within the scheme route.

7.3.3.1.2 Operation

It is possible that the operation of shaft sites and new infrastructure may affect the setting of nearby designated heritage assets. It is anticipated that the extent and nature of any such effects will be fully investigated, and mitigation strategies identified as part of future heritage statement assessment reports.

It is unlikely that the operation of any element of the scheme will have further effects upon non-designated archaeological remains following construction. It is considered unlikely that there are any risks to archaeological deposits associated with the operation of the scheme. Any such risks are thought to be limited to the construction phase of the project only.

It is unlikely that below-ground pipelines, once constructed, will have any effect upon the setting of nearby designated heritage asset receptors.

7.3.3.2 Impact risk and additional mitigation requirements

7.3.3.2.1 Construction

The assessment has identified amber risks associated with both the construction and operation of the Beckton water recycling scheme, see **Table 7-26**. Several of the development shaft and infrastructure sites are located near to designated heritage assets, which may be negatively affected temporarily during construction works as well as permanently during the scheme's operation. It is considered likely that full heritage statement assessments would be required to fully understand the potential of the scheme to affect the identified designated assets and to inform a suitable mitigation strategy.

All shaft and infrastructure sites are located within areas of known archaeological sensitivity, with several located upon known heritage sites. All sites also have the potential to contain as-yet unidentified archaeological remains. Mitigation of these risks is considered to comprise a full programme of best practice archaeological works including desk-based assessments and archaeological recording activity.

The potential of the tunnelled pipelines to affect any known or unknown heritage assets is considered to be negligible as the tunnelling is likely to be at a significant depth below the extent of any present archaeological remains.

Further mitigation may be required at shaft site 5 where a listed building is directly adjacent to the shaft site. The potential permanent effects of a shaft at this location require further investigation.

Additional assessment may be required to fully understand the potential permanent effects to the settings of the designated assets located near to shaft sites 3 and 10, and to the River Lee Diversion Channel outfall site. Although the assets are not located directly adjacent to any element of the scheme, there is a potential for the receptors to be affected negatively.

Currently unidentified archaeological remains may be present within any shaft or infrastructure site along the scheme route. The extent and nature of any archaeological remains present is currently unknown.

7.3.3.2.2 Operation

The operation of the Beckton water recycling scheme has the potential to permanently affect the settings of a registered park and garden and two listed buildings.

It is considered unlikely that there are any risks to archaeological deposits associated with the operation of the scheme. Any such risks are thought to be limited to the construction phase of the project only.

7.3.3.3 Uncertainties

No red RAG ratings have been identified for any element of the Beckton water recycling scheme.

Further mitigation may be required at shaft site 5 where a listed building is directly adjacent to the shaft site. The potential permanent effects of a shaft at this location require further investigation.

Additional assessment may be required to fully understand the potential permanent effects to the settings of the designated assets located near to shaft sites 3 and 10, and to the King George V reservoir outfall site. Although the assets are not located directly adjacent to any element of the scheme, there is a potential for the receptors to be affected negatively.

Currently unidentified archaeological remains may be present within any shaft or infrastructure site along the scheme route. The extent and nature of any archaeological remains present is currently unknown.

Table 7-26 Beckton water recycling scheme: summary of historic environment initial risk appraisal: construction

Activity and impact	Receptor	Embedded Mitigation	Effect[56]	RAG Rating	Additional mitigation
Construction of shafts.	Listed buildings. Registered park and garden. APAs. Known non-designated heritage assets. Unknown non-designated heritage assets.	Requirements for archaeology not typically included	Construction of shaft sites will impact upon the following heritage assets: Wanstead Park Grade II* registered park and garden. The Coppermills (OA 2) Grade II Listed Building. Retort House and King George Pumping Station Grade II Listed Building. Six separate Archaeological Priority Areas. Historic sewage treatment works (OA 89). The projected route of a Roman road (OA 93). Former 20th century pylons (OA 123). Potential permanent disturbance to or loss of known and unknown Paleoenvironmental and archaeological remains at all shaft sites and associated temporary compounds.	A	Employment of best archaeological practice strategies during construction phase. This could include archaeological desk-based assessment, heritage assessment, and intrusive archaeological recording action. Consultation with Greater London Archaeology Advisory Service (GLAAS) is also likely to be required.
Construction of new infrastructure sites.	Listed building. APAs. Known non-designated heritage assets.	Requirements for archaeology not typically included	Construction of new infrastructure sites will impact upon the following heritage assets: Retort House and King George Pumping Station Grade II Listed Building. Three separate Archaeological Priority Areas.	A	Employment of best archaeological practice strategies during construction phase. This could include archaeological desk-based assessment, heritage assessment, and intrusive archaeological recording action. Consultation with Greater London Archaeology Advisory

[56] See Appendix 2 gazetteer of heritage assets for (OA x) reference.

Activity and impact	Receptor	Embedded Mitigation	Effect[56]	RAG Rating	Additional mitigation
	Unknown non-designated heritage assets.		Historic sewage treatment works (OA 89). Potential permanent disturbance or loss of known and unknown Paleoenvironmental and archaeological remains at all new infrastructure sites.		Service (GLAAS) is also likely to be required.
Construction of tunnel sections.	No receptors identified.	Requirements for archaeology not typically included	No risks identified.	G	No additional mitigation required.

Table 7-27 Beckton water recycling scheme: summary of historic environment initial risk appraisal: operation

Activity and impact	Receptor	Embedded Mitigation	Effect[57]	RAG Rating	Additional mitigation
Operation of shafts.	Listed buildings. Registered park and garden.	Requirements for archaeology not typically included	Operation of shaft sites will impact upon the following heritage assets: Wanstead Park Grade II* Registered Park / Garden (OA 1), at shaft site 3. The Coppermills (OA 2) Grade II Listed Building. Retort House and King George Pumping Station Grade II Listed Building.	A	Full heritage assessment of potential effects to designated asset settings to assist identification of suitable mitigation.
Operation of new infrastructure sites.	Listed building.	Requirements for archaeology not typically included	Potential permanent negative effect upon setting of Grade II listed building, Retort House and King George Pumping Station (OA 4), at King George V reservoir outfall site.	A	Full heritage assessment of potential effects to designated asset settings to assist identification of suitable mitigation.
Operation of tunnel sections.	No receptors identified.	Requirements for archaeology not typically included	No risks identified.	G	No additional mitigation required.

[57] See Appendix 2 gazetteer of heritage assets for (OA x) reference.

7.3.4 Landscape and visual effects

7.3.4.1 Activities and pathways for impact

7.3.4.1.1 Construction

Key construction activities and works that could result in landscape/townscape and visual effects are:

- Vegetation clearance, earthworks and soil preparation to prepare for construction activities;
- Presence and movement of plant, machinery and construction traffic within and around the site;
- Presence of tall plant and machinery (including cranes if used) on the skyline;
- Establishment of construction compound(s) and welfare facilities;
- Presence of hoarding/ safety fencing around the boundary of demolition or construction areas;
- Presence of lighting to light construction activities after dark, and;
- Formation of landform, drainage and soft landscaping activities.

7.3.4.1.2 Operation

Key aspects of the completed proposed development that could result in landscape/townscape and visual effects are:

- New AWRP layout at Beckton STW, including a number of buildings between 6m and 17m tall, associated access roads and car parks.
- Presence of permanent access hatch at shaft sites, and telemetry kiosks at some sites.
- New discharge outfall structure into River Lee Diversion Channel.
- Any security lighting to sites and structures, if considered essential.

7.3.4.1 Impact risks and additional mitigation requirements

The most severe levels of effect are considered to be during the construction of the AWRP at Beckton STW on neighbouring recreational receptors, and during the construction of the discharge outfall structure at King George V Reservoir on neighbouring recreational receptors and local community. It is considered that other landscape/townscape and visual receptors will have a lower level of impact, assuming that the suitable mitigation measures identified are undertaken. **Table 7-28** and **Table 7-29** provide the initial environmental risk assessment for construction and operation respectively.

Further assessment will be required during winter months when deciduous vegetation is leafless. This may highlight potential for higher levels of effect. Some uncertainty regarding effects in winter months will remain, until this work can be done.

Note that this is a preliminary assessment based upon limited project information and knowledge of the construction methodologies and duration proposed. A full landscape/townscape and visual impact assessment will be required as part of the EIA during Gate 3, once detailed designs and construction methods are available.

7.3.4.2 Uncertainties

A detailed design for the Beckton AWRP will enable a more precise assessment to be undertaken, including identifying specific representative viewpoints. This includes an understanding of the vegetation removal, access points, building heights and locations, building materials, boundary treatments, and any proposed soft landscaping.

An understanding of construction impacts on public rights of way, including plans to close/divert footpaths will enable a more precise assessment to be undertaken for the construction impacts of the shaft compounds, Beckton AWRP and discharge outfall structure.

In all locations, avoiding mature trees and minimising vegetation removal and ensuring replacement planting will help reduce levels of effect.

Similarly careful and appropriate restoration of grassed and paved areas, ensuring a match with local character and materials, will help reduce levels of effect.

Table 7-28 Beckton water recycling scheme: summary of landscape and visual amenity initial risk appraisal: construction

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Construction of shafts and tunnel sections – site clearance, compound hoardings, tall plant and machinery, spoil heaps, movement of site traffic, digging shafts, placing access hatch, constructing telemetry kiosks.	Local landscape of the site Local communities, recreational users, pedestrians and road users	Minimise loss of vegetation through design and sensitive location of construction compounds, including locating shafts in areas with existing hardstanding e.g., car parks, roads, pavements Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting).	Construction of shafts will result in unavoidable direct impacts on the immediate character of the site due to changes to the physical and perceptual characteristics during construction. The timescales will be relatively short and the effects relating to construction partially reversible (e.g., once hoardings and machinery are removed). Construction activities will be noticeable for the local community, although a certain level of construction activities is accepted in urban areas. The construction of the tunnel sections will be by tunnel boring machine, and will not impact the landscape character of the route or visual receptors as this will occur underground.	G	Particular attention will need to be given to the location of the shafts and construction compounds under the following scenarios: For shafts that lie in recreation areas, locate compounds and shaft sites within existing hardstanding areas wherever possible. Avoid intersecting public rights of way, or locally used paths. Minimise land take, reduce removal of trees to a minimum. Where permanent infrastructure is required, there should be careful consideration of positioning so that it does not appear out of place. For shafts that lie within protected wildlife sites, take additional care when removing or replacing vegetation. For shafts that lie in Areas of Special Character, limit the impact upon protected characteristic traits by setting development back.
Construction of AWRP at Beckton STW – site clearance, compound hoardings, tall plant and machinery, spoil heaps, site traffic, construction of a number of buildings between 6m and 17m tall, associated access roads and car parks.	Local landscape of the site. Recreational users of the Northern Lagoon Walkway, local footpaths and Beckton Creekside Nature Reserve. Visitors to and employees at the Jenkins Lane industrial estate.	Retain areas of undeveloped land around buildings, to keep the landscape of contrasts with industrial buildings and post-industrial wildlife areas. Minimise loss of vegetation through design and sensitive location of construction compounds, including creating a wildlife/vegetation buffer between the site compounds and the fencing along the local footpaths. Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting). Use appropriate materials and colours for buildings to allow them to be less obtrusive in views. Restrict development heights to below tree level as much as possible.	Construction of the AWRP at Beckton STW will have an unavoidable, direct impact on the immediate character of the site due to changes to the physical and perceptual characteristics during construction. The timescales will be relatively short, and effects relating to construction will be partially reversible (e.g., hoardings and machinery removed). Construction hoardings and tall plant and machinery will be visible for users of local footpaths including the Northern Lagoon Walkway, and Beckton Creekside Nature Reserve, and employees and users of the Jenkins Lane industrial estate. As an industrial area within London a certain level of construction activity is expected. Access to the Beckton Creekside Nature Reserve may be restricted/removed during construction, which will negatively impact recreational users.	A	Retain access along the Northern Lagoon Walkway, local footpaths and Beckton Creekside Nature Reserve during construction where possible.
Construction of discharge outfall structure north of King George V Reservoir – site clearance, compound hoarding, site traffic	Local landscape character of the site Recreational users of the London Loop and public rights of way through the site and close to the site. Residents/employees in properties adjacent to the west of the site. Local community north of the site on Enfield Island Village.	Minimise loss of vegetation through design and sensitive location of construction compounds, including locating shafts in areas with existing hardstanding e.g., car parks, roads and pavements. Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting).	Construction activities will have an unavoidable, direct impact on the immediate character of the site due to changes to the physical and perceptual characteristics during construction. The timescales will be relatively short and the effects relating to construction will be partially reversible (e.g., hoardings and machinery removed). Construction hoardings and machinery will be visible in close proximity for recreational users of the London Loop and other footpaths, and for residents in the properties to the west of the site. The change in views will be large, although as above the timescales will be short and the effects from construction partially reversible (e.g. hoardings and machinery removed). There may be glimpsed views of hoarding and machinery from properties to the north on Enfield Island Village, although these will be partially screened by mature vegetation (less so in winter). A certain level of construction activity is accepted within London.	A	The site is within the Lea Valley Rivers and Reservoirs Enfield Area of Special Character. The King George V reservoir and River Lee and River Lee Diversion are protected characteristic traits of this Special Character Area, and construction should limit the impact on these features. Avoid closing or diverting the London Loop during construction if possible.

Table 7-29 Beckton water recycling scheme: summary of potential landscape and visual amenity initial risk appraisal: operation

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Permanent access hatch at shafts – metal access hatches set into the ground, telemetry kiosks will be placed at some access hatches, including at Lockwood (site compound 6).	Local landscape of the site Local communities, recreational users, pedestrians and road users	N/A – would be additional	Permanent access hatches will result in unavoidable direct impacts on the immediate site. This will be a small change, and will be seen in context of other urban ground-level infrastructure e.g., manhole covers, drain covers. The change in visual amenity for local communities, recreational users, pedestrians and road users will be small, and barely perceptible in most cases. Sites which also include telemetry kiosks will be slightly more noticeable, but these will be seen in the context of urban infrastructure.	G	No additional mitigation required.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
AWRP at Beckton STW – Change in land use from undeveloped grassland/Beckton Creekside Nature Reserve to development of up to 14 new buildings, including pumping stations, remineralisation, chemical storage and an administration building, associated access roads and car parks.	Local landscape of the site. Recreational users of the Northern Lagoon Walkway, local footpaths and the Beckton Creekside Nature Reserve. Visitors to and employees at Jenkins Lane industrial estate.	N/A – would be additional	The addition of the AWRP to Beckton STW will have an unavoidable, direct impact on the immediate character of the site, and will change the site land use from undeveloped scrub to built infrastructure. This will be a large change for the character of the site. Employees and visitors to the neighbouring industrial parks will see the new buildings in context with the existing Beckton STW, and the change in views will moderate. The new AWRP will be a new feature in views for users of the Northern Lagoon Walkway, and visitors to the Beckton Creekside Nature Reserve. However, if vegetation is retained along the existing site boundaries of Beckton STW this change will be relatively small (less so in winter), and will be seen in context with the existing Beckton STW and wider industrial landscape.	G	No additional mitigation required.
Discharge outfall structure north of King George V Reservoir –	Local landscape character of the site. Recreational users of the London Loop and public rights of way through the site and close to the site. Residents/employees in properties adjacent to the west of the site. Local community north of the site on Enfield Island Village.	N/A – would be additional	The discharge outfall structure will result in unavoidable direct impacts on the immediate site. This will be a small change, and will be seen in context of other urban ground-level infrastructure e.g., manhole covers, drain covers. The structure will not impact any of the protected characteristic traits identified in the Lea Valley and Reservoirs Area of Special Character. The change in visual amenity for local communities and recreational users will be small, and barely perceptible for most people.	G	No additional mitigation required.

7.3.5 Soils and contaminated land

7.3.5.1 Impact risk, pathways and uncertainties

There is a low risk to human health during construction as shallow ground contamination from former activities and current uses may come into contact with construction workers. There is a risk of dermal contact, ingestion and inhalation of potential ground contamination. The risk is low as construction workers should be asbestos awareness trained, provided with personal protective equipment (PPE) and adopt good hygiene measures.

There is a risk to human health during construction as dust from stockpiles and bare earth surfaces could be inhaled and or ingested. Therefore, a Construction Environmental Management Plan (CEMP) should be prepared, detailing measures to prevent mobilisation of dust or surface run-off from stockpiles to off-site receptors.

The risk to Secondary A and Secondary Undifferentiated aquifers would be medium and should be assessed further by groundwater sampling during ground investigation to confirm the risk.

The risk of ground gas is high as the two shaft locations (shafts 4 and 9) and the conveyance routes intersects two landfills. Further assessment to establish composition of waste in existing/historic landfills and risk of encountering contaminated soils, landfill gas and leachate should be undertaken by carrying out site investigations and Envirocheck review where conveyance cannot be re-routed to avoid landfill areas.

It is recommended that a Phase 1 Preliminary Risk Assessment, where a desk-based assessment is undertaken, reviewing historical mapping, British Geological Survey data, UXO screening and creating conceptual site models.

7.3.6 Transport

7.3.6.1 Activities and pathways for impact

The construction phase of the Beckton water recycling scheme will require HGV movements, as spoil will need to be transported off-site, and materials will need to be transported to site. The summary of HGV movements required for construction of the Beckton water recycling scheme has been taken from the relevant CDR. Depending on whether a 100 Ml/d, 200 Ml/d or 300 Ml/d scheme is adopted, and the number of phases, different volumes of HGV movements would be needed. Estimates of HGVs are currently only available for one 150 Ml/d phase of the scheme, and therefore this has been used as a worst case indication. This will need to be revised with a more accurate reflection of the phasing at Gate 3.

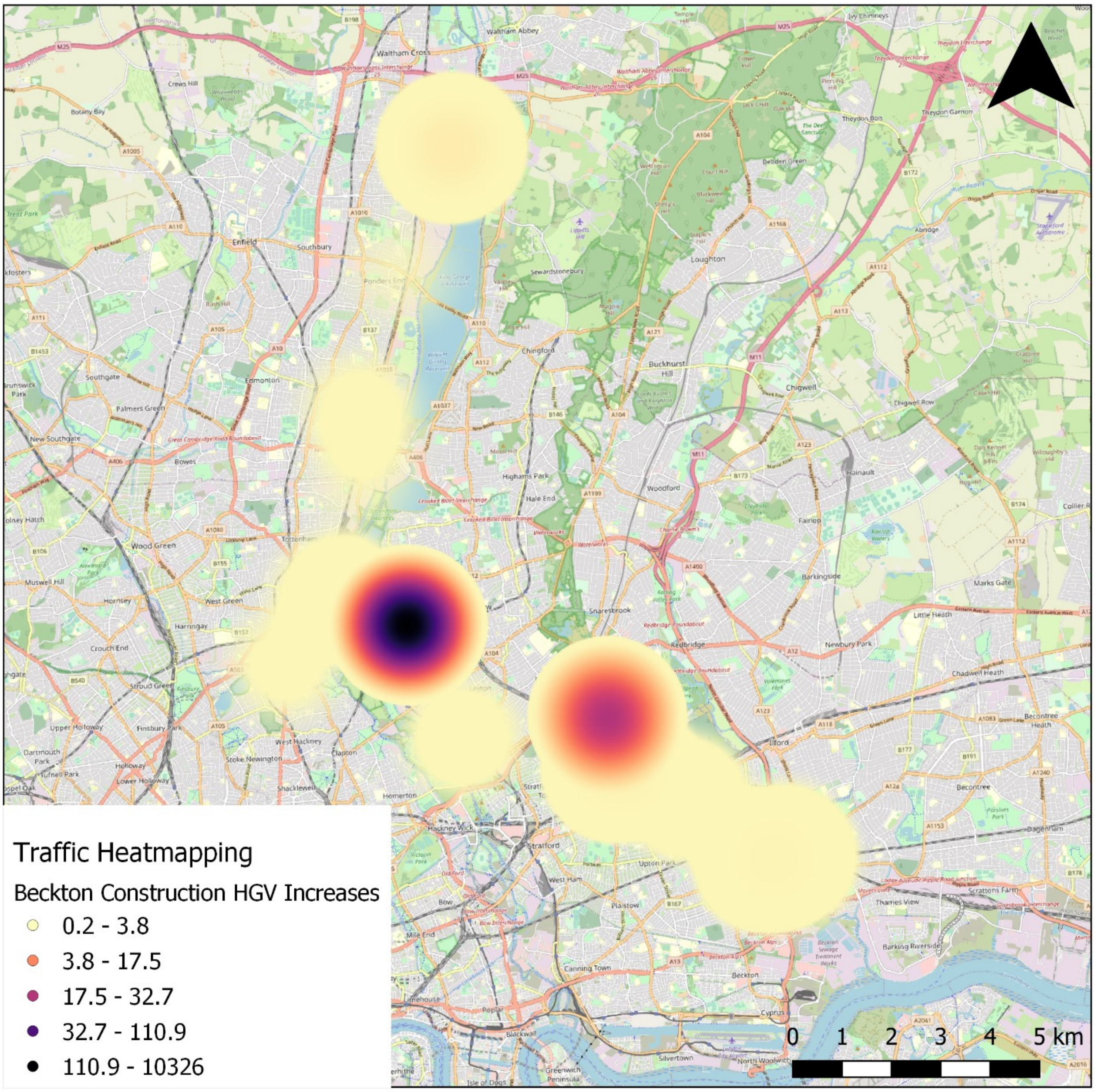
Operational movements are considered to be less significant with c. 108 HGV movements required per year for chemical delivery (largest sized option). Key infrastructure is also located within existing Thames Water owned sites, and therefore subject to existing vehicle movements for personnel. This will be revisited for Gate 3 when further information on operational movements is available.

The vehicle movements associated with the construction site compounds have the potential to adversely impact upon the road networks surrounding them. Traffic increases, particularly increases in HGVs can adversely impact upon a local area in a range of ways;

- Severance – the effect of perceived division that can occur in a community when it becomes separated by a major artery (for example, a road becoming much more congested and therefore more difficult to cross);
- Driver Delay – this can occur at any point in the road network, although it is only likely to be significant when, as a baseline, the traffic is predicted to be close to the capacity of the system.
- Pedestrian Delay – A change in the volume or composition of traffic may affect the ability of an individual to cross a road.
- Pedestrian Amenity – the relative pleasantness of a journey. It is affected by both traffic volume and composition.
- Fear and Intimidation – this is dependent upon the volume of traffic, HGV composition, proximity of traffic to people and proximity of traffic to people (e.g., footway width).
- Accidents and Safety – Increases in traffic levels increase in turn the likelihood of a traffic collision in any one part of road. This effect is exacerbated at junctions.

Figure 7-5 shows that the relative increase of HGV movements around the Enfield Island Village is not as pronounced as overall traffic increases. This is likely because that even though overall traffic levels in this area are low, there is a relatively high proportion of HGVs movements in this area, as it is in close proximity to the Innova Business Park, Enfield Power Station, and the Waltham Point Distribution Centre, all of which may be associated with HGV movements.

Figure 7-5 Beckton water recycling scheme: heatmap showing potential HGV increases (as a % of the current AADF) during construction



7.3.6.2 *Impact risk and additional mitigation requirements*

The overall risk rating for the potential transport impacts on pedestrians and road user receptors due to HGV movements from construction activities are provided in **Table 7-30**.

Table 7-30 Beckton water recycling scheme: summary of transport initial risk appraisal: construction

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
HGV movements for construction at Shaft 2	Users of the surrounding road and pedestrian network	**Severance** – perceived division in a community when it becomes separated by a road becoming more congested and difficult to cross; **Driver Delay** –significant when the traffic is close to the capacity of the system. **Pedestrian Delay** – The ability of an individual to cross a road. **Pedestrian Amenity** – relative pleasantness of a journey. **Fear and Intimidation** – dependent upon the volume of traffic, HGV composition, proximity of traffic to people and of traffic to people. **Accidents and Safety** – Increases in traffic levels increase the likelihood of a collision in any one part of road.	A	Schedule traffic movements to take place outside of peak traffic times or anti-social hours. Appropriately time traffic movements to ensure there is no build-up of HGVs around construction sites. The production of a traffic management plan and a construction logistics plan.
HGV movements for construction at Shaft 3			A	
HGV movements for construction at Shaft 4			A	
HGV movements for construction at Shaft 5			A	
Traffic movements for construction around Enfield Island, AWRP and shafts 1, 6-9.			G	

7.3.7 Navigation

Refer to ***Annex B.2.7. Navigation Assessment Report*** for full details.

The Port of London Authority (PLA) has particular concerns about any limitation on the ability of vessels of various draughts to navigate in the upper Tideway around low water when a London Effluent Reuse SRO scheme is in operation.

Two scenarios were modelled for a variety of parameters – a 1:5 return frequency moderate-low flow year (A82); and a 1:20 return frequency very low flow year (M96)), with the following impacts identified:

- **Minimum water levels:** Negligible change in minimum water level longitudinally along the estuarine Thames Tideway, with no discernible difference between the baseline minimum water level and minimum water level when the 300 Ml/d Beckton water recycling scheme is operational.
- **Mean water levels:** Negligible change in the mean water levels longitudinally along the estuarine Thames Tideway, with no discernible difference between the baseline mean water level and mean water level when the 300 Ml/d Beckton water recycling scheme is operational.
- **Flow changes across shoals:** No increases in the duration of low water navigational restrictions at all the shoal locations when the Beckton water recycling scheme is operational during both a moderate low flow year and a very low flow year.
- **Sedimentation:** increase in salinity has the potential to cause flocculation and increase the deposition of sediment along the channel perimeter. The model has been used to estimate if there is likely to be an increase in sediment deposition that could restrict navigational operations along the estuarine Thames Tideway. It is expected that the scheme would have a minor effect upon salinity when the Beckton scheme would be operational. For the minimum salinity concentrations, the increases in salinity occurs adjacent to the Thames Barrier. It is expected that the scheme would not have a discernible effect on sediment deposition during a moderate low river flow year. This would have a negligible effect on navigational operations.

7.3.8 Noise

7.3.8.1 Activities and pathways for impact

At this initial appraisal stage, potential causes of noise effects have focussed on the noise from construction plant which are likely to generate the greatest increase over baseline. At later stages, vibration from construction and tunnelling activities, construction traffic as well as operational noise sources[58], will be assessed in more detail when information becomes available during Gate 3.

7.3.8.1.1 Construction

The approach to calculating the construction noise levels is provided in **Appendix 6.**

The assessment used the methodology of BS5228-1:2009. Under this approach, the adverse impact threshold is determined at a dwelling using the existing ambient noise level, rounded to the nearest 5dB for the appropriate period (day, evening or night). This result is used to determine the assessment category: A, B or C, which then defines the adverse noise impact threshold,

The predicted construction noise level is then compared to the appropriate noise impact threshold level to determine whether or not the threshold is exceeded. If the threshold is exceeded, a significant effect is likely to occur. However, other factors should be taken into account in assessing the overall significance. These include the duration of the works, the quality of the sound insulation of the receptor building façade, ambient noise levels at particularly noisy or quiet locations and the number of residents likely to be affected.

Such information is not currently available thus the initial assessment of significant effects has concentrated on two factors. Firstly, whether the BS5228 threshold level is likely to be exceeded and secondly, identifying receptors where the baseline noise levels are likely to be exceeded by more than 10dB. The assessment is shown in **Table 7-31**.

Table 7-31 Beckton water recycling scheme: number of receptor properties where significant construction noise effects are likely to occur

Construction sites	Highest Construction Noise @ 10m	At Nearest Receptors			BS5228 ABC Criterion	Estimated No. of Properties	
		Distance from works	Construction noise level^	Ambient LAEQ			
	dB(A)	m	dB(A)	dB(A)	dB(A)	Above criterion	<10dB above ambient
AWRP	80	480	40	55	65	0	0
Shaft 1	81	53	59	52	65	0	0
Shaft 2	81	111	53	54	65	0	0
Shaft 3	81	140	51	54	65	0	0
Shaft 4	81	117	53	48	65	0	0
Shaft 5	81	624	38	47	65	0	0
Lockwood	81	283	45	55	65	0	0
Shaft 7	81	297	44	47	65	0	0
Shaft 8	81	112	53	50	65	0	0
Shaft 9	81	329	44	57	65	0	0
KGV Shaft/Lee Outfall	87	55	65	48	65	0	35

^Includes noise attenuation by 2m site hoarding at shaft and structure sites.

The initial assessment showed that the BS5228 ABC threshold was not likely to be exceeded while the construction noise level was likely to exceed the baseline level by 10dB or more, at 35 properties at the Lee Diversion Channel outfall. This simplified assessment has been undertaken due to the limited accuracy of the baseline data. When more reliable data has been collected, it may be that receptors affected by the Lee Diversion Channel outfall construction, will be reduced due the location of the works relative to any one receptor. However, there may also be increased effects due to the length of the construction period.

[58] Information on the noise levels generated by the plant and equipment, and infrastructure within which the plant will be housed, was not available at Gate 2. It is considered that the design of the new structures could ensure that operational effects are negligible.

Construction noise effects from the Beckton AWRP site are not likely to be significant due to distance separation from the nearest receptors of 480m.

7.3.8.1.2 Operation

It is understood that shafts, once completed, would be capped, with occasional maintenance access required. This would result in negligible noise effects at the nearest receptors. Operational noise levels from the AWRP at Beckton STW are not likely to cause significant effects due to a distance separation of 480m from the nearest receptors. At the Lee Diversion Channel outfall structure, significant noise effects are not likely to occur, however there is uncertainty regarding baseline noise levels and mechanical plant associated with the structure. Further assessment of both infrastructure components will be required at Gate 3.

7.3.8.2 Impact risks and additional mitigation requirements

7.3.8.2.1 Overview

The potential risk of significant noise effects during construction and operation of the scheme is summarised below, based on limited baseline data and lack of detail on some construction methods, including tunnelling equipment and operational noise from mechanical plant. The assessment is therefore based on limited data and professional judgement from similar projects.

Vibration effects during construction and operation are not expected to be significant but this will be verified at a later stage of the scheme development.

7.3.8.2.2 Construction

The initial assessment has shown that construction noise effects are negligible at most receptors close to the shaft sites and at the receptors nearest the Beckton AWRP site. At the site of the KGV shaft and Lee Diversion Channel outfall structure, noise effects are not expected to be significant, but this will be verified when more baseline data is available. Vibration effects of tunnelling are considered to be negligible but will be assessed when more information is available.

Table 7-32 Beckton water recycling scheme: summary of noise initial risk appraisal: construction

Activity and impact	Receptor	Best Practice	Effect	RAG Rating	Additional mitigation
Construction of shafts	Residential	BPM (Best Practicable Means) as below.	Not significant	G	Not required
Construction of Beckton AWRP	Residential	BPM (Best Practicable Means) as below.	Not significant	G	Not required
Construction of Lee Diversion Channel outfall structure	Residential	BPM (Best Practicable Means) as below.	Moderate significance	A	Acoustic site hoardings
Tunnelling	Residential/ School	BPM (Best Practicable Means) as below.	Not Significant	G	Not required
Vibration	Residential	BPM (Best Practicable Means) as below.	Not Significant	G	Not required

7.3.8.2.2.1 Best Practicable Means

The following are considered Best Practicable Means to reduce noise:

- Contractors should bring to site and employ only the most environmentally acceptable plant and equipment compatible with the safe and efficient execution of the works.
- All plant items should be properly maintained and operated according to manufacturers' recommendations and in such a manner as to avoid causing excessive noise.
- All plant items should be sited so that noise at nearby sensitive properties is minimised.
- All plant items operating intermittently on the application site should be shut down in the intervening periods.
- All pneumatic tools should be fitted with silencers or mufflers where practicable.

- No radios or music should be played on site.
- Wherever possible, dead-weight rollers should be used rather than vibratory rollers / compactors.
- Deliveries should be programmed to arrive during daytime hours only and care taken to minimise noise during unloading.
- Delivery vehicles should be routed so as to minimise disturbance to local residents and should be prohibited from waiting on the highway or within the works site with their engines running.
- Construction related vehicles should not idle on local roads waiting to enter the Site.
- Prior to the commencement of construction works, formal contact should be established with the nearest neighbours and those who are most likely to be affected by the works.
- The importance of noise and its potential to affect those living and working nearby should be included in the general induction training for the Site and specific training will be given to staff who will have responsibility for managing noise during construction.
- Construction mitigation measures to be included in the CEMP, Construction Environmental Management Plan.

7.3.8.2.3 Operation

Operational noise effects from the shaft sites are not likely to occur as the sites are effectively sealed. Noise effects from the Lee Diversion Channel outfall structure are considered unlikely but will be further assessed when more detailed information on baseline noise levels and mechanical plant are available. Operational noise effects from the Beckton AWRP would be negligible due to distance separation from the nearest receptors.

Table 7-33 Beckton water recycling scheme: summary of noise initial risk appraisal: operation

Activity and impact	Receptor	Best Practice	Effect	RAG Rating	Additional mitigation
Shafts	Residential	No operational noise	Not significant	G	Not required
Mechanical plant at Beckton AWRP	Residential	Adequate screening/enclosures for mechanical plant	Not significant	G	Not required
Mechanical plant at Lee Diversion Channel outfall structure	Residential	Adequate screening/enclosures for mechanical plant	Not expected to be significant	Uncertain – further information required	
Vibration	Residential	Operational vibration unlikely	Not significant	G	Not required

7.3.9 Air quality

7.3.9.1 Activities and pathways for impact

7.3.9.1.1 Construction

7.3.9.1.1.1 Fugitive construction dust impact risk assessment

Human Receptors

Using the methodology provided in **Appendix 4**, the risk of dust impacts due to where earthworks and construction of shafts and tunnels at the nearby human receptors can be classified as moderate as the maximum risk (amber) occurs for those receptors (>100) within 20 m of the construction activities. However, the dust risk can be mitigated using the medium risk dust mitigation measures available from the IAQM dust guidance.

For the receptors which are over 50 m away from the construction site, the risk is expected to be minor (i.e., dust risk can be mitigated with suitable best practice low risk dust mitigation measures available from the IAQM dust guidance).

Ecological Receptors

Using the methodology provided in **Appendix 4**, the risk of dust impacts due to earthworks and construction of shafts and tunnels at the nearby ecological receptors can be classified as major as the maximum risk (red) occurs for the ecological receptors within 20 m of the construction activities, and as such would require high risk dust mitigation measures depending on the sensitivity of the species. For the ecological receptors which are over 50 m away from the construction site, the risk is expected to be moderate (i.e., dust risk can be mitigated using the medium risk dust mitigation measures available from the IAQM dust guidance).

7.3.9.1.1.2 Traffic emissions air quality impact risk assessment

During the construction phase, it is anticipated that the construction of the 11 tunnel sections and the 11 shafts would progress for approximately 290 weeks. This is equivalent to c.5.5 years assuming that each of the activities are undertaken sequentially and not ongoing at the same time. It is anticipated that this will involve a total of c.80,000 vehicle movements. Even assuming that the construction was spread evenly across the 5.5 year period, this would be equivalent to 40 HGVs per day. Given that there are 1,561 receptors within 20m of the traffic route, and the number of HGVs generated within an AQMA is >50HDVs, the risk of air quality impacts is likely to be major.

7.3.9.1.1.3 Barge emissions air quality impact risk assessment

Given the proximity of the Beckton water recycling scheme to the river network, barge movements could be used as an alternative to HGV movements. It has been estimated that up to c.4,000 barge loads will also be required in addition to the HGVs to remove spoil and waste from the Beckton water recycling scheme. Further consideration of the air quality impacts associated with the barge movements would be required as well as suitable mitigation measures appropriate to the severity of the air quality impacts would be determined, if barges can be utilised, and when more details are known on the operation of the barges.

7.3.9.1.1.4 Non-road mobile machinery (NRMM), generator and combustion plant emissions air quality impact risk assessment

The Beckton water recycling scheme would employ the use of up to c.70 plant items consisting of excavators, concrete pump, dumpers, rollers, cranes, generators etc. The exact details on the power rating and emissions standards of the plants are not yet known. Therefore, NOx and PM_{10} emissions data for the NRMM has been derived from the EMEP EEA air pollutant emission inventory guidebook 2019 specific to non-road mobile machinery (1.A.4) based on a power rating of <130kW and EU Stage IIIA emissions standard.

Details on the % on-time has been provided for the plants and it has been assumed that construction hours would be 8am to 6pm, 7 days a week for the duration (289 weeks) of the construction of the tunnels and shafts.

Using the above assumptions, it has been estimated that the operation of all the plant would result in approximately 0.29 g/s and 4.74 g/s of PM_{10} and NOx, respectively. This exceeds the threshold of 5 mg/s and the risk of air quality impacts is considered to be major. As such detailed modelling would be required to determine the potential air quality impacts at nearby receptors.

The exact location of the plants are not yet known at this stage to determine whether there are receptors within 500 m, however based on the route location there are receptors within 500 m of the route.

7.3.9.1.2 Operation

During the operational phase, it is anticipated that chemical deliveries will be delivered by tankers at the following 25% plant utilisation rate for all Beckton water recycling size options.

Table 7-34 Beckton water recycling scheme chemical deliveries per year at 25% utilisation[59]

Output (ML/d)	Ammonium Sulphate & Sodium Hypochlorite	Sulphuric Acid	Anti-Scalant	Sodium Bisulphite	Hydrogen Peroxide (H_2O_2)	Hydrated Lime	Ferric Sulphate	Total HGV per year
100	1	4.25	0.75	1.75	2.25	26.25	-	36
150	1.5	6.25	1.25	2.5	3.25	39.25	-	54
300	3	12.5	2.5	5	6.5	78.5	-	108

All the Beckton water recycling sizes are currently anticipated to generate less than 25 HGVs per day, and as such air quality impacts are deemed negligible (as per IAQM guidance thresholds, see Appendix 4).

[59] Number of $30m^3$ Bulk Chemical Road Tankers per Year – HGV.

7.3.9.2 Impact risk and additional mitigation requirements

The overall risk rating for the potential air quality impacts on human and ecological receptors due to fugitive dust emissions from construction activities; exhaust emissions to air from additional traffic on local roadwork during the construction and operational phase are provided in **Table 7-35**.

Table 7-35 Summary of initial appraisal of air quality risk for Beckton water recycling scheme

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Earthworks, construction of shafts and tunnel (dust impact)	Human receptor	Moderate	A	Medium risk IAQM mitigation measures
Earthworks, construction of shafts and tunnel (dust impact)	Ecological receptor	Major	R	High risk IAQM mitigation measures
Construction traffic (air quality impacts)	Human and Ecological receptor	Major	R	Assessment to be refined once haul routes confirmed. Use of electrically driven or low emitting vehicles
Construction NRMM (air quality impacts)	Human and Ecological receptor	Major	R	Use of EU Stage VI plant
Construction barge (air quality impacts)	Further consideration of the air quality impacts associated with the barge would be required.			
Operational traffic (air quality impacts)	Human and Ecological receptor	Minor	G	Use of Euro VI HGVs

7.3.10 People and communities

During construction, the Beckton water recycling scheme could impact upon the people and communities surrounding the construction areas. Construction activities in close proximity to residential dwellings can adversely impact upon the wellbeing of individuals by increasing traffic, noise, dust and light levels in the local area. Construction activity can also increase fear and feelings of isolation in a community, particularly when road closures and increased congestion leads to reductions in the provision of education, healthcare and community recreational facilities.

There are areas within proximity of the Beckton water recycling construction that rank within the most health deprived 30% of England, particularly around Beckton STW, shaft site 1 and shaft site 4. More deprived communities are likely to experience more substantial effects. In terms of living environment (another deprivation indicator that may be impacted by construction), large areas surrounding the construction areas, particularly around the Beckton STW, shaft 3 and shaft 7, are in the most deprived 10% of England in terms of the living environment.

In terms of cultural infrastructure, the majority of assets described in Section 7.2.10.4 are not anticipated to be impacted by construction. However, the assets surrounding Wanstead Flats (those in Cann Hall and Forest Gate North wards) may experience impacts as these are in a usually quiet residential area. The same is also true for those assets nearby Enfield Island Village (within Enfield Lock ward).

The Beckton water recycling scheme would not cause adverse impacts on people or communities during its operation. Beneficial impacts would be felt by increasing the resilience of the municipal water supply, meaning demand management measures would theoretically be less likely.

7.4 SUMMARY AND GATE 3 LOOKAHEAD

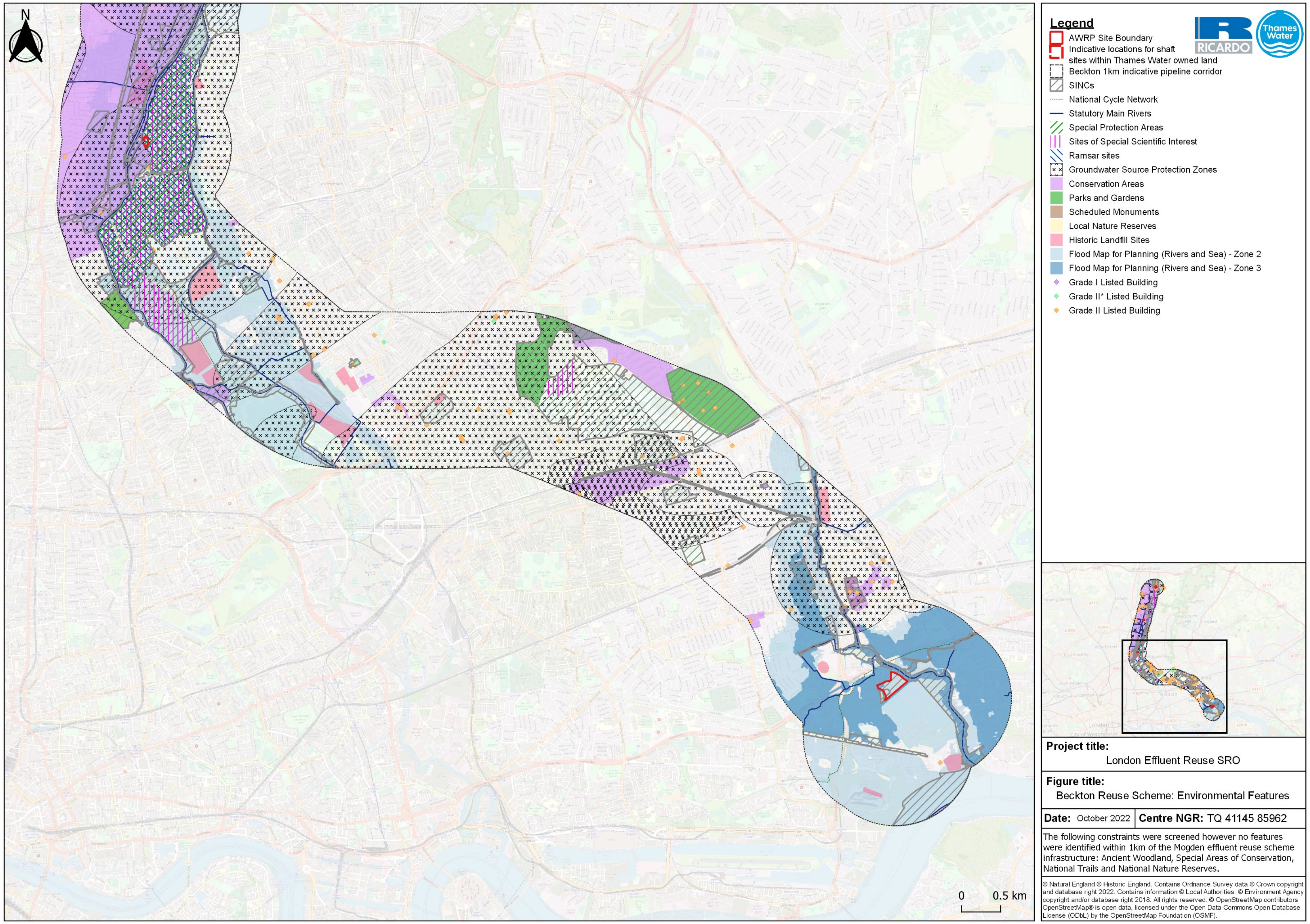
Figure 7-6 and **Figure 7-7** provide a high level summary of the receptors being considered for the Beckton water recycling scheme. In summary, those that are considered to be highest risk (red and amber) are as follows:

- **Physical environment**: increases in very low flows within ~100m reach of Enfield Island Loop between 80% (100 Ml/d scheme) and 240% (300 Ml/d scheme). Increases in velocity and depth under some conditions.

- **Flood Risk**: Some elements of construction will be in Flood Zone 3.
- **Aquatic ecology:**
    - Adverse impacts are anticipated on diatom communities that are immobile, resulting from low flows.
    - Temperature changes could also alter relative fitness of diatom species, altering community structure.
- **Terrestrial ecology**:
    - Permanent loss of >6ha of priority habitat.
    - Permanent habitat loss with the Lee Valley SPA and Ramsar site at Lockwood, and temporary disturbance of qualifying features (overwintering birds) at various locations along reservoir complex that could affect the SPA or functionally linked habitat, adversely impacting upon important bird populations.
    - 0.03 ha temporary habitat loss of the priority habitats saltmarsh and saline reedbeds.
- **Soils and contaminated land**: risk of ground gas is high as the two shaft locations (shafts 4 and 9) which make require significant mitigation.
- **Air quality:** impacts to both human and ecological receptors from earthworks, construction of shafts and tunnel (dust impact), construction traffic and NRMM emissions.
- **Historic environment:** Impacts upon local designated heritage assets during construction.
- **Landscape:**
    - Impacts upon local landscape character surrounding the Beckton STW and King George V Reservoir;
    - Impacts upon recreational users of National Trails, and Public Rights of Way surrounding the Beckton STW and King George V Reservoir.
- **Traffic:** Impacts upon communities and road users arising from increased traffic around shafts 2-5.
- **Noise:** Noise impacts upon residents surrounding the Lee Diversion Channel outfall, during construction.

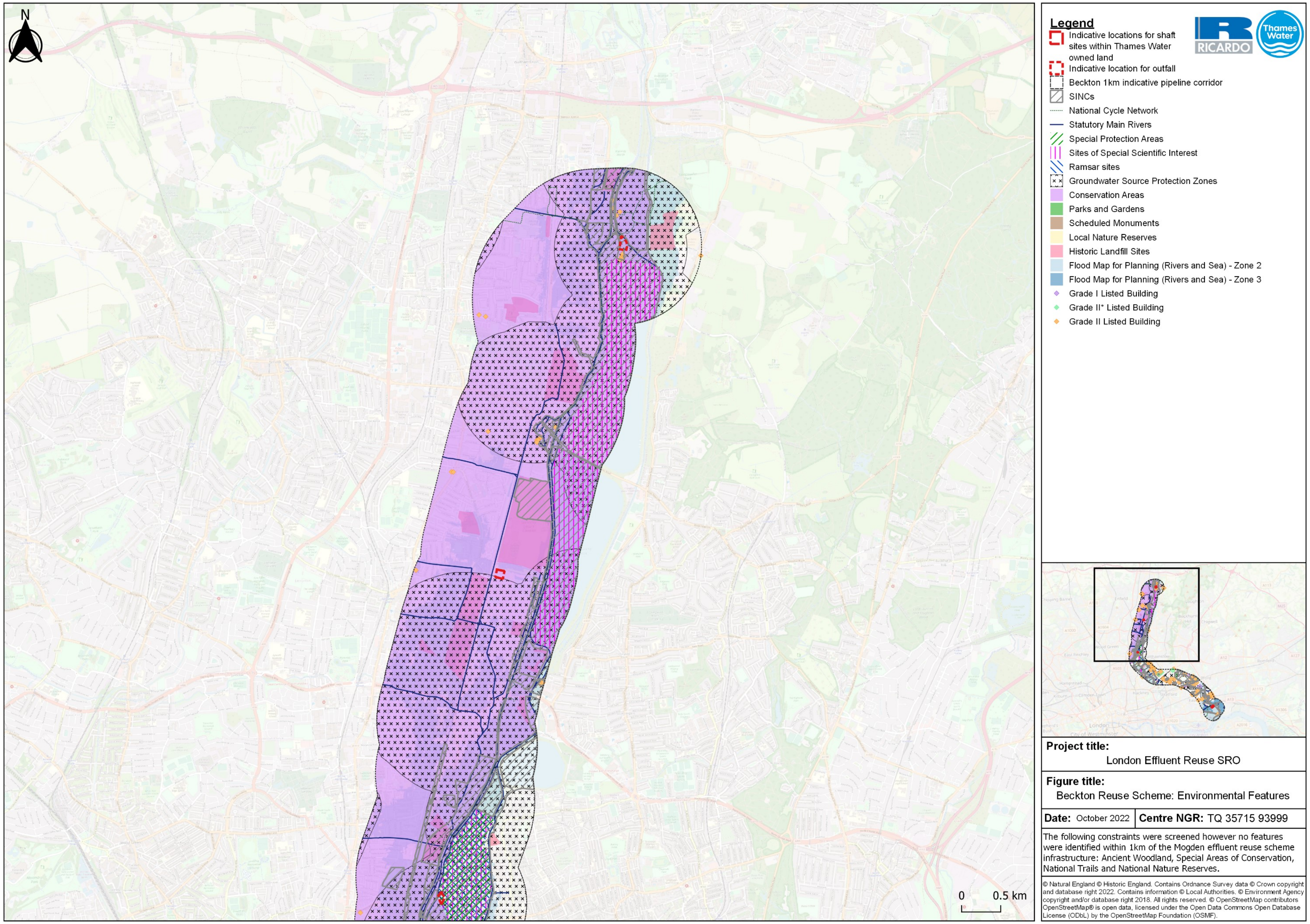
Table 7-36 provides a summary of the data gaps remaining at the end of Gate 2, and the uncertainties, with a lookahead to how these will be addressed for Gate 3, assuming an Environmental Impact Assessment will be required in the next couple of years. If the WRSE modelling shows that the scheme is not required as early, the level of detail undertaken for Gate 3 may be revised.

Figure 7-6 Beckton water recycling scheme: environmental constraints – Beckton STW to Lockwood Reservoir[60]



[60] Figure shows the search area for the conveyance route, not a construction corridor. The pipeline itself is buried but shaft sites will be located within the area demarcated on the figure.

Figure 7-7 Beckton water recycling scheme: environmental constraints – Lockwood Reservoir to King George V Reservoir[61]



[61] Figure shows the search area for the conveyance route, not a construction corridor. The pipeline itself is buried but shaft sites will be located within the area demarcated on the figure.

Table 7-36 Beckton water recycling scheme: Gate 3 Lookahead

Environmental Topic Area	Data gaps/uncertainties	Proposed work at Gate 3[62]
WATER		
Physical environment	In the Enfield Island Loop of the Lee Diversion Channel the major flow changes from flow augmentation from a Beckton water recycling scheme are for a ~100m length of heavily modified channel. There may be an additional zone of influence for the downstream ~500m of the Enfield Island Loop, but the flow regime in that reach is determined by operation of the intake to the King George V Reservoir, which may abstract no water, or abstract all of the flow, including all of the augmented flow from a Beckton water recycling scheme. High-spec ADCP surveys of river depth and flow velocity through the water column have been repeatedly undertaken in the reach and provide context of change from flow change. River condition surveys have also been undertaken. Fisheries assessment for Gate 2 may identify that specific further surveys are required to further clarify the fisheries assessments.	As engineering design progresses, Gate 2 tools can be re-used to assess variants in outfall velocities or discharge angle for discharge in the 3D Telemac model of the River Thames. A 2D hydrodynamic model of the Enfield Island Loop locally between Rifle Weir and the Lee Diversion Channel may assist with detailed design of a Beckton water recycling outfall. The use of water resources modelling at Gate 2 has provided the best available information on likely patterns of scheme use available at the time. However, with WRSE and other Regional Groups WRMP24 Plan reconciliation, the pattern of use of London Effluent Reuse SRO and other SROs will develop. New variants on operating patterns and cumulatives can be readily tested through scenarios using the Gate 2 river and estuary modelling tools. These include variants in standby and ramp-up/ ramp-down patterns within the 1D model of the River Thames.
Water quality	*Freshwater Lee Diversion Channel* Further pH data would benefit re-mineralisation design for Beckton water recycling Schemes at the point of discharge in the Enfield Island Loop. Continuous sonde data would assist understanding of daily and sub-daily variability in pH. *Estuarine Thames Tideway* Dissolved oxygen concentration data for Beckton were not available, this would benefit the estuarine Thames Tideway assessment for the Beckton water recycling scheme.	Continuation of current monitoring programme.
Flood risk	For sites where an FRA and/or Drainage Strategy is required, the following information could be needed to inform the baseline conditions: • EA Product 4 data for detailed flow rates, flood levels and extents from EA hydraulic models; • A topographical survey to show the levels and features at the site; • Existing sewer infrastructure located on-site, including any public sewers that are not linked to the proposed development; • Phase 2 Ground Investigations to assess the ground conditions and groundwater at the site. This may include soakage tests to assess the infiltration rates for drainage, depending on the proposed development at the site.	There are 12 sites that will require an FRA based on the NPPF requirements, including sites larger than 1ha. Out of the remaining sites, there is one site which may require a drainage strategy due to an increase in the impermeable area. This is dependent on the detailed proposals and may require input from the LLFAs regarding their requirements. For sites with no increase in impermeable area, SuDS may still be required depending on the size of the site and the proposals. Confirmation of this should be obtained from the LLFAs. There are two sites which the SFRA maps show have a high risk of groundwater flooding. This may require further assessment with a Ground Investigation to determine the site-specific risk to the proposed development and surrounding area.
BIODIVERSITY		
Fisheries	There may be an additional zone of influence for the downstream ~500m of the Enfield Island Loop, but the flow regime in that reach is determined by operation of the intake to the King George V Reservoir, which may abstract no water, or abstract all of the flow, including all of the augmented flow from a Beckton water recycling scheme. As such, the flow changes need to be considered in relation to the fish habitat present within Enfield Island Loop of the Lee Diversion Channel and the swimming speeds of freshwater and migratory fish such as European eel. There is some uncertainty around the potential use of the Enfield Island Loop and Upper Lee catchment by sea lamprey and twaite shad.	As engineering design progresses, Gate 2 tools can be re-used to assess variants in outfall velocities or discharge angle for discharge in the 3D Telemac model of the River Thames. A 2D hydrodynamic model of the Enfield Island Loop locally between Rifle Weir and the Lee Diversion Channel may assist with detailed design of a Beckton water recycling outfall and support the sustainable fish swimming speeds of freshwater fish movements within the channel and to European eel migration. Records of sea lamprey and river lamprey are inconclusive within both the River Thames and River Lee catchments. Future investigations via eDNA of Lampetra sp. and Petromyzon sp. should be carried out within the Thames and Lee catchments and existing European smelt eDNA fish monitoring expanded to include twaite shad.
Aquatic ecology	*Aquatic Invertebrates* Additional monitoring is required to provide a robust dataset (Reaches E, F, I) against which the potential effects of the schemes can be fully assessed. *Marginal Habitats* Additional monitoring is required to provide a robust dataset (Reach H) against which the potential effects of the schemes can be fully assessed. A minimum of one RCA (MoRPh survey) would provide a baseline in order to establish any potential impacts. *Macrophytes* Additional monitoring is required to provide a robust dataset (Reaches E, F, I) against which the potential effects of the schemes can be fully assessed. *Diatoms* Additional monitoring is required to provide a robust dataset (Reaches E, F, I) against which the potential effects of the schemes can be fully assessed. *Macroalgae, Angiosperm and Phytoplankton* Macroalgae surveys are proposed within Reach E and Reach F during August 2022. Marine angiosperms are not present within the upper and middle Thames Tideway and angiosperm beds are circa 45km down river of Beckton STW. As such, there are no proposals to undertake angiosperm surveys within Gate 3.	Future assessments of aquatic/estuarine invertebrates and macrophytes will need to consider changes in community composition to understand if there are any signification of correlations with inter annual variation in mean river temperatures, with a specific focus on those invertebrate taxa which are considered to be emergent species. Further specificity can be added to the aquatic ecology investigations at Gate 3 through additional data and evidence gathering in Reaches E and F for: • Invertebrates, • Macrophytes, and • Diatoms.

[62] This scope will be reviewed once the Environmental Impact Assessment and planning application timescales have been confirmed.

Environmental Topic Area	Data gaps/uncertainties	Proposed work at Gate 3[62]
	A minimum of three years of monitoring, encompassing two seasonal periods, ideally spring and autumn, in each year would provide a baseline in order to establish whether the aquatic/estuarine, macrophyte and diatom community responds to inter-annual changes and be comparable against current WFD standards.	
INNS	It is not likely that the introduction or transfer of INNS will occur during the operation of this option, as the effluent discharge is treated in several steps prior to discharge into the freshwater River Lee Diversion which eliminates all pathways that are likely to introduce or transfer INNS during normal operation.	
Terrestrial ecology	Some UKHab surveys were not completed during the optimal time of year to assess annual flowering plants. Therefore, repeat surveys are recommended during spring and summer. Local record centre data records could only be used to identify record within 2km, not exact site or age of record. No WeBS data is available for Barking Creek, adjacent to Beckton STW.	Further surveys to reflect PEA findings; great crested newts, badger, bats, kingfisher and riparian mammals on site following current best practice guidelines. Birds: • Supporting habitat for breeding Cetti's warbler and kingfisher has been identified within the footprint of the works, for example, and both are WCA Schedule 1 species protected from disturbance. • Wintering bird surveys are also recommended at Barking Creek where there is potential functionally linked mudflat and saltmarsh habitat for the Thames Estuary and Marshes SPA and Ramsar site qualifying features, plus at reservoirs associated with the Lee Valley SPA. Vantage point surveys should be positioned within close proximity of proposed construction works (where possible) and should cover the extent of the habitat where noise levels are predicted to increase significantly above ambient noise conditions. Distributional data overlayed with noise impact assessment outputs will enable quantification of potential impacts due to construction disturbance. See the Habitats Regulations Assessment Report63 for more detail.
Historic environment	Additional assessment may be required to fully understand the potential permanent effects to the settings of the designated assets located near to shaft sites 3 and 10, and to the King George V outfall site. Although the assets are not located directly adjacent to any element of the scheme, there is a potential for the receptors to be affected negatively. Currently unidentified archaeological remains may be present within any shaft or infrastructure site along the scheme route. The extent and nature of any archaeological remains present is currently unknown.	Further investigation of all sites is likely to be required in advance of any planning application to determine the extent and nature of any affects the proposals may have upon the setting and character of designated heritage assets, and to identify suitable mitigation strategies where required. Further investigation may also be required to determine the potential for any part of the scheme to contain surviving archaeological remains and what the nature of any such remains might be. This investigation is likely to comprise a series of desk-based archaeological and heritage assessment reports, which may be targeted upon those aspects of the scheme identified within this report as posing a potential risk to any aspect of the historic environment. All assessment reports would assist in forming suitable mitigation strategies designed to record any archaeological deposits present within the site and would seek to identify strategies by which potential negative setting and character effects upon designated assets may be reduced to an acceptable level or avoided entirely. Mitigation may involve a series of intrusive archaeological recording and design recommendations. The nature and scope of any archaeological recommendations should be agreed with the Greater London Archaeology Advisory Service (GLAAS) in advance of any construction work commencement.
Landscape and visual effects	Further assessment will be required during winter months when deciduous vegetation is leafless. This may highlight potential for higher levels of effect. Some uncertainty regarding effects in winter months will remain, until this work can be done. Final heights of buildings, layouts and treatments unknown. Photomontages and view point analysis will be required for both winter (worst case) and summer.	In order to progress to Gate 3 the finalised designs for the schemes will be required, including exact locations, building materials, access points, vegetation removal, and any soft landscaping/replanting. A full Landscape/Townscape and Visual Impact Assessment will be undertaken.
Soils and contaminated land	Desk based assessment only using publicly available data sets which often have limited detail on the composition of the waste.	Further assessment to establish composition of waste in existing/historic landfills and risk of encountering contaminated soils, landfill gas and leachate should be undertaken by carrying out site investigations and Envirocheck review where conveyance cannot be re-routed to avoid landfill areas. Phase 1 Preliminary Risk Assessments will be progressed where a desk-based assessment is undertaken, reviewing historical mapping, British Geological Survey data, UXO screening and creating conceptual site models (as required).
Transport	Desk based assessment only using publicly available data sets. Indicative numbers of HGV movements during construction which will require refinement. Operational vehicle numbers are unlikely to be significant, but need to be confirmed and assessed.	Traffic counts may be required at certain locations, and further discussion is required with Transport for London (TfL) to scope the requirements of a future Transport Assessment.
Navigation	The navigational impacts resulting from the lower flow changes proposed within the Beckton water recycling scheme have not been assessed at Gate 2. There is also some uncertainty with the amount of sediment deposition that will occur along the Thames Tideway during each of the London Effluent Reuse scenarios. While the changes in SSC and salinity have been modelled, the amount of sediment deposition has not been modelled during Gate 2. Sediment deposition can be affected by a wide range of factors in addition to salinity and SSC, which has not been accounted for in this assessment.	As engineering design progresses, Gate 2 tools can be re-used to assess variants in each of the schemes and the impacts that this would have on navigation. This would be undertaken with bespoke modelling that incorporates any additional information that have arisen as the options progress to Gate 3. The impact of the flow changes for each option will be undertaken, instead of solely modelling the worst-case scenarios. Further scenario modelling at Gate 3 could also include for potential future developments, such as an upgraded/ replacement Thames Barrier; and the inclusion of future climate scenarios. Future climate scenarios would account for sea level change, changes in river flows and changes in London Effluent Reuse scheme operating pattern. Consider construction related impacts when installing intakes and outfalls.
Noise	The baseline assumptions are sufficient for an initial appraisal of risk only. Indicative construction methods, plant numbers and likely noise levels have been used in the calculations which will need to be refined.	Information on noise and vibration emissions from tunnelling will be required as well as details of potential mechanical operational noise from the structures. Any changes to construction methodology and plant would be required

[63] Ricardo Energy and Environment (2022). London Effluent Reuse SRO, Habitats Regulations Assessment. Report for Thames Water Utilities Ltd.

Environmental Topic Area	Data gaps/uncertainties	Proposed work at Gate 3[62]
	A critical requirement for Gate 3 is baseline noise surveys at the nearest receptors to the Beckton water recycling shaft and structures sites.	Consultation with the London Boroughs affected by the developments would be required regarding local planning policy on noise and vibration and their criteria for construction noise and vibration. Details of proposed baseline noise surveys would ideally be approved by the local environmental health officers.
Air quality	Extensive baseline NO_2 monitoring data from diffusion tubes and automatic monitors is available in close proximity (within 1km) to the Beckton water recycling scheme. PM_{10} and $PM_{2.5}$ monitoring data is available from automatic monitors within up to 4km of the all the schemes. In addition, Defra background maps, provide background concentrations for the three schemes for all the relevant pollutants of concern. Therefore, it is concluded that suitable baseline data is available to establish baseline condition for future EIA work. The initial appraisal of risk was undertaken using a number of conservative assumptions, and did not include any modelling: - The assessment is based on an unmitigated scheme and does not consider any embedded construction mitigation measures. - The magnitude of unmitigated dust effects of the relevant sources (earthworks and construction of shafts and tunnels) has been assessed as “large” according to IAQM classifications. - It is assumed that construction activity occurs everywhere, along each pipeline route, at all times for the duration of approximately one year (considered worse case). - The sensitivity of individual receptors has been considered as high. Additional criteria not considered in the assessment at this stage: • History of dust generating activities in the area. • Likely cumulative dust effects from nearby construction sites. • Pre-existing physical screening such as trees or buildings. • Impact of road network used by the construction vehicles. • The influence of the prevailing wind direction. • Local topography	Monitoring of $PM_{2.5}$ could potentially be considered nearer the SRO in order to provide data which would be relevant given the expected new $PM_{2.5}$ target. A full air quality assessment will be required to inform Gate 3.
People and communities	High level assessment only.	Full socio-economic assessment to be progressed for Gate 3. HUDU (Rapid Risk Assessment) / Health Impact Assessment

8 IMPACT RISK ASSESSMENT: MOGDEN WATER RECYCLING

8.1 INTRODUCTION

Using a RAG based approach (see Section 5.3 for further information), the key risks of the Mogden water recycling scheme have been identified under each environmental topic. The approach seeks to understand the mechanisms (activities and pathways) by which activities arising from the scheme might affect the identified receptors, and the likely significance of the impact. Where amber or red risks have been identified, additional mitigation that could be implemented is stated.

8.2 BASELINE, EXISTING EVIDENCE BASE AND RECEPTORS

8.2.1 Water

Refer to ***Annex B.2.1. Physical Environment Assessment Report*** and ***Annex B2.2. Water Quality Assessment Report*** for full details.

8.2.1.1 Physical environment

See Section 7.2.1.1 for a description of the evidence based used for the physical environment assessment.

The reaches relevant to the Mogden water recycling scheme are Reaches A-F.

8.2.1.2 Water quality

See Section 7.2.1.2 for a description of the evidence base used for the water quality assessment.

8.2.1.2.1 Effluent temperature

For Mogden STW final effluent the minimum effluent temperatures recorded were 7.2^{o}C with a maximum of 25.5^{o}C. Mean temperatures measured 17.3^{o}C. Temperatures were higher in the summer and lower in the winter.

8.2.1.2.2 STW final effluent general physico-chemicals water quality

Prior to treatment through the AWRP for a Mogden water recycling scheme, source water quality in final effluent is as follows;

The mean DO value from the dataset is 5.5 mg/l and the median is 5.4 mg/l. The lowest value is 3.0 mg/l, and the highest is 8.3 mg/l. Dissolved Oxygen Saturation exhibited a seasonal trend, with lows in the summer months (June – July) and highs in the winter (January – March).

The mean ammonia value is 3.2 mg/l, and the median is 1.9 mg/l. The minimum value within the dataset is 0.1 mg/l and the maximum value is 23.2 mg/l. There is no trend associated with this dataset.

The mean suspended solids value is 13.6 mg/l, and the median value is 12 mg/l. The minimum value is 2 mg/l, and the maximum value is 77 mg/l. Suspended Solids showed a slight trend towards the end of the dataset, with more variability in 2013 – 2015 compared to 2016 – 2017.

The mean BOD value is 5.6 mg/l, and the median value is 5.1 mg/l. The minimum value is 1.9 mg/l, and the maximum value is 20.9 mg/l. The biological oxygen demand showed no trend other than a spike in values in 2015.

The mean ammonia (NH_3) concentrations are below average with values of 0.06 mg/l. Nitrite (NO_3), however, is amongst the highest values, averaging at 32.4 mg/l, over 7 mg/l greater than the average.

Most determinands had the highest values in the summer with all nitrogen based determinands showing a steep decrease in values in September, with concentrations slowly recovering towards the end of the year. After the decrease, ammonium and nitrite values remained low.

The soluble reactive phosphorus (SRP) and total phosphorus (TP)[64] values at Mogden STW Final Effluent, show mean values of 2.89 and 3.43 mg/l respectively. SRP and TP are most elevated in the summer, then

[64] Total phosphorus (TP) is a measure of all the forms of phosphorus, dissolved or particulate, that are found in a sample. Soluble reactive phosphorus (SRP) is a measure of orthophosphate, the filterable (soluble, inorganic) fraction of phosphorus, the form directly taken up by plant cells

display a steep decrease in values in September, with concentrations slowly recovering towards the end of the year. After the decrease both TP and SRP recovered quickly reaching values close to the averages by the next monitoring period.

The hardness of the freshwater River Thames has been calculated at 313 mg/l (very hard water), whilst the hardness calculated within the Mogden STW effluent is 361 mg/l, an increase of 48 mg/l, from the river due to elevated calcium and magnesium concentrations within the effluent.

Effluent chemicals: Of the 81 determinands in the chemical suite, 33 were found to be consistently below the LOD in final effluent, leaving 47 determinands for analysis. Of these chemicals, Perfluorooctane sulfonic acid and its derivatives, dissolved copper and dissolved zinc frequently exceeded their LOD, and chlorine, cybutryne, cypermethrin, dicofol, hexachlorocyclohexane, permethrin, napthalene and tricholorobenzene occasionally exceeded their LOD.

8.2.1.3 Flood risk

See Section 7.2.1.3 for the approach to establishing the flood risk baseline data set.

8.2.2 Biodiversity

Refer to ***Annex B.2.3. Fish Assessment Report***, ***Annex B2.4. Aquatic Ecology Assessment Report***, ***Annex B2.5 INNS Report*** and ***B2.6. Terrestrial Ecology Assessment Report*** for full details.

8.2.2.1 Fisheries

A catalogue of the evidence base for the fish topic has been compiled which covers freshwater and estuarine fish species, weir pool and marginal habitat assessment, migratory fish species, olfactory cues and inhibitors and an assessment of European smelt. The baseline data collected is summarised in **Table 8-1**.

Table 8-1 Mogden water recycling scheme: summary of fisheries baseline

Reach	Receptor					
	Freshwater Fish	**Weir Pool and Marginal Habitat (including Sunbury Creek)**	**Estuarine Fish (including European eel)**	**Migratory Fish (including European eel)**	**European Smelt**	**Olfactory Inhibitors**
Freshwater River Thames						
A – Shepperton Weir to Affinity Water Walton Intake	EA monitoring programme data records (2010–2021) were supplemented by project-specific fisheries monitoring completed in 2021. Baseline data from 37 fisheries surveys across 10 sites indicates that under present conditions, the fish community is diverse, and representative of the dominant habitats associated with a typical slow-flowing glided reach, and characteristic of a lowland river.	The result of the assessment (TR_01) found this section of the River Thames to be 'Large' type and in 'Fairly Poor' condition.	N/A	Presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009) recorded. Historical datasets since 1993 indicate presence of *Lampetra* sp. (combined brook and river lamprey) in tributaries of the River Mole, which run into the River Thames as the River Ember at Hampton Court, upstream of Reach A.	N/A	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 6 sites between 2021-2022. Of 53 determinands, 27 were consistently below the LOD, with 26 still requiring analysis.
B – Affinity Water Walton Intake to Thames Water Walton Intake	EA monitoring programme data records (2010-2021) were complemented by project-specific fisheries monitoring completed in 2021. Baseline data from 12 fisheries surveys across 5 sites indicates that under present conditions, the fish community is diverse, and representative of the dominant habitats associated with a typical slow-flowing glided reach, and characteristic of a lowland river.	Three assessments (TR_02, TR_03 and TR_04) found the main channel of this reach to be 'Large' or 'H' type and in 'Poor', 'Fairly Poor' or 'Fairly Good' condition, respectively. Lower extent of the reach includes Sunbury Weir and Sunbury Creek side channel.	N/A	Presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009) recorded.	N/A	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 6 sites between 2021-2022.
C – Thames Water Walton Intake to Teddington Weir	EA monitoring programme data records (2010–2021) were supplemented by project-specific fisheries monitoring completed in 2021 and 2022. Baseline data from 33 fisheries surveys across 12 sites indicates that under present conditions, the fish community is diverse and representative of the dominant habitats associated with a typical slow-flowing glided reach, and characteristic of a lowland river.	Four assessments were conducted in this reach. Three of the four surveys indicated a 'Large' type with one in 'Poor' (TR_05), and two in 'Fairly Poor' (TR_06; TR_08) condition, respectively. The fourth assessment found this section to be a 'K' type and in 'Fairly Poor' condition.	N/A	Presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009) across differing life-stages; brown/sea trout (UK BAP Priority species); and Atlantic salmon (Habitats Regulations, 2017; UK BAP Priority species) recorded.	N/A	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 6 sites between 2021-2022.
Estuarine Thames Tideway						
D – Teddington Weir to Battersea Park	Data was obtained from EA TraC monitoring records (2010–2021). Baseline data from 70 fisheries surveys across 4 sites indicated that freshwater species dominance was apparent at the most upstream site (i.e., Richmond), with a diverse fish community recorded. Catch abundance was dominated by taxa with a high (roach: 33%) and medium-tolerance (dace: 43%) for environmental disturbance. At the second site (i.e., Kew), 5 km further downstream of Teddington Weir, a community transition is apparent. While freshwater species remain dominant, the catch abundance of roach and dace shifts to 11% and 18%, respectively. Further downstream at Chiswick and Battersea, freshwater species presence is still apparent, but the catch abundance proportion is smaller as the	x – No Weir Pool/ River Condition Assessment completed	Data was obtained from EA TraC monitoring records (2010–2021). Baseline data from 70 fisheries surveys across 4 sites indicates that under present conditions, the fish community is predominantly freshwater, but estuarine and marine juvenile species presence is apparent owing to the transitional status of the Upper Tideway. Species assemblages reflect this shift, with representation (<25% annual catch abundance) of marine species at the most upstream location. By Kew, overall annual catch abundance for marine species was still <25%, but some annual records note a higher marine to freshwater ratio. Flounder was the most frequently captured species, accounting for 32% of catch	Data obtained from EA TraC monitoring records (2010–2021) indicated presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009); and brown/ sea trout (UK BAP Priority species) recorded at the Kew site. Anecdotal historical datasets also note low number presence of adult and juvenile twaite shad (section 5, Wildlife and Countryside Act, 1981; UK BAP Priority species); Atlantic salmon (Habitats Regulations, 2017; UK BAP Priority species), sea lamprey (Habitats Regulations, 2017; UK BAP Priority species); and river lamprey (Habitats Regulations, 2017; UK BAP Priority species) within the tideway.	Data obtained from EA TraC monitoring records (2010–2021) indicated presence of European smelt (UK BAP Priority species) at all 4 sites within the reach.	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 1 site between 2021-2022. Of 53 determinands, 29 were consistently below the LOD, with 2 having no available, and 24 still requiring analysis.

Reach	Receptor					
	Freshwater Fish	**Weir Pool and Marginal Habitat (including Sunbury Creek)**	**Estuarine Fish (including European eel)**	**Migratory Fish (including European eel)**	**European Smelt**	**Olfactory Inhibitors**
	community progresses further toward an estuarine indicative species assemblage. Presence of European bullhead (Habitats Regulations, 2017).		abundance, with sea bass (17%), common goby (10%) and smelt (4%), also accounting for a large proportion of catch abundance. Further down river, at Chiswick and Battersea, fish assemblages shift to a predominantly marine community, at >75% and >85% of catch abundance, respectively.			
E – Battersea Park to Tower Bridge	x - No monitoring programme data available from 2010–2021 to allow for baseline assessment. NRA data available from 1992-1993 at Vauxhall site, provisioning presence/absence indications. Historical presence of 2 high-tolerant disturbance-sensitivity taxa, namely, dace and perch.	x – No Weir Pools present. No River Condition Assessment completed	x - No baseline assessment. NRA data available from 1992-1993 at Vauxhall site, provisioning presence/absence indications. Historical presence of two estuarine species: flounder and bass.	x - No baseline assessment. NRA data available from 1992-1993 at Vauxhall site, provisioning presence/absence indications. Data indicates historical presence of Atlantic salmon (Habitats Regulations, 2017; UK BAP Priority species); and European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009) recorded. Further anecdotal historical datasets (see also, Gollock *et al*., 2008[65]), obtained from a systematic review of open-source data, also note low number presence of adult and juvenile twaite shad (section 5, Wildlife and Countryside Act, 1981; UK BAP Priority species); sea lamprey (Habitats Regulations, 2017; UK BAP Priority species); and river lamprey (Habitats Regulations, 2017; UK BAP Priority species) within the tideway.	x – no data available. EA non-statutory monitoring as part of Thames Foreshore events at Tower Bridge has recorded European smelt at this location (see also, Colclough *et al*., 2002[66]; Gollock *et al*., 2008[67]; Attrill and Power, 2004[68]).	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 1 site between 2021-2022. Of 53 determinands, 29 were consistently below the LOD, with 2 having no available, and 24 still requiring analysis.
F – Tower Bridge to 3km seawards of Beckton STW	The fish community within the reach was highly diverse and dominated by estuarine/marine species. At the furthest upstream site (i.e., Greenwich), species typical of freshwater are present, accounting for ~23% of catch abundance, and dominated by species with a high- (e.g., perch, roach, 3-spined stickleback) and mid-range (e.g., dace, pike) tolerance for environmental disturbance. Further downriver (i.e., Woolwich), high-tolerant freshwater species accounted for <0.1% of total catch abundance	x – No Weir Pools present. No River Condition Assessment completed	Data was obtained from EA TraC monitoring records (2010–2021). Baseline data from 71 fisheries surveys across 2 sites indicates that under present conditions, the fish community is diverse and demonstrates the transitional nature of the reach within the middle of the Thames Tideway. Upstream (i.e., Greenwich), catch abundance is dominated by species indicative of estuaries (~73%), with a transition in dominance to >99% of estuarine/marine species at the downriver site (i.e., Woolwich), including flounder, pouting, dover sole, herring, and cod.	Data obtained from EA TraC monitoring records (2010–2021) indicated presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009) across differing life-stages recorded at both sites. Anecdotal historical datasets, obtained from a systematic review of open-source data, also note low number presence of adult and juvenile twaite shad (section 5, Wildlife and Countryside Act, 1981; UK BAP Priority species); Atlantic salmon (Habitats Regulations, 2017; UK BAP Priority species), sea lamprey (Habitats Regulations, 2017; UK BAP Priority species); and river lamprey (Habitats Regulations, 2017; UK BAP Priority species) within the tideway.	Data obtained from EA TraC monitoring records (2010–2021) indicated presence of European smelt (UK BAP Priority species) recorded at both sites.	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 1 site between 2021-2022. Of 53 determinands, 29 were consistently below the LOD, with 2 having no available, and 24 still requiring analysis.

[65] Gollock, M., Shaw, A., Pryor, A., Godsall, B., Causon, P., Dutton, C., and Kowalik, R. Aquatic wildlife of the Thames Estuary: Monitoring Results 2007-2008. ZSL, EA, and RWE power. Pp. 10-11, Nov 2008.
[66] Colclough, S.R., Gray, G., Bark, A., and Knights, B. Fish and fisheries of the tidal Thames: management of the modern resource, research aims and future pressures. J. Fish. Biol. 60, pp. 1-10, 2002.
[67] Gollock, M., Shaw, A., Pryor, A., Godsall, B., Causon, P., Dutton, C., and Kowalik, R. Aquatic wildlife of the Thames Estuary: Monitoring Results 2007-2008. ZSL, EA, and RWE power. Pp. 10-11, Nov 2008.
[68] Attrill, M.J., and Power, M. Partitioning of temperature resources amongst an estuarine fish assemblage. Estuar. Coast. Shelf. Sci. 61, pp. 725-738, 2004.

8.2.2.2 Aquatic ecology

The following baseline data has been updated between Gates 1 and 2, and is summarised in **Table 8-2**:

- Aquatic macroinvertebrates freshwater and estuarine.
- Marginal habitat assessment.
- Plants/diatoms.
- Macroalgae, angiosperm and phytoplankton.
- Designated and protected sites and species.

The relevant reaches for the Mogden water recycling scheme are Reaches A-C on the freshwater Thames and Reaches D-F on the Thames Tideway. Reach A was initially included in the Gate 1 assessments and early part of the Gate 2 assessments on account of the potential for an alternative Mogden water recycling discharge location in the Desborough Loop (Reach A). However, as the design has developed through Gate 2 the alternative discharge location has been removed, making Reach A upstream of any Mogden water recycling discharge, and as such is not considered further. The reaches are shown in **Figure 7-1** (Section 7.2.2.2).

Table 8-2 Mogden water recycling scheme: summary of aquatic ecology baseline

Reach	Receptor					
	Aquatic/estuarine invertebrates	**Marginal habitat**	**Macrophytes**	**Diatoms**	**Macroalgae, angiosperm and phytoplankton**	**Designated and protected sites and species (within 2km)**
Freshwater River Thames						
Reach B Affinity Water Walton Intake to Thames Water Walton Intake	LIFE data: invertebrate community in the impacted reach has a low to moderate sensitivity to reduced flows. Baseline data suggest that the invertebrate community within the reach from Affinity Water Walton Intake to Thames Water Walton Intake is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slow flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). Invertebrates of interest were recorded in the freshwater River Thames along this reach including *Ephemera lineata* and *Pseudanodonta complanata*. *Ephemera lineata* is considered Vulnerable by ICUN Red list and Nationally Scarce whilst *Pseudanodonta complanate* is considered a priority species	RCA (X3): • TR_02: 'Large' type and Poor condition • TR_03 (Sunbury Creek): 'H' type and Fairly Good condition • TR_04: 'Large' type and Fairly Poor condition 'H' type rivers are those which typically have a straight/sinuous planform, sand dominated substrate with gravel / cobble and are unconfined or partially confined in their valley.	Biological status of the macrophyte community is considered moderate, based on the calculated EQR values. This suggests that the macrophyte community within this reach is in an unimpacted or natural state. Mean RMNI scores suggests that the community within this reach is associated with slightly higher nutrient enriched rivers	Low percentage of diatoms that are tolerant of slightly saline waters, suggests there has been little influence of saline waters in this reach. Varied mobility of diatoms within the reach. Percentage PTV scores across the sites were generally low and diatoms were classed as only being tolerant to no organic pollution, with the exception of the LRUS-002 autumn sample date which recorded a score indicative of having mild organic pollution tolerance.	N/A	Five designated sites within 2km: 1 SPA, 1 Ramsar, 2 SSSIs and 1 LNR. None were considered to be hydrologically connected, therefore no pathway for impact.
Reach C Thames Water Walton Intake to Teddington Weir	LIFE data indicates that under present conditions, the invertebrate community in the impacted reach is moderately sensitive to reduced flows. Baseline data suggest that the invertebrate community within the reach from Thames Water Walton Intake to Teddington Weir is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slower flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). Invertebrates of interest were recorded in the freshwater River Thames along this reach including *Stenelmis canaliculata* and *Ephemera lineata*. *Ephemera lineata* is considered Vulnerable by ICUN Red list whilst *Ephemera lineata is* considered Vulnerable by ICUN Red list and Nationally Scarce.	RCA (x4): • TR_05: 'Large' type and Poor condition • TR_06: 'Large' type and Fairly Poor condition • TR_07: 'K' type and Fairly Poor condition • TR_08: 'Large' type and Fairly Poor condition 'K' type rivers are those which typically have a straight/sinuous planform, silt / clay dominated substrate with sand/gravel and are unconfined or partially confined in their valley.	Biological status of the macrophyte community ranges from Poor to Good, based on the calculated EQR values. This suggests that some areas of the reach contain macrophyte community within this reach is in a fairly unimpacted and natural state. Five of the seven sites contain a macrophyte community with biological status of Poor or Bad, which suggests that large sections of the reach contain macrophyte communities that are highly degraded. Mean RMNI scores suggests that the community within this reach is associated with higher nutrient enriched rivers. All sites had a similar number of Algal taxa present, along with similar amounts of functional macrophyte groups	Low percentage of diatoms that are tolerant of slightly saline waters, suggests there has been little influence of saline waters in this reach. Varied mobility of diatoms within the reach. PTV scores across the sites were generally low and diatoms were classed as only being sensitive to organic pollution.	N/A	Twelve designated sites within 2 km: 1 SAC, 3 SSSIs, 1 NNR and 7 LNRs. One site was considered to be hydrologically connected to scheme, Ham Lands LNR, and therefore requires further assessment.
Estuarine Thames Tideway						
Reach D Teddington Weir to Battersea Park	LIFE data: invertebrate community in the impacted reaches are not sensitive to reduced flows. The baseline data suggest that the invertebrate community within the reach from the Teddington Weir to Battersea Park is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slow flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes).	x – no River Corridor Assessment completed	N/A	x – no data available	Vaucheria only algal taxon recorded - species are mostly found in freshwater or low salinity estuarine waters while a small number are fully marine. Vaucheria spp. Was noted to be patchily distributed and the percent coverage of the AIH across the survey sites in Reach D was 8.5%. Biological status of the macroalgal community is considered Bad, based on the calculated EQR values (<0). This suggests that the macrophyte	Sixteen designated sites within 2km; 1 SAC. 4 SSSIs, 1 NNR and 10 LNRs. The following were considered to be hydrologically connected (therefore pathway for impact): • Ham Lands LNR • Isleworth Ait LRN • Syon Park SSSI • Barn Elms Wetland Centre SSSI • Duke's Hollow LNR

Reach	Receptor					
	Aquatic/estuarine invertebrates	Marginal habitat	Macrophytes	Diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species (within 2km)
	No other invertebrates of interest were recorded in the estuarine Thames Tideway Teddington Weir to Battersea Park.				community within this reach is in an impacted state.	• Chiswick Eyot LNR • Leg of Mutton Reservoir LNR • Battersea Park Nature Areas LNR
Reach E Battersea Park to Tower Bridge	x – no data available	x – no River Corridor Assessment completed	N/A	Data shows a general low saline tolerance across all sample dates, with only one recording a saline tolerant score, with that being sampled in 2007. This therefore suggests there has been little influence of saline waters in this reach. Diatoms were classed as being either tolerant to moderate or no organic pollution	x – no data available	One designated site, Battersea Park Nature Areas LNR was identified within 2 km of the reach.
Reach F Tower Bridge to 3km seawards of Beckton STW	x – no data available	x – no River Corridor Assessment completed	N/A	x – no data available	No opportunistic algae were recorded. Ulva spp. was recorded on hard substrates, along with *Fucus vesiculosus* on riprap on the upper shore at the estuarine Thames Tideway survey area.	Thirteen designated sites were identified within 2 km; 1 SSSI and 12 LNRs. None were considered to be hydrologically connected, therefore no pathway for impact.

8.2.2.3 Invasive Non-Native Species

For the Mogden water recycling scheme, Reaches A - F are considered as the relevant zone of influence. The following summary is provided for the INNS baseline for the relevant reaches potentially impacted by the scheme.

- **Reach A – Shepperton Weir to Affinity Water Walton Intake:** A total of 14 INNS of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most frequently recorded species within this reach is the aquatic plant species Floating pennywort (*Hydrocotyle ranunculoides*), followed by several aquatic invertebrate species including Zebra Mussel (*Dreissena polymorpha*) and terrestrial plant species such as Japanese Knotweed (*Fallopia japonica*).
- **Reach B – Affinity Water Walton Intake to Thames Water Walton Intake:** A total of 17 INNS of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most common species recorded within this reach were aquatic invertebrate species, with the most abundant being Caspian Mud Shrimp followed by Zebra Mussel and Demon shrimp.
- **Reach C – Thames Water Walton Intake to Teddington Weir:** A total of 30 INNS of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most frequently recorded species was Caspian Mud Shrimp, followed by Demon shrimp and Ponto-Caspian Polycheate Worm (*Hypania invalida).*
- **Reach D – Teddington Weir to Battersea Park:** A total of 32 INNS of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most abundant species were aquatic invertebrates, with New Zealand mudsnail being the most frequent, followed by Asian clam and Caspian Mud shrimp.
- **Reach E – Battersea Park to Tower Bridge:** A total of 11 species of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most frequently recorded species was the aquatic invertebrate species New Zealand mudsnail, followed by two terrestrial plant species False acacia and Spanish bluebell.
- **Reach F – Tower Bridge to 3km seawards of Beckton STW:** A total of 20 INNS species of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring survey. The most frequently recorded species were aquatic invertebrates, with the most abundant being New Zealand mudsnail, followed by Chinese mitten crab and red-gilled mudworms *Marenzelleria viridis*.

8.2.2.4 Terrestrial ecology

8.2.2.4.1 Designated Sites

A total of two SSSIs, seven LNRs and twelve SINCs have been identified within 2km.

8.2.2.4.2 Priority Habitats

UKHab surveys have been undertaken to inform the Gate 2 assessment, with the exception of Shafts 3, 7, 17 (including Walton Road Bridge start and end), 18 and 19.

The UKHab surveys undertaken in Gate 2 identified that the habitats within the site compounds and at the discharge location were typically dominated by low and moderate distinctiveness habitats such as other neutral grassland, modified grassland, other broadleaved woodland, scrub, hedgerows (non-priority), and urban habitats (e.g., developed land sealed surface). However, priority habitats were present at one shaft compound, Mogden Shaft 6: Crane walk - reedbeds.

8.2.2.4.3 Other Protected, Notable and/or Invasive Species

Local environmental record centre data were requested of protected and notable species within 2 km of all infrastructure and construction locations associated with the Mogden water recycling scheme. The following were recorded within 2km: bats, badger, stag beetle, notable terrestrial invertebrates (large heath *Coenonympha tullia*, marsh fritillary *Euphydryas aurinia*, white-letter hairstreak *Satyrium w-album*, and brown hair streak *Thecla betulae*), reptiles, European hedgehog, amphibians and hazel dormice (see **Table 8-3** for scoped in receptors).

No PEA was completed for the Mogden water recycling sites; however, the Jacobs UK Habs reports for the conveyance routes sites show a number of suitable habitats and some observations of the likely presence of protected species including bats, great crested newts, breeding birds, badger, riparian mammals (Eurasian otter and water vole), terrestrial invertebrates, and common species of reptiles.

A total of 12 protected and notable plant species were identified within 2km of the Mogden Water Recycling Scheme including bluebell and meadow clary (*Salvia pratensis*) which are listed under Schedule 8 of the Wildlife and Countryside act and three NERC act Section 41 Priority species: True Fox-sedge (*Carex vullpina*), Cornflower (*Centaurea cyanus*), Northern Hawk's-beard (*Crepis mollis*) and Greater Water-parsnip (*Sium latifolium*).

8.2.2.4.4 Birds

A total of 98 bird species have been recorded by GiGL within 2 km of Mogden water recycling scheme from 2000 – 2022. This includes 38 waterfowl (waders, wildfowl and divers, plus kingfisher,12 gull and tern species and 8 birds of prey. The remaining 40 species are associated with woodland, parkland, wetland, scrub and heathland habitats. Of those species, 61 are 'notable' species (as defined above) and 37 are protected under local plans and local species of conservation concern. Of the 561 'notable' species, 42 are Wildlife and Countryside Act Schedule 1, 20 NERC Section 41 species and 12 Birds of Conservation Concern red listed species.

A total of 59 bird species have been recorded to Surrey Biodiversity Information Centre (SBIC) from 2000 – 2022, with the latest record submitted in 2020. SBIC covers Mogden from the discharge point in Walton-on-Thames to Surbiton, 8.3 km downstream. Of those 59 species recorded, 30 are 'notable' species and the remining 29 are protected under local plans and local species of conservation concern. Of the 30 'notable' species, 23 are Birds of Conservation Concern red listed, eight are NERC Section 41 species and 10 are WCA Schedule 1 species.

WeBS core count data was requested where impact pathways have been identified at reservoirs associated with South West London Waterbodies SPA and Ramsar site. The sites include Kempton Local Nature Reserve (24103) and Red House Reservoir (24104).

8.2.2.5 Summary of receptors

Receptors identified at this initial stage for further assessment are listed in **Table 8-3**.

Local record centre data provided data to 2km and with no age of the record. As such, the exact location could not be identified, nor whether the record was within the last 10 years, and therefore of relevance. As such, the following species/groups could be found within the Mogden water recycling study area: bats, stag beetle, notable invertebrates (large heath (*Coenonympha tullia*), marsh fritillary (*Euphydryas aurinia*), white-letter hairstreak (*Satyrium w-album*), and brown hair streak (*Thecla betulae*)), reptiles, European hedgehog, amphibians and hazel dormouse.

The Jacobs UKHab reports for the Mogden water recycling conveyance routes identified that habitats on site were considered to be suitable for protected and notable species including bats, great crested newts, breeding birds, badger, riparian mammals (Eurasian otter and water vole), terrestrial invertebrates, and common species of reptiles. The habitats are also considered to be potentially suitable for hazel dormouse and common toad which are not identified in the Jacobs UKHab reports.

Table 8-3 Mogden water recycling scheme: summary of ecological receptors

Scheme component	Topic area	Receptor
Mogden STW and shaft 1	Terrestrial ecology	Designated sites Mogden STW SINC Proximity to Isleworth Ait LNR Proximity to Duke of Northumberland's River North of Kneller Road SINC Protected and/or notable species PEA: hazel dormouse, Eurasian hedgehog
Shaft 2	Terrestrial ecology	Designates sites Proximity to Duke of Northumberland's River North of Kneller Road SINC Protected and/or notable species PEA: hazel dormouse, Eurasian hedgehog
Shaft 3	Terrestrial ecology	Designated sites

Scheme component	Topic area	Receptor
		Adjacent to Duke of Northumberland's River north of Kneller Road SINC Protected and/or notable species PEA: hazel dormouse, Eurasian hedgehog
Shaft 4	Terrestrial ecology	Designates sites Proximity to Duke of Northumberland's River North of Kneller Road SINC Protected and/or notable species PEA: hazel dormouse, badger, riparian mammals (water vole and otter), Eurasian hedgehog
Shaft 5	Terrestrial ecology	Designated sites Proximity to Crane Park Island LNR Proximity to Duke of Northumberland's River North of Kneller Road SINC Protected and/or notable species PEA: hazel dormouse, stag beetle, riparian mammals (water vole and otter), Eurasian hedgehog
Shaft 6	Terrestrial ecology	Designated sites Crane Corridor SINC Proximity to Crane Park Island LNR Priority habitats Reedbeds Protected and/or notable species PEA: hazel dormouse, reptiles, riparian mammals (water vole and otter), Eurasian hedgehog
Shaft 7	Terrestrial ecology	Designated sites Fulwell and Twickenham Golf Courses SINC Proximity to Crane Park Island LNR Proximity to Oak Avenue Hampton LNR and SINC Protected and/or notable species PEA: hazel dormouse, Eurasian hedgehog
Shaft 8	Terrestrial ecology	Designated sites Proximity to Crane Park Island LNR Proximity to Oak Avenue Hampton LNR Protected and/or notable species PEA: hazel dormouse, reptiles, Eurasian hedgehog
Shaft 9	Terrestrial ecology	Designated sites Proximity to Crane Park Island LNR Proximity to Oak Avenue Hampton LNR and SINC Protected and/or notable species PEA: hazel dormouse, riparian mammals (water vole and otter), Eurasian hedgehog
Shaft 10	Terrestrial ecology	Designated sites Proximity to South West London Waterbodies SPA and Ramsar Proximity to Kempton Park Reservoirs SSSI Proximity to Oak Avenue Hampton LNR and SINC Proximity to Hampton Water Treatment Works SINC Protected and/or notable species PEA: hazel dormouse, badger, Eurasian hedgehog
AWRP site, shaft sites (11&12)	Terrestrial ecology	Designated sites Proximity to South West London Waterbodies SPA and Ramsar Proximity to Kempton Park Reservoirs SSSI

Scheme component	Topic area	Receptor
		Potential direct loss within a non-statutory designated site of local importance depending on the exact location of the AWRP Proximity to Oak Avenue Hampton LNR and SINC Proximity to Hampton Water Treatment Works SINC Priority habitats Lowland calcareous grassland and lowland mixed deciduous woodland. Protected and/or notable species PEA: hazel dormouse, reptiles, Eurasian hedgehog
Shaft 13	Terrestrial ecology	Designated sites Proximity to Oak Avenue Hampton LNR and SINC Proximity to Hampton Water Treatment Works SINC Protected and/or notable species PEA: hazel dormouse, reptiles, Eurasian hedgehog
Shaft 14	Terrestrial ecology	Designated sites Proximity to Oak Avenue Hampton LNR and SINC Protected and/or notable species PEA: hazel dormouse, Eurasian hedgehog
Shaft 15	Terrestrial ecology	Protected and/or notable species PEA: hazel dormouse, Eurasian hedgehog
Shaft 16	Terrestrial ecology	Protected and/or notable species PEA: hazel dormouse, Eurasian hedgehog
Walton Bridge outfall	Terrestrial ecology	Protected and/or notable species PEA: hazel dormouse, Eurasian hedgehog

8.2.3 Historic environment

8.2.3.1 Baseline

The approach to the baseline data collection is set out in Section 7.2.3.1.

8.2.3.1.1 National designations

There is one Scheduled Monument located within the study area located at the northern end of the scheme, east of Mogden STW.

There are 63 Listed Buildings within the Mogden water recycling scheme study area comprising three Grade I listed buildings, four Grade II* listed buildings, and 56 Grade II listed buildings. Most of these Listed Buildings are concentrated within the historic core of Walton-on-Thames and the Lower Halliford Conservation Area to the south of the scheme, the Hampton Village Conservation Area in the centre of the scheme, and the Isleworth Riverside and St. Margaret's Estate Conservation Areas to the north of the scheme.

Platt's Eyot, Hampton Conservation Area and the four listed buildings contained within it to the south-east of the proposed AWRP site are listed on Historic England's Heritage at Risk register. The Grade II registered park and garden, Oatlands, is located within the study area south of the scheme, south-west of the proposed Walton discharge site.

8.2.3.1.2 Regional and local designations

There are a total of 12 conservation areas within the Mogden water recycling scheme study area that are dispersed evenly along the scheme route.

There are five APAs located within the study area. These are mostly concentrated within the northern part of the study area.

There are seven AHAPs located within the study area, which are distributed evenly along the southern half of the Mogden water recycling scheme study area.

There are seven locally listed buildings within the study area, all of which are clustered within Walton-on-Thames.

8.2.3.1.3 Known non-designated heritage assets

There have been 51 previous archaeological events undertaken within the Mogden water recycling scheme study area. Most of these are clustered to the north of the scheme, north-east of Mogden STW and at the south of the scheme near Walton-on-Thames.

There are a total of 83 known non-designated heritage assets located across the study area. Most of these are clustered in the southern and northern areas of the scheme around Walton-on-Thames and Mogden STW.

8.2.3.2 Summary of receptors

Table 8-4 provides a summary of designated receptors identified along the route of the Mogden water recycling scheme. Receptors are defined as any designated heritage asset located within 100m, or non-designated heritage asset located within 50m, of proposed new infrastructure, trenched pipeline section, or shaft site (including the associated temporary site compound). A proximity of 0m indicates that the scheme site is located directly within or on a receptor location, or that the receptor is contained within the site area.

Table 8-4 Mogden water recycling scheme: summary of historic environment receptors

Scheme Component	OA[69]	Name	Proximity (m)
Final Effluent Pumping Station, Shaft site 1	98	Mogden Lane [Mogden Sewage Works]; prehistoric findspot	<50
Shaft site 2	111	Whitton Brook; early medieval parish boundary/watercourse	<50
Shaft site 4	– – 112	Crane Valley APA Rosecraft Gardens Conservation Area Meadway Twickenham [Kneller Gardens]; historic park	<50 <50 <50
Shaft site 5	– 112	Crane Valley APA Meadway Twickenham [Kneller Gardens]; historic park	<50 <50
Shaft site 6	– – 114	Crane Valley APA River Crane Valley APA Ellerman Avenue/Hanworth Road/Great Chertsey Road [Crane Park]; historic park	<50 50-100 <50
AWRP site and shaft sites 11 and 12	115	Staines to Ewell; Roman road	<50
Trenched AWRP to Walton Discharge Pipeline between shaft sites 14 and 15	23 24 –	Hawke House; listed building Walls and railings to front of Hawke House; listed building Bronze Age enclosure, Watersplash Farm, Shepperton AHAP	50-100 50-100 <50
Shaft site 15	122	Ring ditch cropmarks, Sunbury; undated heritage monument	<50
Trenched AWRP to Walton Discharge Pipeline between shaft site 16 and Walton discharge	– 116	Lower Halliford Conservation Area Late Iron Age 'Belgic' urns, near Upper Halliford; prehistoric heritage monument	50-100 <50
Walton discharge features	117 118 119	Later Mesolithic Thames pick and Neolithic greenstone axe; prehistoric findspot Walton Bridge House (site of); post-medieval heritage monument Walton Yacht Works and Wharf (demolished); modern heritage monument	<50 <50 <50

[69] See Appendix 2 for gazetteer of heritage assets (OA x references) and corresponding figures.

Scheme Component	OA[69]	Name	Proximity (m)
	120	Callender-Hamilton Bridge; modern heritage monument	<50
	121	Walton Bridge, bridge approach and toll house; post-medieval heritage monument	<50

8.2.4 Landscape and visual amenity

8.2.4.1 Baseline

A study area of 500m to either side of the Mogden water recycling scheme was applied for the initial appraisal. The study area was informed by desk and an initial site visit. Field survey work was carried out on 6 June 2022 under clear weather conditions. This included visits to the sites and study areas to consider the likely effects of the proposed developments on landscape/townscape character and on views and visual amenity.

The study area has also been informed by an understanding of the topography, vegetation and built development in the surrounding landscape/townscape.

8.2.4.1.1 National designations

Nationally important landscapes (National Parks and Areas of Outstanding Natural Beauty) have protection through law. There are no nationally important landscapes in the study areas for this assessment.

8.2.4.1.2 Local designations

The existing Mogden STW is one of the largest sewage works in the UK, and contains a number of Art Deco infrastructure buildings. The STW is contained by a dense bank of vegetation along the northern, eastern and southern boundaries. The Crane River Walk runs through the centre of the existing STW. The proposed development site is within the eastern boundary of the STW. The existing Mogden STW is designated as the Mogden Sewage Works SINC. Land to the east, south and west of Mogden STW is designated as Open Space (Other).

The potential new AWRP site near Kempton WTW consists of mature woodland, scrub and vegetation. The site lies east of Kempton Park Racecourse, between Hampton to the east and Sunbury to the west. There is no public access to the landscape, which lies west of Hampton, and the north-east of the east of the site is part of the Green Belt. If this site is selected as part of the options appraisal process, there is potential for impacts to a non-statutory designated site of local importance.

The pipeline route and shaft sites cross the landscape / townscape between Mogden STW and new AWRP site near Kempton WTW, and onwards to Walton on Thames. The route crosses a number of parks and public open spaces, public rights of way, Conservation Areas and SINCs.

Photo 2 Typical view of Mogden STW from local roads, hidden by mature vegetation

Photo 3 Typical view towards new AWRP site from Upper Sunbury Road. The site lies approximately 75m north of the road. Views are heavily restricted by fencing and mature vegetation

8.2.4.2 Summary of receptors

The receptors are divided into landscape/townscape and visual receptors. Receptors have been scoped out where there is unlikely to be significant effects due to the size and scale of the proposed developments. For each of the proposed schemes this will include:

8.2.4.2.1 Landscape/townscape receptors

- Immediate local landscape/townscape character.
- Landscape/townscape character of the site.
- Any landscape/townscape designations.

8.2.4.2.2 Visual receptors

- Local communities.
- Local recreational users, including parks, public rights of way, and sports facilities.
- Local pedestrians and road users.

8.2.5 Soil and contaminated land

8.2.5.1 Baseline

The approach to the baseline data collection is set out in Section 7.2.5.1. The geology of the shaft locations and conveyance route was analysed through British Geological Survey Geology (BGS)[37]. The identified superficial and bedrock geology are listed in **Table 8-5**.

The historic landfills within 1.5km of the conveyance route and which are intersected by the proposed route are noted in **Table 8-5.**

Table 8-5 Mogden water recycling scheme: contaminated land baseline

Location	Close to waste?	Historic landfill / type of waste	Geology	Potential pathway
Shaft 1	Yes, located <50m East.	Redlees Park. Reference: EAHLD11059. Inert Waste. Last input December 1946.	Superficial: Langley Silt Member – clay and silt. Bedrock: London Clay Formation – clay and silt.	Yes, via excavation through waste
Shaft 2	No. Closest located 150-200m South.	-	Superficial: Langley Silt Member – clay and silt. Bedrock: London Clay Formation – clay and silt.	None
Shaft 3	No. Closest located 350-400m East.	-	Superficial: Kempton Park Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 4	No. Closest located >2km North East	-	Superficial: Kempton Park Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 5	No. Closest located >1.5km North East	-	Superficial: Taplow Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 6	No. Closest located 150-200m East.	-	Superficial: Alluvium – Clay, silt, sand and gravel.	None

Location	Close to waste?	Historic landfill / type of waste	Geology	Potential pathway
			Bed rock: London Clay Formation – clay and silt.	
Shaft 7	No. Closest located 350-400m East.	-	Superficial: Taplow Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 8	No. Closest located 650-700m North East	-	Superficial: Taplow Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 9	No. Closest located 900-950m North East.	-	Superficial: Taplow Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 10	No. Closest located 600-650m West.	-	Superficial: Taplow Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 11	No. Closest located 200-250m West.	-	Superficial: Taplow Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 12	Yes. Tunnel crosses landfill.	Land at Oliver Close. Inert Waste. EAHLD11403.	Superficial: Taplow Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	Yes, via excavation through waste
Shaft 13	No. Closest located 300-350m west.	-	Superficial: Taplow Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 14	No. Closest located 150-200m South West.	-	Superficial: Kempton Park Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 15	Yes. Located within historic landfill.	Kempton Park Gravel Pit. Reference: EAHLD11741. Inert landfill. Last input 1981.	Superficial: Kempton Park Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	Yes, via excavation through waste
Shaft 16	Yes. Located within historic landfill.		Superficial: Kempton Park Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	Yes, via excavation through waste
Shaft 17	No. Closest located <50m North.	-	Superficial: Kempton Park Gravel Member – Sand and Gravel. Bedrock: London Clay Formation – clay and silt.	None

Location	Close to waste?	Historic landfill / type of waste	Geology	Potential pathway
Shaft 18	No. Closest located 300-350m South-East.	-	Superficial: Shepperton Gravel Member – sand and gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 19	No. Closest located 300-350m South-East.	-	Superficial: Shepperton Gravel Member – sand and gravel. Bedrock: London Clay Formation – clay and silt.	None
Shaft 20	No. Closest located 100-150m North.	-	Superficial: Alluvium – clay, silt, sand and gravel. Bedrock: Claygate Member – sand, silt and clay.	None
Tunnel length between shafts 15 and 16	Yes, located within landfill.	Kempton Park Gravel Pit. Reference: EAHLD11741. Inert landfill. Last input 1981.	Superficial: Kempton Park Gravel Member – Sand and Gravel. (Although now anticipated to be waste / made ground). Bedrock: London Clay Formation – clay and silt.	Yes, via excavation through waste
Tunnel length between shafts 17 and 18	Yes. Located along 900-950m of route.	Vicarage Farm. Reference: EAHLD11743. Inert landfill. Last input April 1979.	Superficial: Kempton Park Gravel Member – Sand and Gravel. (Although now anticipated to be waste / made ground). Bedrock: London Clay Formation – clay and silt.	Yes, via excavation through waste
Tunnel length between shafts 19 and end of route	Yes. Located within landfill.	Fordbridge Road. Reference: EAHLD11576. Industrial waste. Last Input 1993.	Superficial: Shepperton Gravel Member – sand and gravel. Bedrock: London Clay Formation – clay and silt.	Yes, via excavation through waste
Tunnel length between shafts 19 and end of route	Yes. Located within landfill.	Fordbridge Road. Reference: EAHLD11577. Industrial waste. Last Input 1993.	Superficial: Shepperton Gravel Member – sand and gravel. Bedrock: London Clay Formation – clay and silt.	Yes, via excavation through waste

Further work will be required for Gate 3 to establish what baseline evidence local planning authorities hold, complete the necessary Envirocheck requests and understand the likelihood of needing preliminary site investigations.

8.2.5.2 Summary of receptors

The hydrogeological properties of the main geological strata are listed below based on the Defra MAGIC aquifer designation map[39]. Secondary A and Secondary Undifferentiated Aquifers are vulnerable to leaching of ground contamination as they may be important in supporting local abstractions or providing baseflow to rivers and streams. Groundwater sampling should be undertaken during ground investigation to confirm the risk.

Geology:

Superficial deposits:

- Alluvium – Secondary Undifferentiated
- Taplow Gravel Member – Secondary A Aquifer
- Langley Silt Member – Unproductive Stratum

- Shepperton Gravel Member – Secondary A Aquifer
- Kempton Park gravel member – Secondary A Aquifer

Bedrock geology:

London Clay Formation is an unproductive stratum which acts as a natural sealant preventing leaching of ground contaminants to groundwater. There is a covering of about 12m of London Clay Formation which will prevent downward migration of contamination and protect the Chalk stratum. Should the proposed conveyance penetrate the base of the London Clay Formation, groundwater sampling and detailed risk assessment should be undertaken to confirm the risk.

Excavating landfill areas as identified in **Table 8-5** will pose a significant ground gas risk and groundwater risk as the landfill condition and engineering is unknown. Therefore, construction workers, nearby occupants and groundwater will be impacted.

8.2.6 Transport

The same approach as outlined for the Beckton water recycling scheme, Section 7.2.6, was applied to the Mogden water recycling scheme. A map of traffic count points used to determine relative increases in traffic flows because of the construction of the Mogden water recycling scheme is shown in **Figure 8-1.**

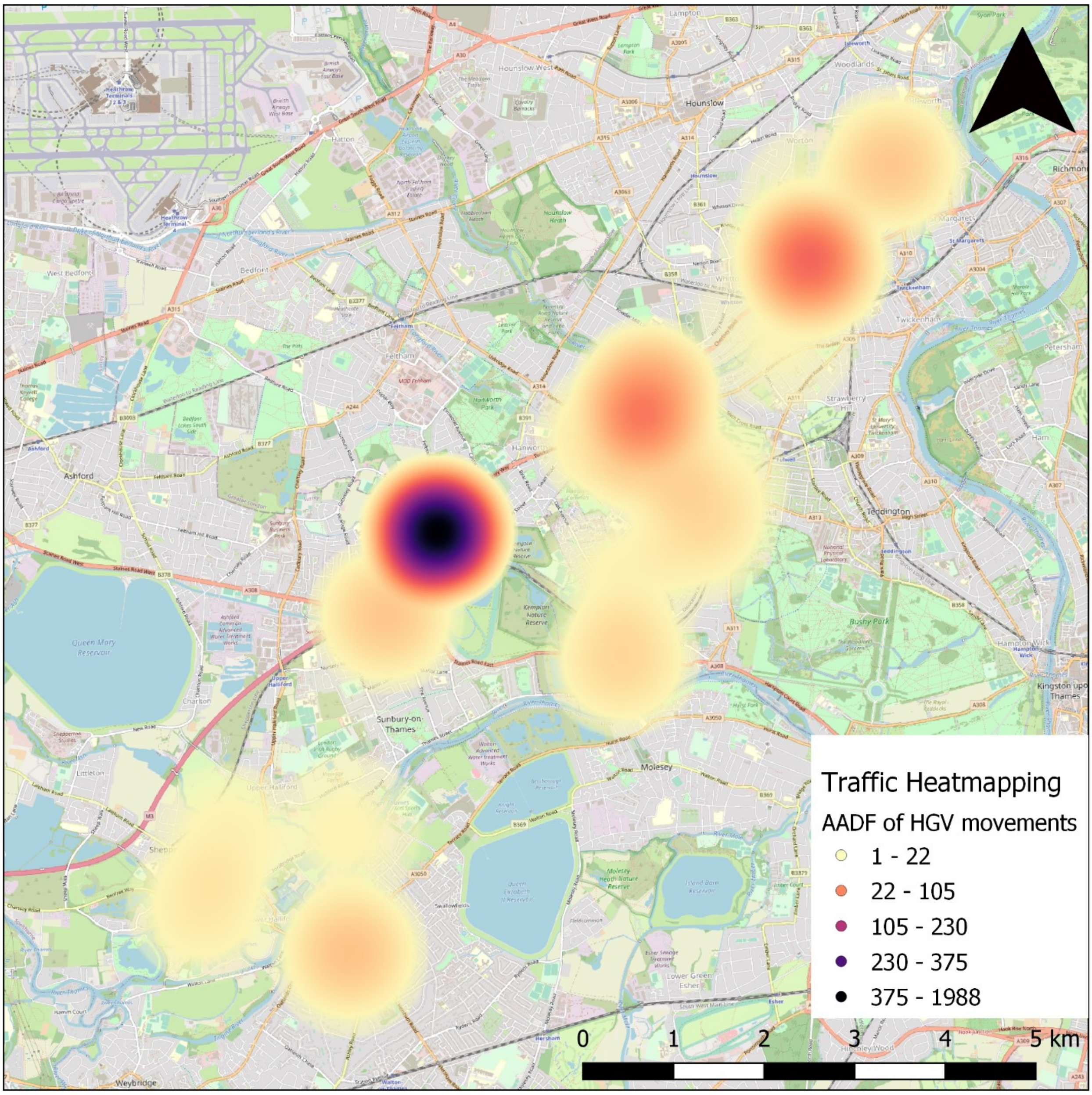
As these traffic count points are located on roads of different natures, they have very different traffic compositions. A heatmap, showing the relative numbers of HGV movements past each of these points, is shown in **Figure 8-2**.

Figure 8-2 clearly shows that HGV movements are largest on Chertsey Road (A316), likely due to the A316 being a major traffic route into Greater and Central London. The area around Mogden STW also experiences elevated HGV levels, likely due to large areas of industry in that area. The areas to the south, around Sunbury-on-Thames and Walton-on-Thames, experience many less HGV movements. These areas are predominantly residential, with smaller roads that in the north of the study area.

Figure 8-2 shows therefore that increases in HGV movements are more likely to be noticeable, and cause material impacts, in the areas to the southwest of the scheme area, around Walton-on-Thames. This is the area.

Figure 8-1 Mogden water recycling scheme: traffic count points

Figure 8-2 Mogden water recycling scheme: baseline HGV movements for the construction area



8.2.7 Navigation

No specific baseline survey work has been undertaken at Gate 2 to complete the assessment. Information on the pathway for impacts has been drawn from the physical environment assessment and modelling the change in flows under the worst-case scenarios, to determine where there would be any limitation on the ability of vessels of various draughts, to navigate in the upper Tideway around low water when the London Water Recycling scheme is in operation. The approach and findings have been consulted on with the PLA.

The scope of the navigation assessment at Gate 2 has focussed on the operation impacts only. If barges are to be used during the construction phase, further assessment of the types and numbers of barges to be used, berthing requirements, and the impacts of these movements on users of navigable waters will be required.

8.2.8 Noise

8.2.8.1 Baseline

The same approach to establishing a baseline, as outlined for the Beckton water recycling scheme (Section 7.2.8) was applied to the Mogden water recycling scheme.

An estimated ambient noise level was assigned to the sensitive receptors nearest to each of the proposed shaft and structure construction sites and to receptors along the sections of trenched pipeline.

At this initial stage of technical studies, baseline night time noise levels have not been considered but may be required at a later stage if night time construction works are likely to be needed.

8.2.8.2 Summary of receptors

Receptors identified at this initial appraisal stage are those nearest to each of the construction site locations. Mapping has been used to identify the nearest receptors and to determine the distance from the construction sites, as listed in **Table 8-6**.

Table 8-6 Mogden water recycling scheme: noise receptors and estimated distance from construction sites

Construction sites – Mogden water recycling	Nearest Receptors	Closest distance to site (m)
Mogden Shaft	Beaumont Place, Trevor Close, Hillary Drive	50-100
Shaft 2	Harlequin Close	50-100
Shaft 3	Chase Bridge Primary School	<50
Shaft 4	Rosecroft Gardens	50-100
Shaft 5	Meadway, Post Lane, Park Crescent	<50
Shaft 6	Crane Park Road	50-100
Shaft 7	Uxbridge Road	50-100
Shaft 8	Stourton Avenue, Wordsworth Road	<50
Shaft 9	Armstrong Road, Green Lane	<50
Shaft 10	Sonning Gardens, Victors Drive	100-150
AWRP Shaft	Hatherop Road	400-450
AWRP/Pipeline Start 12	St Mary's Hampton PS	250-300
Pipeline 12-13	Staines Road East	<50
Shaft 13	Staines Road East, Elm Drive	<50
Pipeline 13-14	The Markway	<50
Shaft 14	Oakington Drive, The Markway	<50
Pipeline 14 - French St.	Oakington Drive, Ilex Close	<50
Pipeline French St - The Avenue	Sunna Gardens, Saxonbury Avenue	<50
Pipeline The Avenue - Green St	Hawkewood Road, Vereker Drive, Queensway	<50
Pipeline Hazelwood Drive - School Walk	Croysdale Avenue, Hazelwood Drive, Hawkedale PS	<50
Pipeline School Walk - Shaft 15	Russett Avenue, Minsterley Avenue	50-100
Shaft 15/16	Park Homes Beasleys Ait Lane	150-200
Pipeline Fordbridge Road	Watersplash Cottages	<50
Pipeline Walton Bridge Road	Walton Bridge Road	<50
Outfall Structure	Swan Walk	<50

8.2.9 Air quality

8.2.9.1 Baseline

The same approach to establishing a baseline, as outlined for the Beckton water recycling scheme (Section 7.2.9) was applied to the Mogden water recycling scheme.

All the local authorities within the boundary of the Mogden water recycling scheme employ the use of NO_2 diffusion tubes (DT) at a range of locations across their authority and some also employ the use of automatic monitoring (AM) stations which measure (NO_2, PM_{10} and $PM_{2.5}$) [70].

Details of the closest monitoring sites (within 1km for DT and within 3km for AM) which monitor annual mean NO_2, hourly mean NO_2, annual mean PM_{10}, daily mean PM_{10} and annual mean $PM_{2.5}$ are presented in the tables within **Appendix 4**. The findings of the data review are as follows:

- **Annual mean NO_2 concentrations** at the monitoring sites have reduced with each year. Using the pre-covid year of 2019, the annual mean NO_2 concentrations still remain mostly below the National Air Quality Objective (NAQO) of 40 µg/m³ except at six sites in Richmond[71].
- **NO_2 hourly mean NAQO** was achieved at all the nearby automatic monitors, with a maximum number of hourly exceedances of 200µg/m³ for two hours at Haslet Road in 2019. This is much lower than the 18 times a year stipulated in the NAQO. The annual mean NO_2 concentrations at the monitoring sites are less than 60 µg/m³ at all the diffusion tubes, and in accordance with Defra guidance for local air quality management, it is expected that the hourly mean objective would also be achieved.
- **Annual mean PM_{10} concentrations** at the automatic monitoring sites are within the NAQO of 40 µg/m³ at all nearby sites with a maximum concentration of 21 µg/m³.
- **PM_{10} daily mean NAQO** was achieved at all the nearby automatic monitors with a maximum number of daily exceedances of 50µg/m³ experienced for 9 days at Haslet Road in 2019. This is much lower than the 35 times a year stipulated in the NAQO.
- **Annual mean $PM_{2.5}$ concentrations** at the nearby automatic monitoring sites are within the NAQO of 25 µg/m³ at all nearby sites with a maximum concentration of 12.9 µg/m³ at Haslet Road in 2019. However, the annual mean $PM_{2.5}$ exceed the proposed Environment Act 2021 target of 10µg/m³ at most of the nearby sites.
- **Background concentrations** are all well within the annual mean NAQOs for all pollutants in 2018 except for the vegetation protection guideline for NO_x. $PM_{2.5}$ complies with the NAQO of 25µg/m³ but is above the proposed Environment Act 2021 target of 10µg/m³.

8.2.9.2 Summary of receptors

Table 8-7 below summarises the locations of the scheme, relevant LAs and nearby sensitive ecological land uses (within 10km for international habitats (SAC, SPA and Ramsar) and 2km for all other habitat types (SSSIs)) and nearest receptors.

Table 8-7 Mogden water recycling scheme: air quality – relevant Local Authorities, human and ecological receptors

	Mogden water recycling
Nearby ecological receptors	**SPA sites** South West London Waterbodies SPA Thames Basin Heaths SPA **Ramsar sites** South West London Waterbodies Ramsar **SAC sites** Richmond Park SAC Wimbledon Common SAC **SSSI sites** Kempton Park Reservoirs SSSI Knight & Bessborough Reservoirs SSSI Bushy Park and Home Park SSSI Syon Park SSSI

[70] NO_2 nitrogen dioxide, PM_{10} Particles, $PM_{2.5}$ Fine Particles, NO_x oxides of nitrogen.

[71] The year 2020 is unlikely to be representative of a typical yearly concentration due to the Covid lockdown restrictions

	Mogden water recycling
Indicative Nearby human receptors	Properties in Sunbury-on-Thames area, Hanworth area, Lower Halliford and Upper Halliford area, Mogden Lane including Laughton Drive, Meadway, Twickenham Road, Hamworth Road, Oak Avenue, Green Lane, Stewards Close, Elm Drive, Harfield Road, French Street, Walton Lane, Russel Road, Staines Road East Hampton Lane etc. Schools - Royal Military School of Music, Hampton School, St Marys Hampton CE Primary School
Local Authority	Spelthorne Borough Council London Borough of Hounslow London Borough of Richmond upon Thames Adjacent to Elmbridge Borough Council

The number of human receptors and ecological receptors within distances specified in the methodology for assessing the dust and traffic impacts are detailed in **Table 8-8** and **Table 8-9**. This information is then used to undertake the risk assessment.

Table 8-8 Mogden water recycling scheme: number of human receptors within 350m

Human receptors	Number
Number of receptors within 20m	538
Number of receptors within 50m	1,401
Number of receptors within 100m	2,849
Number of receptors within 350m	12,883

Table 8-9 Mogden water recycling scheme: number of ecological receptors within 50m

Ecological receptors	Number of SPA	ID – SPA name	Number of Ramsar	ID – Ramsar name	Number of SSSI	ID – SSSI name
Number of receptors within 20m	2	401 - South West London Waterbodies 400 - South West London Waterbodies	2	474 - South West London Waterbodies 475 - South West London Waterbodies	2	6869 - Kempton Park Reservoirs 6882 -Kempton Park Reservoirs
Number of receptors within 50m	2	401 - South West London Waterbodies 400 - South West London Waterbodies	2	474 - South West London Waterbodies 475 - South West London Waterbodies	2	6869 - Kempton Park Reservoirs 6882 - Kempton Park Reservoirs

8.2.10 People and communities

8.2.10.1 Socio-economics

The Mogden water recycling scheme covers three LAs in London and Surrey; London Borough of Hounslow, London Borough of Richmond upon Thames and Spelthorne Borough Council. Current populations estimates in these LAs, London and England from the 2021 Census are highlighted in **Table 8-10.**

Table 8-10 Mogden water recycling scheme: total population by area[72]

Area	Population
Hounslow	288,000
Richmond upon Thames	195,200
Spelthorne	103,000
London	8,799,800
England	56,489,800

Table 8-11 shows further baseline data on the demographic distribution of population by age and gender in the reaches that will be impacted by the Mogden water recycling scheme.

Table 8-11 Mogden water recycling scheme: population distribution by age and gender[73]

Area	Female Population	Male Population	Ages 0-19	Ages 20+
Hounslow	145,000	143,100	72,200	216,100
Richmond upon Thames	101,300	93,900	47,200	148,000
Spelthorne	52,300	50,600	23,600	79,200
London	4,531,500	4,268,300	2,085,300	6,714,500
England	28,833,500	27,656,300	13,057,600	43,432,100

Table 8-12 highlights the percentage proportion of ethnic diversity within the assessment area, London and England.

Table 8-12 Mogden water recycling scheme: ethnicity per area[74]

Area	White British	All White Other	Mixed Ethnic Groups	Asian/Asian British	Black/African/ Caribbean/ Black British	Other Ethnicity Group
Hounslow	33.58%	16.42%	2.61%	35.07%	5.60%	6.72%
Richmond upon Thames	72.31%	14.36%	3.59%	5.13%	1.54%	3.08%
Spelthorne	75.51%	9.18%	4.08%	9.18%	1.02%	1.02%
London	43.80%	15.57%	3.72%	18.37%	12.49%	6.06%
England	78.74%	6.16%	1.75%	7.95%	3.52%	1.87%

London is a heavily built up area with typically high population density. **Table 8-13** shows the population density of the LAs within the Mogden water recycling scheme area compared with London and England.

[72] Office for National Statistics (2021) Census 2021. P01. Available at: https://census.gov.uk/census-2021-results
[73] Office for National Statistics (2021) Census 2021. P02. Available at: https://census.gov.uk/census-2021-results
[74] Office for National Statistics (2021) Population estimates by ethnic group and religion, England and Wales: 2019. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/populationestimatesbyethnicgroupandreligionenglandandwales/2019

Table 8-13 Mogden water recycling scheme: population density by area[75]

Area	Population Density (number of residents per km^2)	Households
Hounslow	5,150	103,000
Richmond upon Thames	3,401	80,700
Spelthorne	2,295	41,800
London	5,598	3,423,800
England	434	23,435,700

The economic profile of the LAs that will be impacted during construction and operation of the Mogden water recycling scheme are highlighted in **Table 8-14**.

Table 8-14 Mogden water recycling scheme: economic profile[76][77][78]

Area	Percentage of people in employment (2020/2021)	Children in low-income families (under 16)	Mean Annual Gross Pay
Hounslow	72.8%	13.8%	£33,890
Richmond upon Thames	75.6%	8.5%	£54,688
Spelthorne	76.5%	12.6%	£31,457 (median)
London	74.5%	18.8%	£42,001
England	75.1%	17.0%	£32,049

8.2.10.2 Human health

Life expectancy at birth is one of the main indicators used to determine the status of health and economic development amongst a demographic. **Table 8-15** shows the life expectancy and mortality rate of the local authorities within the Mogden water recycling scheme area compared with London and England.

The London Borough of Richmond upon Thames has a life expectancy significantly higher than that of the National and Regional average. Under 75 mortality rate and percentage of physically active adults has the ability to measure the fitness and health of a local community profile. The London Borough of Hounslow has a lower percentage of adults that are physically active as well as an above average under 75 mortality rate for the London LAs.

[75] Office for National Statistics (2021) Census 2021. P04. Available at: https://census.gov.uk/census-2021-results

[76] Office for National Statistics (2022) Labour Force Survey. Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/methodologies/labourforcesurveyuserguidance

[77] HMRC (2022) Personal Tax Credits: Child Poverty Statistics. Available at: https://www.gov.uk/government/collections/personal-tax-credits-statistics

[78] Office for National Statistics (2021) Earnings and hours worked, place of residence by local authority. Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/placeofresidencebylocalauthorityashetable8

Table 8-15 Mogden water recycling scheme: health and wellbeing[79][80][81]

Area	Life Expectancy at Birth (Male)	Life Expectancy at Birth (Female)	Under 75 mortality rate from all causes (per 100,000)	Percentage of Physically active adults (2020/2021)
Hounslow	79.4	83.7	332.2	57.9%
Richmond upon Thames	82.2	86.4	236.3	74.0%
Spelthorne	80.4	83.9	290.4	64.1%
London	80.3	84.3	316.1	64.9%
England	79.4	83.1	336.5	65.9%

8.2.10.3 Index of multiple deprivation

The Index of Multiple Deprivation[82] is the official measure of relative deprivation in England which combines information from the seven domains (Income Deprivation; Employment Deprivation: Education, Skills and Training Deprivation; Health Deprivation and Disability; Crime; Barriers to Housing and Services; and Living Environment Deprivation).

Where each local authority ranks nationally based on the average score achieved is highlighted in **Table 8-16**. The average score measure is calculated by averaging the LSOA ranks in each larger area after being weighted by population. A rank of 1 (out of 317) represents the highest average score equating to the highest area of deprivation. Both London Borough of Richmond upon Thames and Spelthorne Borough Council are ranked in the 50% least deprived areas nationally with London Borough of Richmond upon Thames one of the least deprived areas in the country. London Borough of Hounslow ranks higher compared to the other local authorities affected by the Mogden water recycling scheme.

Also included in **Table 8-16** are the proportion of Lower Layer Super Output Areas (LSOAs) in the most deprived 10% nationally. A small proportion (0.7%) of London Borough of Hounslow is in the most deprived 10% nationally.

Table 8-16 Mogden water recycling scheme: index of multiple deprivation

Area	IMD 2019 – Local Authority Rank	IMD 2019 – Proportion of LSOAs in most deprived 10% nationally
Hounslow	95	0.07%
Richmond upon Thames	297	0.00%
Spelthorne	201	0.00%

8.2.10.4 Cultural infrastructure

Table 8-17 shows the cultural infrastructure, as defined within the London Cultural Infrastructure Plan, that is within 500m of a construction site associated with the Mogden water recycling scheme. These cultural assets are important for a number of reasons; they support local culture and identity, they support jobs and businesses and they help to maintain London's status as a global centre of culture.

---

[79] ONS (2021) Life Expectancy Estimates. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/datasets/lifeexpectancyestimatesallagesuk

[80] Office for Health Improvement and Disparities (2021) Mortality Profiles. Available at: https://www.gov.uk/government/statistics/mortality-profile-december-2021

[81] Office for Health Improvement and Disparities (2022) Physical Activity. Available at: https://www.gov.uk/government/statistics/physical-activity-data-tool-january-2022-update

[82] Ministry of Housing, Communities & Local Government (2019) English Indices of Deprivation 2019. Available at: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019

These assets may be impacted by construction in a number of different ways;

- The setting of them could be impacted by construction work nearby, lowering their attractiveness to visitors and the community;
- They may become temporarily more difficult to access due to nearby construction work causing road closures, diversions, or by increasing traffic volume;
- An increase in land purchasing in an area may result in an increase in land value, meaning cultural assets may begin to be displaced.

Table 8-17 Mogden water recycling scheme: cultural Infrastructure within 500m of infrastructure

Name	Type	Ward
The Bridgelink Centre	Community Centre	Isleworth
Crane Community Centre	Community Centre	West Twickenham
Whitton Community Centre	Community Centre	Heathfield
DERA Social Centre	Community Centre	Whitton
Richmond Upon Thames College	Dance Studio	St Margaret's and North Twickenham
Heathfield Library Access Point	Library	Heathfield
Museum of Army Music	Museum / Library	Whitton
World Rugby Museum	Museum / Library	St Margaret's and North Twickenham
Sussex Arms	Music Venue / Pub	West Twickenham
Royal Oak	Pub	Hampton North
Prince Blucher	Pub	South Twickenham
TW2 Bar & Grill	Pub	South Twickenham
Bloomsbury	Pub	West Twickenham
Winning Post	Pub	Heathfield

8.3 ASSESSMENT

8.3.1 Water

Refer to ***Annex B.2.1. Physical Environment Assessment Report*** and ***Annex B2.2. Water Quality Assessment Report*** for full details.

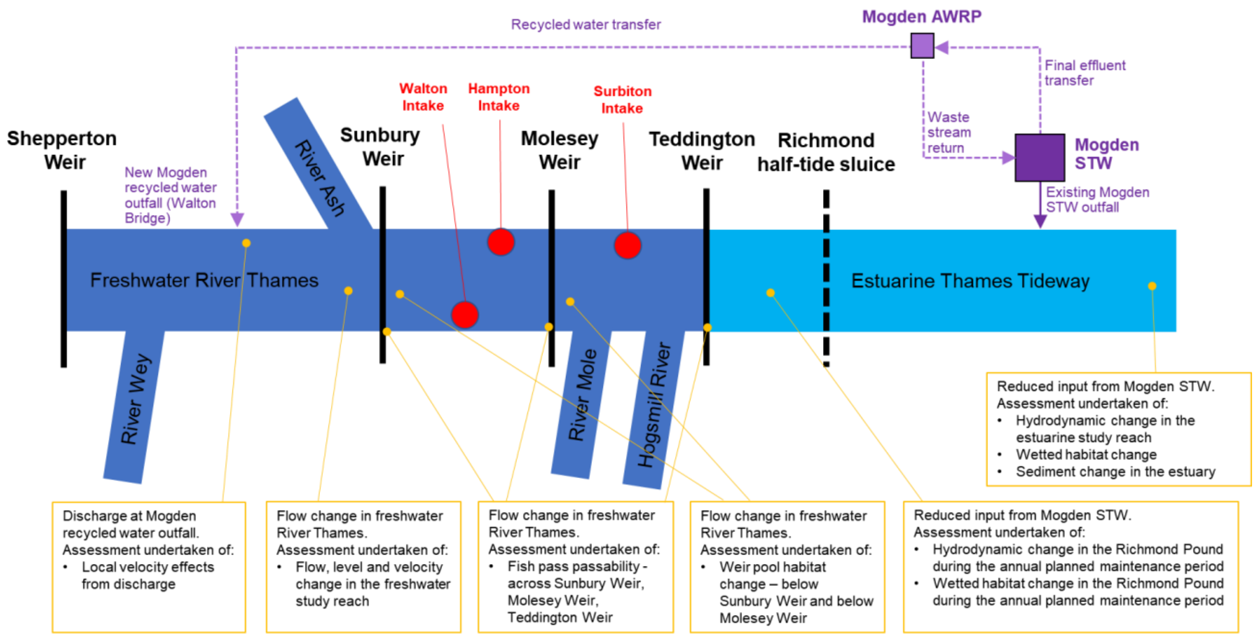
8.3.1.1 Physical Environment

8.3.1.1.1 Activities and pathways for impact

The physical environment assessment for the Mogden water recycling scheme considered the following points, and summarised in **Figure 8-3:**

- Flow changes from Mogden water recycling schemes;
- Review of Mogden water recycling outfall design including screening;
- Wetted habitat change in freshwater River Thames and estuarine Thames Tideway;
- Sunbury Weir, Molesey Weir and Teddington Weir fish pass and barrier passability;
- Richmond Pound drawdown physical environment assessment; and
- Thames Tideway estuarine sediment assessment.

Figure 8-3 Representation of the Mogden water recycling scheme study area with conceptualisation of physical environment effects and listing of assessment undertaken for Gate 2



8.3.1.1.2 Impact risk and additional mitigation requirements

The Mogden water recycling scheme may lead to up to moderate impacts on flows when compared to the baseline conditions in the River Thames. However, these changes are negligible when considering impacts to water level depth and average flow velocities. Additionally, the data indicates that there are negligible impacts on fish pass barrier possibility, negligible impacts on the Richmond Pound and on wetted habitat, water level and suspended sediment concentration in the Thames Tideway.

Table 8-18 summarises the potential physical environment impacts for each of the sizes of a Mogden water recycling scheme.

Table 8-18 Mogden water recycling scheme: summary of potential physical environment impacts

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Flows	3.4km reach (Walton Bridge outfall to Walton intake	**50 Ml/d** 5% increase in very low flows (Q95)	G	Not required.
		100 Ml/d 11% increase in very low flows (Q95)	G	Not required.
		150 Ml/d 16% increase in very low flows (Q95)	G	Not required.
		200 Ml/d 21% increase in very low flows (Q95) with main flow	G	Not required.
	5.4km downstream of outfall (Hampton intake)	**50, 100, 150 and 200 Ml/d** No change in flows.	G	Not required.
Outfall design	Freshwater River Thames	**50, 100 and 150 Ml/d** Negligible; plume velocity characteristics inferred from larger schemes modelling.	G	Not required.
		200 Ml/d Negligible. Increased velocities from plume of (0.05-0.075m/s) stretches	G	Not required.

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
		downstream to around 260m for discharge into 970 Ml/d (Q91) scenario.		
Wetted habitat	Sunbury Weir pool	**50, 100, 150 and 200 Ml/d** Very minor increase in flow velocities in Sunbury Weir pool.	G	Not required.
	Molesey Weir pool	**50, 100, 150 and 200 Ml/d** No change in wetted habitats modelled in Molesey Weir pool as no expected change in flows over Molesey Weir.	G	Not required.
	Teddington Weir	**50, 100, 150 and 200 Ml/d** No change in wetted habitats modelled in Teddington Weir pool as no expected change in flow.	G	Not required.
	Estuarine Thames Tideway	**50, 100, 150 and 200 Ml/d** Negligible changes in exposure of estuarine wetted habitat inferred from larger schemes modelling.	G	Not required.
Barrier passability	Freshwater River Thames	**50, 100 and 150 Ml/d** Negligible change in river levels for scheme when compared to baseline	G	Not required.
	Freshwater River Thames	**200 Ml/d** Negligible change of between 0-0.04m in river levels for scheme when compared to baseline.	G	Not required
Richmond Pound drawdown	Freshwater River Thames	Negligible changes in physical environment within Richmond Pound under all sizes,	G	Not required.
Estuarine sediment	Estuarine Thames Tideway	Negligible changes in suspended solids concentration within the estuary.	G	Not required.

8.3.1.2 Water quality

8.3.1.2.1 Activities and pathways for impact

The following assessments were completed to assess the water quality impacts of the Mogden water recycling scheme:

The assessments have been undertaken for the following for each task:

- Source water of Mogden STW final effluent including effluent temperature, general physico-chemical parameters, and effluent chemicals, including olfactory inhibitors.
- Water temperature across the freshwater River Thames and estuarine Thames Tideway.
- WFD physico-chemical supporting elements to ecological status, including dissolved oxygen saturation, total ammonia, reactive phosphorus, water temperature, pH and BOD across the freshwater River Thames and estuarine Thames Tideway.
- WFD chemical suite across the freshwater River Thames and estuarine Thames Tideway.
- Olfactory water quality, including those determinands which were added for the assessment at Gate 2 and for which data was available.
- Richmond Pound drawdown water quality, including water temperature, conductivity, and dissolved oxygen for the Thames Tideway reach between Teddington Weir and Richmond Half-tide Sluice for the period without tidal level management.

The Mogden water recycling scheme may lead up to minor changes in the general physico-chemical environment compared to the baseline conditions of the River Thames. The schemes sized up to 150 Ml/d have a negligible impact on WFD chemicals, EQSD chemicals and Olfactory water quality. The 200 Ml/d scheme induces some minor changes in the physico-chemical environment.

8.3.1.2.2 Impact risk and additional mitigation requirements

Table 8-19 summarises the potential water quality impacts for each of the sizes of a Mogden water recycling scheme.

Table 8-19 Mogden water recycling scheme: summary of potential water quality impacts

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Water temperature	Freshwater River Thames	**50, 100, 150 and 200 Ml/d** Negligible change.	G	None required.
	Estuarine Thames	**50, 100 and 150 Ml/d** Negligible change.		
		200 Ml/d ~1°C change.	G	None required.
General physico-chemical	Freshwater River Thames	**50, 100 and 150 Ml/d** Negligible general physio-chemical characteristics inferred from larger schemes modelling.	G	None required.
		200 Ml/d Ammoniacal nitrogen: A82 - minor changes with both increases and decreases on pressure. M96 - added pressure at 90%ile. M96 future; minor added pressure. Oxygen saturation: A82 - reduced pressure at Mogden water recycling outfall. M96 - minor changes with reduction at Mogden water recycling outfall. M96 future; increase in pressure. Suspended Solids: A82 - Minor increase in pressure from suspended solids at 25%ile, minor decrease at 75%ile. M96 - increase in pressure across all percentiles.M96 future; decrease in pressure across all percentiles. Phosphorous: Decrease in pressure across all scenarios and percentiles. Water temperature: Minor increase in pressure across all scenarios and percentiles. Hardness: Increase in 48mg/l ANC: No change affected by scheme in operation. pH: No change affected by scheme in operation. Langelier Saturation Index: LSI of 0 is achievable.	G	None required.
	Estuarine Thames	**50, 100, 150 and 200 Ml/d** Salinity: There is a minor increase in salinity under both scenarios. DIN: There is a decrease in pressure with a decrease in DIN under both scenarios.	A	None required.
WFD chemicals	Freshwater River Thames	**50, 100 and 150 Ml/d** The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	G	None required.
		200 Ml/d The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would	G	None required.

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
		be without chemicals, except those added by the re-mineralisation process.		
	Estuarine Thames	**50, 100 and 150 Ml/d** Negligible WFD chemicals inferred from larger schemes modelling.	G	None required.
		200 Ml/d 15 determinants were exceeding standards under reference conditions. Seven continued to exceed standards under the A82 scenario and eight new pressures exceeded standards. The same occurs in the M96 scenario with one additional pressure.	G	None required.
EQSD chemicals	Freshwater River Thames	**50, 100 and 150 Ml/d** The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	G	None required.
		200 Ml/d The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	G	None required.
	Estuarine Thames	**50, 100 and 150 Ml/d** Negligible EQSD chemicals inferred from larger schemes modelling.	G	None required.
		200 Ml/d A82 and M96 estuary; three new chemical exceedances.	G	None required.
Olfactory water quality	Freshwater River Thames	**50, 100 Ml/d and 150 Ml/d** Negligible Olfactory water quality inferred from larger schemes modelling.	G	None required.
		200 Ml/d The reverse osmosis process in the AWRP would treat the recycled water of the Beckton water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process.	G	None required.
	Estuarine Thames	**50, 100 and 150 Ml/d** Negligible Olfactory water quality inferred from larger schemes modelling.	G	None required.
		200 Ml/d A82 and M96 have five exceedances which is the same number present at baseline.	G	None required.
Richmond Pound Drawdown	All receptors	Negligible changes on all schemes up to 200Ml/d. The 200Ml/d scheme shows negligible effects, but the changes are the following; Salinity – a maximum increase of 0.55ppt under both A82 and M96 scenarios. Suspended sediment – a maximum decrease of 0.045 and 0.015kg/m^3 under the A82 and M96 scenarios (respectively). Temperature – a maximum increase of 0.1°C under both the A82 and M96 scenario, and a maximum increase of 1°C under both the A82 and M96 scenarios.	G	None required.

8.3.1.3 Flood risk

8.3.1.3.1 Activities and pathways for impact

The same activities and pathways for impact, as identified for the Beckton water recycling scheme in Section 7.3.1.3.1 are applicable to the Mogden water recycling scheme.

8.3.1.3.2 Impact risk and additional mitigation requirements

Further definition has been applied to the RAG criteria, relevant to each type flooding. This is provided in **Appendix 5**.

8.3.1.3.2.1 Construction

Without mitigation, the construction related impacts have the potential to have an Amber RAG rating at sites where there is a high flood risk or where the construction phase would displace floodwater elsewhere by increasing surface water runoff or taking up floodplain storage. Best practice flood risk construction measures, as outlined in Section 7.3.1.3.2 should be employed.

8.3.1.3.2.2 Operation

Flood Zones

Out of the 17 sites assessed, two sites are classified as having a red RAG rating and three sites are classified as having an amber RAG rating. The sites with a red or amber rating are shown in **Table 8-20**. Additional mitigation requirements as outlined in Section 7.3.1.3 will be required for those sites identified as red/amber RAG.

Table 8-20 Mogden water recycling scheme: Flood Zone RAG Results

Assessment	Sites
Red	Shaft 14
	Shaft 15
Amber	New AWRP site near Kempton WTW
	Shaft 2
	Shaft 3

Surface Water

Out of the 17 sites assessed, four sites are classified as having a red RAG rating and 11 sites are classified as having an amber RAG rating. The sites with a red or amber rating are shown in **Table 8-21**. Additional mitigation requirements as outlined in Section 7.3.1.3 will be required for those sites identified as red/amber RAG.

Table 8-21 Mogden water recycling scheme: surface water RAG results

Assessment	Sites	Reason
Red	New AWRP site near Kempton WTW	Site containing areas classified as having a high surface water flood risk in the EA surface water maps; Proposed development introducing significant impermeable areas to the site (increase of more than 0.2ha).
	Shaft 2	Site located in a critical drainage area.
	Shaft 3	Site located in a critical drainage area.
	Shaft 13	Site containing areas classified as having a high surface water flood risk in the EA surface water maps.
Amber	Shaft 1	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).

Assessment	Sites	Reason
	Shaft 2	Site containing areas classified as having a medium surface water flood risk in the EA surface water maps.
	Shaft 4	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 5	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 6	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 8	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 9	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 10	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 12	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 14	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).
	Shaft 15	Proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha).

Other Flood Sources

Out of the 17 sites assessed, nine sites are classified as having a red RAG rating and six sites are classified as having an amber RAG rating. The red and amber ratings are all linked to groundwater flood risk. The sites with a red or amber rating are shown in **Table 8-22**. Additional mitigation requirements for these sites are as outlined in Section 7.3.1.3.

Table 8-22 Mogden water recycling scheme: other flood sources RAG results

Assessment	Sites
Red	Shaft 2
	Shaft 3
	Shaft 4
	Shaft 5
	Shaft 6
	Shaft 12
	Shaft 13
	Shaft 14
	Shaft 15
Amber	New AWRP site near Kempton WTW
	Shaft 1

Assessment	Sites
	Shaft 7
	Shaft 8
	Shaft 16
	Final Effluent Pumping Station

River Flows

The Mogden water recycling options will increase flows in the River Thames of up to 200 Ml/d (2.3m³/s) at the Walton Bridge discharge. These flow changes will only occur during periods of low flow.

The flow statistics for the River Thames at Walton (Ref. 39121) National River Flow Archive gauge are provided in **Table 8-23**. This shows that an increase in flows of 2.3m³/s will not significantly increase low flows to present a flood risk as the flows remain below existing Q50 flows.

Table 8-23 Thames at Walton (Ref. 39121) NRFA Flow Statistics

Percentile Flow	Baseline Flow (m³/s)	Proposed Flow when Scheme is Operational (m³/s)
Q95	9.85	12.15
Q70	17	19.3
Q50	32.6	-
Q10	143	-
Q5	200	-

During higher flows, a reduced sweetening flow will continue to be discharged. However, this will be suspended during high flow events so that this will not increase flood risk. Therefore, the change in River Thames flows as a result of the Mogden water recycling scheme has a Green RAG rating for flood risk.

8.3.2 Biodiversity

Refer to ***Annex B.2.3. Fish Assessment Report***, ***Annex B2.4. Aquatic Ecology Assessment Report***, ***Annex B2.5 INNS Report*** and ***B2.6. Terrestrial Ecology Assessment Report*** for full details.

8.3.2.1 Fisheries

The purpose of fish assessment report is to identify the source of greatest potential magnitude of change that a London Effluent Reuse SRO might cause within that reach, and then assess the potential for change to the fish community present within that reach and also in relation to any migratory species present or moving through the reach.

8.3.2.1.1 Activities and pathways for impact

The Mogden water recycling scheme fish assessment has covered the following sections:

- Freshwater fish
- Weir pool/marginal habitat (including Sunbury creek)
- Estuarine fish (including European eel)
- Migratory fish (including European eel)
- European smelt
- Olfactory cues

Impact pathways resulting from implementation of the scheme fall are summarised below:

- Increased velocities and the resulting impact on the upstream and/or downstream migration of Atlantic salmon, sea trout, shad, smelt, lamprey and European eel.

- Increased velocities and the resulting impact on the local migration of coarse fish and brown trout to spawning areas.
- Loss/decrease in habitat quantity and quality due to changes in hydraulics (i.e., increased velocity and depth) resulting in increased competition for space.
- Loss of juvenile and adult habitats within margins due to increase wetted width and velocities, including habitats for lamprey ammocoetes.
- Risk of displacement of juvenile fish due to increased flows.
- Changes in water quality could have a direct impact on fish populations (e.g., mortality as a result of localised dissolved oxygen sags).
- Changes in the availability of food (biofilm, macrophytes, macroinvertebrates) due to increased flows and changes in water quality.

8.3.2.1.2 Impact risk and additional mitigation requirements

The potential changes in flow are not considered to be of a magnitude such that the resident fish communities within the freshwater River Thames or Thames Tideway will be affected. Localised increases in flow may act to reduce the overall accessible habitat for migratory species or may act as an attractant during migrations as species respond to flow related cues during freshwater migrations. However, the potential changes in flows are considered not likely to result in significant impacts to migratory species associated with the Thames Estuary.

The results of the water quality monitoring indicate that the water quality and temperature changes within the freshwater River Thames are likely to result in changes to the freshwater fish community. Impacts to temperature are not likely to exceed the thermal tolerances of species present but may result in impacts to the behaviour of fish species particularly at or close the discharge location where temperatures are highest. Reaches A, B and C fall within the WFD Lower Thames Operational Catchment, which is formed by 17 waterbodies and includes the Thames (Cookham to Egham) and the Thames (Egham to Teddington) waterbodies[83]. The current WFD status of temperature within these waterbodies is moderate which for WFD salmonid waters[84] equates to river temperature as a 98%ile not exceeding 28^{o}C. For river temperature to achieve good then river temperature as a 98%ile should not exceed 23^{o}C.

8.3.2.2 Aquatic ecology

8.3.2.2.1 Activities and pathways for impact

8.3.2.2.1.1 Construction

An assessment of construction related impacts has not been completed at Gate 2, the focus has been around determining where the operational impacts are significant, thereby confirming the size of the scheme to be progressed to Gate 3. Construction impacts are considered to be manageable with best practice construction techniques and a suite of standard mitigation measures which will be confirmed as part of the Gate 3 work.

8.3.2.2.1.2 Operation

In summary, the aquatic ecology assessment has considered changes to:

- Aquatic invertebrates across Reaches B and C in the freshwater River Thames and Reaches D, E and F in the estuarine Thames Tideway
- Marginal habitats across Reaches B and C in the freshwater River Thames
- Macrophytes across Reaches B and C in the freshwater River Thames
- Diatoms across Reaches B and C in the freshwater River Thames and Reach E in the estuarine Thames Tideway
- Macroalgae, Angiosperm and Phytoplankton across Reaches D, E and F in the estuarine Thames Tideway
- Designated and protected sites and species across Reaches B and C in the freshwater River Thames and Reaches D, E and F in the estuarine Thames Tideway

[83] https://environment.data.gov.uk/catchment-planning/

[84] The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015

8.3.2.2.2 Impact risk and additional mitigation requirements

For the scheme sizes 50, 100 and 150 Ml/d, negligible impacts are predicted across all receptors (inferred from the assessment of the 200 Ml/d size), therefore **Table 8-24** includes a summary of the risks anticipated for the 200 Ml/d size only.

There is no macroinvertebrate, macroalgae or diatom data to complete an assessment for Reaches E (Battersea Park to Tower Bridge) and F (Tower Bridge to 3km seawards of Beckton STW). There are no data available to make an assessment on diatoms within Reach D.

Table 8-24 Mogden Efluent Reuse scheme: ssummary of potential aquatic ecology impacts

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Reach B – Affinity Water Walton Intake to Thames Water Walton Intake				
Velocities and flows	Macroinvertebrates, macrophytes	Overall increased flows have the potential to increase the fitness and available habitat for species with a preference or tolerance to faster flows. However, velocity increases appear to be limited to the surface of the watercourse therefore the impact to the benthic communities may be limited.	G	Not required.
	Diatoms	Increased flows at discharge outfall potential to increase fitness and habitat availability for diatom species with high motility. In areas up and downstream of the outfall with reduced flow there will likely be a minor adverse impact on diatom communities with low motility.	G	Not required.
Wetted width	Marginal habitat	There will be the addition of artificial bank face structures (outfall) within the section of the river. Channel bed hydraulic features was assessed to increase in this reach due to the discharge which has been shown to alter flow patterns, introducing more diversity of flow immediately downstream. This change in flow velocity rapidly declines by ~150m downstream of the discharge. There are negligible predicted changes in wetted width, and there are no assessed changes to the channel margin natural indicators.	G	Not required.
Temperature	Macroinvertebrates, macrophytes	Temperature increase not likely to exceed tolerable range. Possible increase in metabolic rates of species present.	G	Not required.
	Diatoms	Temperature increases of up to 0.98 °C may improve the fitness of individual diatom species. Conversely, an increase in temperature also may have negative impacts on diatom communities. It is possible that by increasing temperature, there will be a reduction in optimum conditions for diatom species. Increasing temperatures have also been found to slow or stop division rates within diatom species when upper tolerances have been reached. Therefore, those diatom species with a higher temperature tolerance may outcompete other species.	A	Further assessment required with regards operational regime.
Oxygen saturation	Macroinvertebrates, macrophytes, diatoms	Minor increases in dissolved oxygen under M96 future may result in a general improvement in biological fitness overall within the community, however this is not likely to result in impacts to the invertebrate community within the freshwater River Thames.	G	Not required.
Phosphorous	Macroinvertebrates	The slight decrease in phosphorous predicted downstream of the outfall under A82 conditions are not likely to result in any measurables impact upon invertebrate preference.	G	Not required.
	Diatoms	Changing phosphorus concentrations has shown growth responses in relation to diatoms. Dependent on current phosphorus concentrations, the reduction in concentration downstream could increase growth within the current diatom communities by bringing concentrations below the threshold. However, it could also lead to areas whereby growth rates and cell-division rates decrease, as diatoms are unable to dominate when phosphate is deficient.	A	Further assessment required with regards operational regime.
pH	Macroinvertebrates	The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the invertebrate community. Therefore, there is predicted to be no impact on invertebrates within the freshwater River Thames due to the scheme.	G	Not required.
Reach C – Thames Water Walton Intake to Teddington Weir				
Velocities and flows	Macroinvertebrates, macrophytes	Overall increased flows have the potential to increase the fitness and available habitat for species with a preference or tolerance to faster flows. However, velocity increases appear to be limited to the surface of the watercourse therefore the impact to the benthic communities may be limited.	G	Not required.
	Diatoms	Increased flows immediately adjacent to the discharge outfall may have the potential to increase the fitness and available habitat for species with high motility. With higher motility, diatoms will be able to find and seek refuge in new habitats along the reach. Overall, the motility is relatively low, and therefore diatoms in this reach are likely to be affected in areas whereby there is a reduction in flows.	G	Not required.
Wetted width	Marginal habitat	There are no predicted changes in the flows 5.4km downstream of the outfall (Hampton intake), and as such negligible change predicted to the RCA indicators.	G	Not required.
Temperature	Macroinvertebrates	Temperature increase not likely to exceed tolerable range. Possible increase in metabolic rates of species present.	G	Not required.
	Diatoms	Temperature increases of up to 1.1 °C such as those predicted above may improve the fitness of individual diatom species. Conversely, an increase in temperature also may have negative impacts on diatom communities. It is possible that by increasing temperature, there will be a reduction in optimum conditions for diatom species. Increasing temperatures have also been found to slow or stop division rates within diatom species when upper tolerances have been reached. Therefore, those diatom species with a higher temperature tolerance may outcompete other species.	A	Further assessment required with regards operational regime.
Oxygen saturation	Macroinvertebrates, macrophytes, diatoms	Minor increases in dissolved oxygen under M96 future may result in a general improvement in biological fitness overall within the community, however this is not likely to result in impacts to the invertebrate community within the freshwater River Thames.	G	Not required.
Phosphorous	Macroinvertebrates, diatoms	The slight decrease in phosphorous predicted downstream of the outfall under A82 conditions are not likely to result in any measurables impact upon invertebrate preference.	G	Not required.
pH	Macroinvertebrates, diatoms	The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the invertebrate community. Therefore, there is predicted to be no impact on invertebrates within the freshwater River Thames due to the scheme.	G	Not required.
Reach D – Teddington Weir to Battersea Park				
Velocities and flows	Macroinvertebrates	No impacts on flow or velocity are expected within this reach.	G	Not required.
Temperature	Macroinvertebrates	Possibility that maximum temperature increases of up to 1.1 °C such as those predicted above coming over Teddington Weir may potentially improve the fitness of individual invertebrate species currently present. The water temperature local to Mogden STW, however, is typically predicted to decrease due to reduction in Mogden STW FE, particularly around the outfall, which is not expected to have an impact on the invertebrate community.	G	Not required.
Oxygen saturation	Macroinvertebrates	Slight increase in oxygen saturation with potential to improve biological fitness.	G	Not required.

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Dissolved inorganic nitrogen	Macroinvertebrates	Significant decreases in DIN are predicted for the Thames Tideway, this is not expected to negatively impact the invertebrate community the invertebrate community as the community has been determined to be tolerant to a wide range of nutrient conditions	G	Not required.
Reach E Battersea Park to Tower Bridge				
Velocities and flows	Diatom	No impacts on flow or velocity are expected within this reach.	G	Not required.
Temperature	Diatom	No impacts on flow or velocity are expected within this reach.	G	Not required.
Oxygen saturation	Diatom	It is predicted that dissolved oxygen in the upper Thames tideway will increase with negligible impacts, this is not likely to affect the diatom community due to the maximum increase of 0.5 mg/l.	G	Not required.
Dissolved inorganic nitrogen	Diatom	Significant decreases in DIN are predicted for the estuarine Thames Tideway, this is not expected to impact the diatom community as the community has been determined to be tolerant to a moderate to low organic pollution. However, the reduction in DIN may increase the presence of more sensitive diatom species.	G	Not required.
Change in water quality and levels	Designated sites (Ham Lands LNR, Isleworth Ait LNR, Syon Park SSSI, Duke's Hollow LNR, Chiswick Eyot LNR)	Modelling and physical environment assessment identified that there would be a negligible change in water level throughout the estuarine Thames Tideway and negligible changes in intertidal exposure in the estuarine Thames Tideway. Minor alterations in intertidal exposure could result in minor increase in exposure of marginal vegetation.	G	Not required.

8.3.2.3 *Invasive Non-native Species*

Minor changes in physico-chemical conditions within the Thames are expected, with changes in flow conditions and localised changes in velocity, along with minor changes in oxygen saturation, phosphorous and pH. These changes in conditions may have minor impacts on the distribution of INNS within the freshwater River Thames, although they are not expected to be major and widespread. Impacts from the 200 Ml/d variant of the Mogden water recycling Scheme is considered to have the greatest impact.

The Mogden water recycling scheme does not need to be assessed using the SAI-rat tool, as the volume discharged would be advanced treated effluent, which eliminates all pathways that are likely to introduce or transfer INNS during normal operation.

8.3.2.4 *Terrestrial ecology*

8.3.2.4.1 Activities and pathways for impact

8.3.2.4.1.1 Construction impacts

The construction activities associated with the 200 Ml/d Mogden water recycling scheme would include the following activities that have potential to result in biophysical changes to important terrestrial ecological features:

- Construction of a new AWRP near Kempton WTW, approximately 6 km south-west of Mogden STW. Note that the water transfer route from Mogden STW to the new AWRP will be primarily constructed using straight pipe jacked tunnels.
- Conveyance from Mogden STW to the AWRP site will be tunnelled via pipe-jack. From the AWRP to the River Thames discharge location will include trenched/ open cut pipeline and trenchless/ tunnelled where required to avoid watercourses. Where trenched/ open cut pipeline is proposed, vegetation removal, earthworks and associated drainage will be required.
- Construction of temporary site compounds and permanent reception shafts at Mogden STW, AWRP site near Kempton WTW and along conveyance route (including vegetation removal, earthworks, provision for compound drainage and SuDS, and creating areas of hardstanding to provide a working area for construction phase activities).
- Construction of temporary access routes (including vegetation removal, earthworks, and associated drainage)
- Construction of discharge/outfall location upstream of the Thames Water Walton Intake on the River Thames.
- Permanent fencing including security gates and cameras at AWRP site near Kempton WTW.

The activities listed above have the potential to result in the following effects:

- Habitat loss or degradation (both temporary and permanent) - It is assumed that all areas of temporary habitat loss will be re-instated to the current baseline condition following completion of the construction phase of the scheme.
- Habitat fragmentation (temporary)
- Management changes to habitats (leading to habitat degradation)
- Disturbance of individuals or groups of animals
- Direct injury or mortality of individual animals and plants
- Pollution e.g., sediment mobilisation, dust, hydrocarbons (habitat degradation and injury/mortality to species)
- Impacts from water level changes (a cause of habitat loss, degradation and/or injury/mortality to species)

8.3.2.4.1.2 Operational impacts

The operational activities associated with the Mogden water recycling scheme would include the following activities that have potential to result in biophysical changes to important terrestrial ecological features:

- Operational changes to flow regime in the River Thames.

- Operation and maintenance of new infrastructure including the conveyance route and within the existing Mogden STW site.

The activities listed above have the potential to result in the following effects:

- Management changes to habitats (leading to habitat degradation).
- Disturbance of individuals or groups of animals via noise, vibration and visual disturbance.
- Direct injury or mortality of individual animals and plants.
- Impacts from water level changes (a cause of habitat loss, degradation and/or indirect injury/mortality to species).

8.3.2.5 Impact risk and additional mitigation requirements

The construction of the Mogden water recycling scheme including Mogden STW, AWRP near Kempton WTW and conveyance routes will result in the direct loss of grassland, scrub and woodland habitat. No direct impact pathways were identified to statutory designated sites; however, a total of 16 non-statutory sites were identified within 2 km of the scheme which included SINCs and an LNR. This includes potential habitat loss in a non-statutory designated site of local importance depending on the exact location of the AWRP, which consists of lowland calcareous grassland priority habitat and deciduous woodland priority habitat. Further surveys are recommended at the AWRP site for badger, hazel dormouse, great crested newt, bats and breeding birds to determine present/ spatial distribution and to aid identification of a compensation site for the purposes of BNG.

Species records received within 2 km of the Mogden water recycling scheme included bats, birds, reptiles, amphibians, hedgehog and stag beetle. As the locations of species records were not provided by GiGL, the search areas for the Teddington DRA and Mogden water recycling scheme overlapped so it is not possible to determine which options the records are in relation to.

Where adjacent habitats haves been identified, indirect impacts from the scheme include noise, visual and vibration disturbance and pollution via vehicle emissions, dust and hydrocarbons. This is specifically concerning South West London Waterbodies SPA and Ramsar, Kempton Park Reservoirs SSSI, Kempton LNR and Kempton Lake Half Moon Convert SINC and associated qualifying bird populations (largely overwintering). Further survey work is recommended for overwintering birds to determine distribution and mitigation measures to reduce anthropogenic disturbance will need to be considered.

Temporary and permanent habitat loss would occur within the footprint of the AWRP and conveyance route compounds and shafts including the priority habitats lowland mixed deciduous woodland and lowland calcareous grassland. Where possible, the removal of woodland and scrub should be avoided when considering the footprint of compounds and shafts. Hard standing and modified grassland is present in the footprint of a number of compounds and shafts, which has low ecological value. However, where compounds and shafts are located close to ecological receptors, additional mitigation measures should be implemented to avoid impact pathways to supporting habitat. Construction and operation of the AWRP has potential for impacts to protected and notable species including bats, hazel dormouse, badger, European hedgehog, amphibians, reptiles, and breeding birds.

During operation of the Mogden water recycling scheme, no discernible impacts were identified on habitats present in freshwater River Thames or adjacent habitats as a result of intermittent disturbance from anthropogenic activity at shafts and the intake/ outfall sites.

Table 8-25 provides a summary of the risks.

Table 8-25 Mogden water recycling scheme: summary of potential terrestrial ecology impacts

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Habitat loss – temporary and permanent	Priority and local value habitats	Fencing of retained adjacent habitats to reduce the potential for works encroachment.	Permanent loss of 4.499 ha of the habitats identified within the footprint of the proposed new above-ground infrastructure associated with the conveyance route and new AWRP. AWRP site will result in the permanent loss of two areas of priority habitat: lowland mixed deciduous woodland (0.37 ha) and lowland calcareous grassland (0.12 ha)	A	Compensation for loss of priority habitat and area of SINC.
Disturbance to protected and notable species	Bat	Construction best practice relating to control of dust and pollution prevention. Avoidance of mature trees, woodland, and hedgerows through scheme design where possible to minimise potential impacts. Fencing of retained adjacent habitats to reduce the potential for works encroachment. Avoidance of night-time working adjacent to suitable habitats.	Woodlands and mature trees which may have potential to support roosting bats were identified within or immediately adjacent to Shaft 4, 5, 8, 9, 10,11, 13, 16, open cut section between Shafts 12 and 13, and discharge location. Direct impacts (Shaft Compounds: • loss, damage and/or disturbance of potential bat roosts. • temporary and permanent loss of foraging or commuting habitats within site compound and permanent infrastructure. Indirect impacts: • disturbance of foraging bats through noise and/or lighting during construction activities.	Uncertain – more data needed[85]	Avoidance of night-time working adjacent to bat roosts (where identified through further surveys) and high value foraging habitats. Lighting of shaft compounds should be designed to minimise light spill on to adjacent high value habitats.
	Badger		Suitable habitats were identified within or immediately adjacent to Shaft 4, 5, 8, 9, 10, 11, 12, 13, 16, and open cut section between Shafts 12 and 13, and discharge location. Direct impacts: • damage or disturbance of badger setts during construction works. • accidental injury or mortality due to presence of excavations and / or plant / vehicle movements.	Uncertain – more data needed	Fencing of site compounds to prevent badger access to exposed excavations and encroachment of works into retained habitats
	Stag beetle		Records of stag beetles were identified within 2 km of the Mogden water recycling scheme. Suitable habitats (woodland, mature trees, hedgerows) were identified within or immediately adjacent to Shafts 4, 5, 8, 9, 10,11, 13, 16, alternative shaft site 14, open cut section between Shafts 12 and 13, and discharge location. Suitable habitats including woodland (large heath and white letter hairstreak), mature trees, and scrub and hedgerows (brown hair streak) were identified within or immediately adjacent to Shafts 4, 5, 6, 8, 9, 10,12, 13, 16, open cut section between Shafts 12 and 13, and discharge location. Direct impacts (Shaft Compounds: • loss or disturbance of larval habitats which include rotting standing trees, stumps or logs. • injury or mortality of larvae and/or adults (May to September) during site clearance. • temporary and permanent loss of supporting habitats within site compound and permanent infrastructure footprint. Indirect impacts: • disturbance of populations through additional artificial lighting attracting night flying insects such as moths. • habitat degradation from pollution including accidental spills and dust.	Uncertain – more data needed	Deadwood suitable for priority invertebrate species should be translocated to retained habitats, and habitats within the areas of temporary loss re-instated on a like-for-like basis.
	Reptiles		The grassland habitats recorded at Shafts 6, 8, 12 and 13 and open cut trenches section between 12 and 13 provided suitable habitat for foraging and basking reptiles. Direct impacts Shaft Compounds: • loss or disturbance of supporting habitats. • injury or mortality during site clearance and construction. Indirect impacts: habitat degradation from pollution including accidental spills and dust.	Uncertain – more data needed	Site clearance in areas containing suitable reptile hibernation features should not be undertaken during the hibernation period (October to March inclusive). The clearance should be supervised by a suitably experienced ecologist following a precautionary working method statement (PWMS).
	Riparian mammals (water vole and otter)		Waterbodies including wet ditches and rivers were recorded within 50m of Shafts 4, 5, 6, 9 and the outfall location. Direct impacts (Shaft Compounds and outfall): • loss or disturbance of supporting habitats. • injury or mortality during site clearance. Indirect impacts:	Uncertain – more data needed	Site clearance should be undertaken under supervision of an Ecological clerk of Works (ECoW). In areas containing suitable hibernation features should not be undertaken during the hibernation period (October to March inclusive).

[85] Insufficient baseline data to confirm whether species/group present or not.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
			habitat degradation from pollution including accidental spills.		
	European hedgehog		Suitable habitats (woodland, scrub, grassland, and hedgerows) were identified within or immediately adjacent to Shafts 4, 5, 8, 9, 10,11, 12, 13, 16, open cut section between Shafts 12 and 13, and the discharge location. Direct impacts (shaft compounds): • loss or disturbance of supporting habitats (e.g. grassland, scrub, woodland, parkland). • injury or mortality during site clearance Indirect impacts: • habitat degradation from pollution including accidental spills and dust.	Uncertain – more data needed	Avoidance of scrub, woodland, and hedgerows through scheme design where possible to minimise potential impacts. Site clearance in areas containing suitable hibernation features should not be undertaken during the hibernation period (October to March inclusive).
	Amphibians		Suitable terrestrial habitats (woodland, rough grassland, scrub, and hedgerows) were identified at Shafts 4, 5, 8, 9, 10,11, 12, 13, 14, 16, open cut section between Shafts 12 and 13, and the discharge location. Direct • permanent loss of supporting habitat within the footprint of the shaft. Indirect • noise, vibration and visual disturbance and exposure to pollution (air, dust, lubricants, detergents, cement, fuel) if birds present.	Uncertain – more data needed	Potential need for exclusion fencing and trapping programmes if great crested newt present. Sensitive clearance of vegetation.
	Hazel dormouse		Historic records of hazel dormouse were identified within 2 km of the Mogden Re-use scheme. The woodland identified at new AWRP had good understorey structure in parts and supports tree and shrub species suitable for foraging and breeding hazel dormouse. Direct impacts: • loss, damage, fragmentation or disturbance of supporting terrestrial habitats • injury or mortality during site clearance and construction. Indirect impacts: • disturbance through noise and/or lighting during construction activities. • habitat degradation from encroachment, pollution including accidental spills and dust.	Uncertain – more data needed	The vegetation clearance should be supervised by a suitably experienced ecologist following a precautionary working method statement (PWMS).
Disturbance to birds	Birds	Screening and noise dampening equipment should be used to minimise noise disturbance and dust emissions. • Measures will be taken to protect any temporary exposure of bare soil from runoff during heavy rainfall events. • All vehicles and any chemical/ oil storage will be fully bunded to prevent any accidental pollution within supporting habitat.	Suitable terrestrial habitats have been identified at all sites. Construction works proposed approximately 17 m from Kempton Waterworks SINC and Kempton Park Reservoirs Site of Special Scientific Interest (SSSI) which supports nationally significant populations of teal and mallard. Direct • loss of potential breeding habitat could occur and destruction of nests if present. Indirect • noise, vibration and visual disturbance and exposure to pollution (air, dust, lubricants, detergents, cement, fuel).	R	Any vegetation clearance required should be undertaken outside of the breeding bird season (March –August inclusive).

8.3.3 Historic environment

8.3.3.1 Activities and pathways for impact

8.3.3.1.1 Construction

The setting of designated heritage assets is likely to be affected by construction works associated with the scheme. However, these effects are anticipated to be temporary, only affecting the asset settings for the duration of the construction phase of the project.

There is the potential for known and currently unknown archaeological deposits to be disturbed or removed by construction activities associated with the scheme. Intrusive groundworks may truncate or destroy any archaeological remains present within the footprint of temporary and permanent compounds, shaft sites, and in the location of any new infrastructure.

The proposed pipelines associated with the scheme are all anticipated to be tunnelled. As tunnelled pipelines will be located at a much lower depth than any surviving archaeological deposits, it is unlikely that these pipelines will have any affect upon archaeological deposits present within the scheme route.

8.3.3.1.2 Operation

It is possible that the operation of shaft sites and new infrastructure may affect the setting of nearby designated heritage assets. It is anticipated that the extent and nature of any such effects will be fully investigated, and mitigation strategies identified as part of future heritage statement assessment reports.

It is unlikely that the operation of any element of the scheme will have further effects upon non-designated archaeological remains following construction.

It is unlikely that below-ground pipelines, once constructed, will have any effect upon the setting of nearby designated heritage asset receptors.

8.3.3.1 Impact risk and additional mitigation requirements

8.3.3.1.1 Construction

The construction phase of the Mogden water recycling scheme has the potential to temporarily affect the settings of two listed buildings and two conservation areas.

Several elements of the scheme are located within APAs and an AHAP, and one infrastructure site is located upon an area of known archaeological remains. The scheme has an overall potential to contain as-yet unidentified archaeological deposits. All such remains are likely to be affected by the construction phase of the scheme. The impact risk appraisal, and requirements for additional mitigation, during the construction phase is provided in **Table 8-26**.

8.3.3.1.2 Operation

The operation of the Mogden water recycling scheme has the potential to permanently affect the setting of a conservation area. It is considered unlikely that there are any risks to archaeological deposits associated with the operation of the scheme. Any such risks are thought to be limited to the construction phase of the project only. The impact risk appraisal, and requirements for additional mitigation, during the operation phase is provided in **Table 8-27**.

8.3.3.2 Uncertainties

No red RAG risk ratings have been identified for any element of the Mogden water recycling scheme at this appraisal stage.

Additional assessment may be required to fully understand the potential permanent effects to the setting of the conservation area near to shaft site 4. Although the asset is not located directly adjacent to the scheme, there is a potential for the receptor to be affected negatively.

At present it is unclear if, and to what extent, there will be any intrusive groundworks associated with the trenchless pipeline sections of the scheme. Further detail would clarify the need for any additional mitigation measures at these sites.

Currently unidentified archaeological remains may be present within any trenched and trenchless section, shaft or infrastructure site along the scheme route. The extent and nature of any archaeological remains present is currently unknown.

Table 8-26 Mogden water recycling scheme: summary of historic environment initial risk appraisal and additional mitigation requirements

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Construction of shafts.	Conservation areas. APAs. Known non-designated heritage assets. Unknown non-designated heritage assets.	N/A	Construction of shafts has the potential to impact upon the following heritage assets; Rosecraft Gardens Conservation Area An Archaeological Priority Area. A known historic park (OA 114). The site of known, undated ring-ditch cropmarks (OA 122). Permanent loss of paleoenvironmental and archaeological remains.	A	Employment of best archaeological practice strategies during construction phase. This could include archaeological desk-based assessment, heritage assessment, and intrusive archaeological recording action.
Construction of new infrastructure sites.	Known non-designated heritage assets. Unknown non-designated heritage assets.	N/A	Construction of new infrastructure sites has the potential to impact upon the following heritage assets; The projected route of a Roman road (OA 115). The former Walton Yacht Works and Wharf (OA 119) and the site of Walton Bridge, bridge approach and toll house (OA 121).	A	Employment of best archaeological practice strategies during construction phase. This could include archaeological desk-based assessment, heritage assessment, and intrusive archaeological recording action.
Construction of trenched sections.	Listed buildings. Conservation area. AHAP. Unknown non-designated heritage assets.	N/A	Construction of trenched section has the potential to impact upon the following heritage assets: Potential temporary negative effect upon setting of two grade II listed buildings, Hawke House (OA 23) and the walls and railings to the front of Hawke House (OA 24). Potential temporary negative effect upon setting of Lower Halliford Conservation Area. An Area of High Archaeological Potential.	A	Employment of best archaeological practice strategies during construction phase. This could include archaeological desk-based assessment, heritage assessment, and intrusive archaeological recording action.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Construction of trenchless sections.	Unknown non-designated heritage assets.	N/A	Construction of trenchless sections has the potential to permanently disturb, or result in the loss, of known and unknown paleoenvironmental and archaeological remains.	G	Should any intrusive groundworks be required, employment of best archaeological practice including desk-based assessment and intrusive archaeological recording action.
Construction of tunnel sections.	No receptors identified	N/A	No risks identified	G	No additional mitigation required

Table 8-27 Mogden water recycling scheme: summary of historic environment initial risk appraisal and additional mitigation requirements during operation

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Operation of shafts.	Conservation area.	N/A	Potential permanent negative effect upon setting of Rosecraft Gardens Conservation Area.	A	Full heritage assessment of potential effects to designated asset settings to assist identification of suitable mitigation.
Operation of new infrastructure sites.	No receptors identified.	N/A	No risks identified.	G	No additional mitigation required.
Operation of trenched sections.	No receptors identified.	N/A	No risks identified.	G	No additional mitigation required.
Operation of trenchless sections.	No receptors identified.	N/A	No risks identified.	G	No additional mitigation required.
Operation of tunnel sections.	No receptors identified.	N/A	No risks identified.	G	No additional mitigation required.

8.3.4 Landscape and visual effects

8.3.4.1 Activities and pathways for impact

8.3.4.1.1 Construction

Key construction activities and works that could result in landscape/townscape and visual effects are:

- Vegetation clearance, earthworks and soil preparation to prepare for construction activities;
- Presence and movement of plant, machinery and construction traffic within and around the site;
- Presence of tall plant and machinery (including cranes if used) on the skyline;
- Establishment of construction compound(s) and welfare facilities;
- Presence of hoarding/ safety fencing around the boundary of demolition or construction areas;
- Presence of lighting to light construction activities after dark, and;
- Formation of landform, drainage and soft landscaping activities.

8.3.4.1.2 Operation

Key aspects of the completed development that could result in landscape/townscape and visual effects are:

- Presence of permanent access hatches at shaft sites and telemetry kiosks at some sites.
- New AWRP near Kempton WTW, including a number of buildings between 6m and 17m tall, associated access roads and car parks.
- New discharge outfall structure at Walton Bridge.
- Any security lighting to sites and structures, if considered essential.

8.3.4.2 Impact risk and additional mitigation requirements

The most severe level of effect from the proposed development is considered to be from the construction and operation of the AWRP site near Kempton WTW and the construction of the Walton Bridge discharge outfall. At the new AWRP site this will impact the immediate character of the site. At Walton Bridge this will affect the character of the site and the visual amenity of recreational users of local rights of way, the Thames Path and users of Walton Bridge. It is considered that other landscape/townscape and visual receptors will have a lower level of impact, assuming that the suitable mitigation measures identified are undertaken.

It is judged that significant landscape/townscape effects will predominantly be very localised, and mainly only impact on the sites themselves and their immediate surroundings. Visual effects will also be localised, and not expected to result in significant effects beyond around 500m distance from the sites.

Further assessment will be required during winter months when deciduous vegetation is leafless. This may highlight potential for higher levels of effect. Some uncertainty regarding effects in winter months will remain, until this work can be done.

Note that this is a preliminary assessment based upon limited project information and knowledge of the construction methodologies and duration proposed. A full landscape/townscape and visual impact assessment will be required as part of the EIA, once detailed designs and construction methods are available.

8.3.4.3 Uncertainties

A detailed design for the new AWRP site near Kempton WTW will enable a more precise assessment to be undertaken, including identifying specific representative viewpoints. This includes an understanding of the vegetation removal, access points, building heights and locations, building materials, boundary treatments, and any proposed soft landscaping.

In all locations, avoiding mature trees and minimising vegetation removal and ensuring replacement planting will help reduce levels of effect.

Similarly, careful and appropriate restoration of grassed and paved areas, ensuring a match with local character and materials, will help reduce levels of effect.

Table 8-28 Mogden water recycling scheme: summary of landscape and visual amenity initial risk appraisal and additional mitigation requirements during construction

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Construction of shafts and trenchless tunnel sections - site clearance, compound hoardings, tall plant and machinery, spoil heaps, movement of site traffic, digging shafts, placing access hatch, constructing telemetry kiosks.	Local landscape of the site. Local communities, recreational users, pedestrians, and road users.	Minimise loss of vegetation through design and sensitive location of construction compounds and tunnel sections, utilising existing hardstanding where possible, and avoiding public rights of way and paths. Replace any vegetation removed as a result of construction with suitable native species. Replace any trees removed at a rate of at least two to one (note that local authorities may have specific tree replacement policies). If pavements are impacted, use locally appropriate materials to repair, as set out in Local Authority Design Guides. Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting).	Construction of shafts and trenchless tunnel sections will result in unavoidable direct impacts on the local character of the sites and pipeline route due to changes to the physical and perceptual characteristics during construction. Only the immediate character areas will be affected. The timescales will be short and the effects from construction partially reversible (e.g., once hoardings and machinery are removed). Construction activities will be noticeable for the local community, although a certain level of construction activities is accepted in urban areas. Again, the timescales will be relatively short and the effects relating to construction of the shafts will be partially reversible (e.g., hoardings and machinery removed). Construction of tunnel sections will be via pipejack and therefore will result in minimal impacts to the local landscape/townscape and visual amenity of local communities.	G	Particular attention will need to be given to the location of the shafts and construction compounds and tunnel sections for the following locations: For shaft sites that lie within popular recreational sites, locate compounds and shaft sites away from the boundary path, and minimise size of construction compound where possible. For shaft sites that intersects popular walking routes, avoid closing or diverting the public rights of way, and minimise size of the construction compound where possible. Avoid cutting down mature trees. Where telemetry kiosks are placed by the access hatches in parks, there should be careful consideration of their position so that they do not appear out of place in a generally open undeveloped space. Kiosks could be placed next to existing small infrastructure e.g., lamp posts, parking meters, sign posts.
Construction of trenched tunnel sections – site clearance, compound hoardings, tall plant and machinery, spoil heaps, movement of site traffic, digging trenches, placing pipes, refill.	Local landscape of the site. Local communities, recreational users, pedestrians and road users.	Minimise loss of vegetation through design and sensitive location of tunnel sections, utilising existing hardstanding where possible, and avoiding public rights of way and paths. If pavements are impacted, use locally appropriate materials to repair, as set out in Local Authority Design Guides. Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting). Replace any vegetation removed as a result of construction with suitable native species. Replace any trees removed at a rate of at least two to one (note that local authorities may have specific tree replacement policies).	Construction of trenched tunnel sections will result in unavoidable direct impacts on the local character areas due to changes to the physical and perceptual characteristics during construction. Construction activities will be noticeable for the local community, although a certain level of construction is expected in London. The timescales will be relatively short and the effects reversible, as the trenches will be filled.	A	Particular attention will need to be given to the location of the shafts and construction compounds and tunnel sections for the following locations: **For trenched tunnel sections that** run through popular recreational routes or alongside a footpath, avoid closing or diverting the public rights of way where possible, and minimise the size of the construction compound.
Construction of AWRP near Kempton WTW – site clearance, compound	Local landscape character of the site.	Minimise loss of vegetation through design and sensitive	The AWRP site's open space is one of the key characteristics of the Richmond Character Area A3: Hampton	A	No additional mitigation recommended at this stage.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
hoardings, tall plant and machinery, spoil heaps, movement of site traffic, construction of a number of buildings with maximum height of 17m (average height 6-10m), access roads and car parks.		location of construction compounds and built elements. Retain as many trees as possible, and replace any removed at a rate of at least two to one. Use native, locally appropriate species. Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting). Incorporate spaces between buildings and soft landscaping into the design where possible. Retain woodland along the site boundaries to reduce impacts on the wider landscape.	Waterworks, and "*presents a rural open space character with natural feeling vegetation which extends into neighbouring Surrey"*. The recreational amenities of the new AWRP site are noted as a valued feature, with the whole character area assessed as having a high sensitivity to change. Development will result in unavoidable direct landscape effects through the change from undeveloped woodland and scrub to the ARWP facility, including removal of vegetation. Direct effects will be localised on the 6ha of land to be developed within the 12ha site. There will also be noticeable movement of construction plant and traffic in and around the site. Direct effects will be large-scale in the context of the site, and semi-permanent due to the removal of vegetation.		
	Recreational users of Hampton Rangers Training Ground. Recreational users of Kempton Park. Users of public rights of way Local community on Upper Sunbury Road.	Minimise loss of vegetation through design and sensitive location of construction compounds and site design. Replant trees that have been removed at a rate of at least two to one. Use native, locally appropriate species. Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting). Retain mature vegetation along the boundary between the site and Hampton Rangers Training Ground, and along Upper Sunbury Road. Set development back from the training ground and public right of way on the eastern boundary. Use appropriate colours for buildings to allow them to be less obtrusive in views. Restrict development heights to below tree level as much as possible.	There are limited views into the site from publicly accessible areas due to distance from public rights of way and Upper Sunbury Road, extensive trees and boundary vegetation within the site and vegetation and fencing along Upper Sunbury Road. Users of Hampton Rangers Training Ground are focussed on the pitch, and less so on the surrounding landscape. There are mature trees bounding the football ground along the site boundary, which should screen the majority of views of construction activities (less so in winter). Some views of tall plant and machinery may be visible above the treeline. Recreational users and local communities are focussed on their surroundings. Mature trees surrounding the new AWRP site, and along Upper Sunbury Road to the south will screen most views of construction (less so in winter). Selective removal of vegetation and tall plant and machinery may be visible, particularly at access points. The impact on views will be localised and semi-temporary, as machinery and hoarding will be removed.	G	No additional mitigation recommended.
Construction of discharge outfall structure at Walton Bridge - site clearance, compound hoarding, site traffic	Local landscape character of the site. Recreational users of the Thames Path and local public rights of way.	Minimise loss of vegetation through design and sensitive location of construction compounds. Replant trees that have been removed at a rate	The site has an open riverside character. Construction will introduce temporary built development into the site, which will be out of place. Construction will close or divert public rights of way through the site. There will be clear views of construction activities	A	No additional mitigation recommended at this stage.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
	Pedestrians and motorists on Walton Bridge. Local community along the north and south bank of the River Thames.	of at least two to one. Use native, locally appropriate species. Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting).	for recreational users and people travelling on Walton Bridge in an otherwise open landscape. Views for the local community will be at an oblique angle. However, a certain level of construction activities is accepted in urban areas. The timescales will be relatively short in duration, and partially reversible (e.g. hoardings and machinery removed).		

Table 8-29 Summary of impact risk and additional mitigation requirements during operation: landscape and visual amenity

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Permanent access hatch at shafts - metal access hatches set into the ground; telemetry kiosks will be placed at some access hatches	Local landscape of the site. Local communities, recreational users, pedestrians and road users.	N/A – would be additional	The permanent access hatch will result in unavoidable direct impacts on the immediate site. This will be a small change, and will be seen in context with other urban ground-level infrastructure e.g., manhole covers and drain covers. The change in visual amenity for local communities, recreational users, pedestrians and road users will be very small, and barely perceptible in most cases.	G	No additional mitigation recommended.
Completed tunnel sections	Local character areas. Local communities, recreational users, pedestrians and road users.	N/A – would be additional	Once in operation the tunnel sections will be imperceptible in the landscape/townscape and to visual receptors.	G	No additional mitigation recommended.
AWRP near Kempton WTW – Change in land use from undeveloped woodland/scrub to development of a number of buildings, with a maximum height of 17m (average height 6-10m), access roads and car parks.	Local landscape of the site. Recreational users of Hampton Rangers Training Ground. Recreational users of Kempton Park. Users of public rights of way. Local community on Upper Sunbury Road.	N/A – would be additional	Development will result in unavoidable direct landscape effects through the change from undeveloped woodland and scrub to the ARWP facility, including removal of vegetation. This will be a large and permanent change for the character of the site. Due to the distance of views for recreational receptors and the local communities' views of the completed development will be limited. There may be views of buildings above the treeline which reach the maximum height of 17m. There are limited tall structures in local views, so these would be a new feature. However, if the boundary vegetation of the site is retained there should be limited impact on local views (greater levels of effect in winter months).	A	No additional mitigation recommended at this stage.
Discharge outfall structure	Local landscape character of the site. Recreational users of the Thames Path and local public rights of way. Pedestrians and motorists on surrounding highways. Local community along the north and south bank of the River Thames.	N/A – would be additional	The discharge outfall structure will result in unavoidable direct impacts on the immediate site. This will be a very small change, and will be seen in context of other urban ground-level infrastructure e.g., manhole covers. The change in visual amenity for local communities and recreational users will be very small, and barely perceptible for most people.	G	No additional mitigation recommended.

8.3.5 Soils and contaminated land

8.3.5.1 Impact risk, pathways and uncertainties

There is a low risk to human health during construction as shallow ground contamination from former activities and current uses may come into contact with construction workers. There is a risk of dermal contact, ingestion and inhalation of potential ground contamination. The risk is low as construction workers should be asbestos awareness trained, provided with personal protective equipment (PPE) and adopt good hygiene measures.

There is a risk to human health during construction as dust from stockpiles and bare earth surfaces could be inhaled and or ingested. Therefore, a Construction Environmental Management Plan (CEMP) should be prepared, detailing measures to prevent mobilisation of dust or surface run-off from stockpiles to off-site receptors.

The risk to Secondary A and Secondary Undifferentiated aquifers would be medium and should be assessed further by groundwater sampling during ground investigation to confirm the risk.

The risk of ground gas is high as the two shaft locations and the conveyance routes intersects four landfills for Mogden water recycling scheme. Further assessment to establish composition of waste in existing/historic landfills and risk of encountering contaminated soils, landfill gas and leachate should be undertaken by carrying out site investigations and Envirocheck review where conveyance cannot be re-routed to avoid landfill areas.

It is recommended that a Phase 1 Preliminary Risk Assessment, where a desk-based assessment is undertaken, reviewing historical mapping, British Geological Survey data, UXO screening and creating conceptual site models.

8.3.6 Transport

8.3.6.1 Activities and pathways for impact

The construction phase of the Mogden water recycling scheme will require traffic movements, as spoil will need to be transported off-site, and materials will need to be transported to site. The summary of HGV movements required for construction of the Mogden water recycling scheme has been taken from the relevant CDR, for a 150 Ml/d sized scheme.

Operational movements are considered to be less significant with c. 73 movements required per year for chemical delivery (largest sized option). Key infrastructure is also located within existing Thames Water owned sites, and therefore subject to existing vehicle movements for personnel. This will be revisited for Gate 3 when further information on operational movements is available.

The vehicle movements associated with these construction site compounds have the potential to adversely impact upon the road networks surrounding them. Traffic increases, particularly increases in Heavy Goods Vehicles (HGVs) can adversely impact upon a local area in a range of ways;

- Severance – the effect of perceived division that can occur in a community when it becomes separated by a major artery (for example, a road becoming much more congested and therefore more difficult to cross);
- Driver Delay – this can occur at any point in the road network, although it is only likely to be significant when, as a baseline, the traffic is predicted to be close to the capacity of the system.
- Pedestrian Delay – A change in the volume or composition of traffic may affect the ability of an individual to cross a road.
- Pedestrian Amenity – the relative pleasantness of a journey. It is affected by both traffic volume and composition.
- Fear and Intimidation – this is dependent upon the volume of traffic, HGV composition, proximity of traffic to people and proximity of traffic to people (e.g., footway width).
- Accidents and Safety – Increases in traffic levels increase in turn the likelihood of a traffic collision in any one part of road. This effect is exacerbated at junctions.

An indication of the change in HGV movements over the existing baseline has been undertaken for a 150 Ml/d sized scheme. As can be seen in **Figure 8-4** the largest relative in HGV traffic is specifically around the new AWRP site near Kempton WTW area, with only smaller increases elsewhere. Relative HGV increases around the Mogden STW are lower as there is already a high number of HGV movements in that area, possibly associated with the operation of the existing Mogden STW.

Figure 8-4 Mogden water recycling scheme: potential HGV movement increases (as a % of baseline AADF) arising from construction

8.3.6.2 *Impact risk and uncertainties*

The overall risk rating for the potential transport impacts on pedestrians and road user receptors due to HGV movements from construction activities are provided in **Table 8-30**.

Table 8-30 Mogden water recycling scheme: summary of transport initial risk appraisal and additional mitigation requirements during construction

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Trenched new AWRP site to Discharge Pipeline between Shaft 14 + 15.	Users of the surrounding road and pedestrian network	**Severance** – perceived division in a community when it becomes separated by a road becoming more congested and difficult to cross;	A	Schedule traffic movements to take place outside of peak traffic times or anti-social hours.
Shaft 15			A	

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Trenched new AWRP site to Discharge pipeline between Shaft 16 and Discharge.		**Driver Delay** – significant when the traffic is close to the capacity of the system. **Pedestrian Delay** – The ability of an individual to cross a road. **Pedestrian Amenity** – relative pleasantness of a journey. **Fear and Intimidation** – dependent upon the volume of traffic, HGV composition, proximity of traffic to people and of traffic to people. **Accidents and Safety** – Increases in traffic levels increase the likelihood of a collision in any one part of road.	A	Appropriately time traffic movements to ensure there is no build-up of HGVs around construction sites. The production of a traffic management plan and a construction logistics plan.
Discharge Structure and other shaft site locations			G	

8.3.7 Navigation

Refer to ***Annex B.2.7. Navigation Assessment Report*** for full details.

The PLA have particular concerns about any limitation on the ability of vessels of various draughts to navigate in the upper Tideway around low water when a London Effluent Reuse SRO is in operation.

Two scenarios were modelled for a variety of parameters – a 1:5 return frequency moderate-low flow year (A82); and a 1:20 return frequency very low flow year (M96)), with the following impacts identified:

- **Minimum water levels:** Since the bed level is approximately 1-2m below the water level, a difference of less than 0.07m in the minimum water level is likely to have a negligible impact on the ability of vessels to navigate the upper Thames Tideway when the Mogden water recycling scheme is operational.
- **Mean water levels:** There is a negligible difference in the mean water levels along the Thalweg when the 300Ml/d Beckton water recycling scheme is operational, compared with the baseline conditions for both modelled flow years.
- **Flow changes across shoals:** the impact of the 200 Ml/d Mogden water recycling scheme will have a minor/negligible impact on the low water navigational restrictions around the shoals, depending on individual shoals and the draft size of the vessel. For vessels with a draught depth of 1.0m, the modelling indicates that the low water navigational restrictions will increase at each of the shoals apart from Wandle. Other vessels with a larger draught of either 2m or 3m are less impacted by the time delays caused by the 200 Ml/d Mogden water recycling scheme.
- **Sedimentation:** It is expected that the scheme would not have a discernible effect on sediment deposition rates during a moderate low river flow year. This would have a negligible effect on navigational operations, including at the Royal Docks and Barking Creek.

8.3.8 Noise

8.3.8.1 Activities and pathways for impact

At this initial appraisal stage, potential causes of noise effects have focussed on the noise from construction plant which are likely to generate the greatest increase over baseline. At later stages, vibration from construction and tunnelling activities, construction traffic as well as operational noise sources[86], will be assessed in more detail when information becomes available during Gate 3.

8.3.8.1.1 Construction

The approach to calculating the construction noise levels is provided in **Appendix 6.**

The assessment used the methodology of BS5228-1:2009. Under this approach, the adverse impact threshold is determined at a dwelling using the existing ambient noise level, rounded to the nearest 5dB for the

[86] Information on the noise levels generated by the plant and equipment, and infrastructure within which the plant will be housed, was not available at Gate 2. It is considered that the design of the new structures could ensure that operational effects are negligible.

appropriate period (day, evening or night). This result is used to determine the assessment category: A, B or C, which then defines the adverse noise impact threshold,

The predicted construction noise level is then compared to the appropriate noise impact threshold level to determine whether or not the threshold is exceeded. If the threshold is exceeded, a significant effect is likely to occur. However, other factors should be taken into account in assessing the overall significance. These include the duration of the works, the quality of the sound insulation of the receptor building façade, ambient noise levels at particularly noisy or quiet locations and the number of residents likely to be affected.

Such information is not currently available thus the initial assessment of significant effects has concentrated on two factors. Firstly, whether the BS5228 threshold level is likely to be exceeded and secondly, identifying receptors where the baseline noise levels are likely to be exceeded by more than 10dB. The assessment is shown in **Table 8-31**.

Table 8-31 Mogden water recycling scheme: number of receptor properties where significant construction noise effects are likely to occur

Construction sites	Highest Construction Noise @ 10m	At Nearest Receptors			BS5228 ABC Threshold	Estimated No. of Properties	
		Distance from works	Construction noise level^	Baseline LAEQ			
	dB(A)	m	dB(A)	dB(A)	dB(A)	Above ABC Threshold	<10dB above Baseline
Mogden Shaft	81	72	57	47	65	0	0
Shaft 2	81	60	58	45	65	0	10
Shaft 3	81	39	62	45	65	0	1
Shaft 4	81	52	60	50	65	0	0
Shaft 5	81	36	63	50	65	0	4
Shaft 6	81	61	58	59	65	0	0
Shaft 7	81	95	54	55	65	0	0
Shaft 8	81	27	65	47	65	0	28
Shaft 9	81	28	65	55	65	0	0
Shaft 10	81	107	53	47	65	0	0
AWRP Shaft	80	406	41	47	65	0	0
AWRP/Pipeline Start 12	87	287	58	55	65	0	0
Pipeline 12-13	78	28	69	60	65	8	0
Shaft 13	81	46	61	60	65	0	0
Pipeline 13-14	78	10	78	55	65	30	30
Shaft 14	81	18	69	47	65	14	28
Pipeline 14 section 1	78	11	77	50	65	36	40
Pipeline 14 section 2	78	25	70	50	65	56	66
Pipeline 14 section 3	78	11	77	50	65	71	75
Pipeline 14 section 4	78	20	72	55	65	29	29
Pipeline 14 - Shaft 15	78	53	64	49	65	0	22
Shaft 15/16	81	164	50	53	65	0	0

Construction sites	Highest Construction Noise @ 10m	At Nearest Receptors			BS5228 ABC Threshold	Estimated No. of Properties	
		Distance from works	Construction noise level^	Baseline LAEQ			
	dB(A)	m	dB(A)	dB(A)	dB(A)	Above ABC Threshold	<10dB above Baseline
Pipeline 15 section 1	78	30	68	60	65	1	0
Pipeline 15 section 2	78	10	78	60	65	63	63
Outfall Structure	87	30	70	60	65	5	8

^Includes noise attenuation by 2m site hoarding at shaft and structure sites

The initial assessment showed that the BS5228 ABC threshold was likely to be exceeded at 313 properties while the construction noise level was likely to exceed the baseline level by 10dB or more, at 404 properties. This simplified assessment has been undertaken due to the limited accuracy of the baseline data. When more reliable data has been collected, it may be that the high number of receptors affected along the trenched pipeline route, will be reduced due the limited duration of the works at any one receptor. Similarly, there may be more receptors affected at locations close to the structure's sites due to longer construction periods.

8.3.8.1.2 Operation

It is understood that shafts, once completed, would be capped, with occasional maintenance access required. This would result in negligible noise effects at the nearest receptors. Operational noise levels from the new ARWP near Kempton WTW and the outfall structure at Walton Bridge are not expected to be significant but due to the uncertainty of baseline noise levels and mechanical plant associated with the structures, further assessment will be required at a later stage.

8.3.8.2 Impact risk and additional mitigation requirements

8.3.8.2.1 Overview

The potential risk of significant noise effects during construction and operation of the scheme is summarised below, based on limited baseline data and lack of detail on some construction methods, including pipejacking equipment and operational mechanical plant. The assessment is therefore based on limited data and professional judgement from similar projects.

Vibration effects during construction and operation are not expected to be significant but this will be verified at a later stage of the scheme development.

8.3.8.2.2 Construction

The initial assessment has shown that minor construction noise effects are possible at receptors close to the shaft sites, but significant effects are likely to occur along the trenched section of pipeline. At the new AWRP site, noise effects are likely to be negligible as the nearest receptors are at a distance of 400m. At the site of the outfall structure, noise effects are not expected to be significant, but this will be verified when more baseline data is available. Similarly, vibration effects of tunnelling are considered to be negligible but will be assessed when more information is available.

Table 8-32 Mogden water recycling scheme: summary of noise initial appraisal and additional mitigation requirements during construction

Activity and impact	Receptor	Best Practice[87]	Effect	RAG Rating	Additional mitigation
Construction of shafts	Residential/ School	BPM (Best Practicable Means)	Significant but mitigatable	A	Acoustic site hoardings
Construction of structures	Residential	BPM (Best Practicable Means)	Not Significant	G	Unlikely to be required

[87] Refer to Section 7.3.8.2.2.1 for Best Practicable Means.

Activity and impact	Receptor	Best Practice[87]	Effect	RAG Rating	Additional mitigation
Construction of trenched pipeline	Residential/ School	BPM (Best Practicable Means)	Significant	R	Acoustic screening of pipeline corridor
Pipejacking	Residential/ School	BPM (Best Practicable Means)	Not Significant	G	Unlikely to be required
Vibration	Residential	BPM (Best Practicable Means)	Not Significant	G	Unlikely to be required

8.3.8.2.3 Operation

Operational noise effects from shaft sites and trenched pipeline sections are not likely to occur as the sites are effectively sealed. Noise effects from the AWRP site are also not likely to occur due to distance separation from the nearest receptors. Noise effects from the outfall structure at Walton Bridge are considered unlikely but will be further assessed when more detailed information on baseline noise levels and mechanical plant are available.

Table 8-33 Mogden water recycling scheme: summary of noise initial appraisal and additional mitigation requirements during operation

Activity and impact	Receptor	Best Practice	Effect	RAG Rating	Additional mitigation
Shafts and trenched sections	Residential/ School	No operational noise	Not Significant	G	Not required
Mechanical plant at AWRP	Residential	Not required due to distance separation	Not Significant	G	Not required
Mechanical plant at Outfall structure	Residential	Adequate screening/enclosures for mechanical plant	Not expected to be significant	Uncertain – further information required	
Vibration	Residential	Operational vibration unlikely	Not Significant	G	Not required

8.3.9 Air quality

8.3.9.1 Activities and pathways for impact

8.3.9.1.1 Construction

8.3.9.1.1.1 Fugitive construction dust impact risk assessment

Human Receptors

Using the methodology provided in **Appendix 4**, the risk of dust impacts due to where earthworks and construction of shafts and tunnels at the nearby human receptors can be classified as moderate as the maximum risk (amber) occurs for those receptors (>100) within 20 m of the construction activities. However, the dust risk can be mitigated using the medium risk dust mitigation measures available from the IAQM dust guidance.

For the receptors which are over 50 m away from the construction site, the risk is expected to be minor green (i.e., dust risk can be mitigated with suitable best practice low risk dust mitigation measures available from the IAQM dust guidance).

Ecological Receptors

Using the methodology provided in **Appendix 4**, the risk of dust impacts due to earthworks and construction of shafts and tunnels at the nearby ecological receptors can be classified as major as the maximum risk (red) occurs for the ecological receptors within 20 m of the construction activities, and as such would require high risk dust mitigation measures depending on the sensitivity of the species. For the ecological receptors which are over 50 m away from the construction site, the risk is expected to be moderate (i.e., dust risk can be mitigated using the medium risk dust mitigation measures available from the IAQM dust guidance).

8.3.9.1.1.2 Traffic emissions air quality impact risk assessment

During the construction phase, it is anticipated that the construction of the 10 pipeline sections and the 11 shafts would progress for a duration of approximately 105 weeks (estimate only, based on 100 Ml/d sized option). This is equivalent to c.2 years assuming that each of the activities are undertaken sequentially and not ongoing at the same time. It is anticipated that this will involve an approximate total of 9,000 vehicle movements. Even if the entire construction occurred in one year, this would be equivalent to approximately 24 HDVs per day. Although, there are receptors within 20m of the route, given that there are less than 25 HDVs per day, the risk of air quality impacts is likely to be minor.

8.3.9.1.1.3 Non-road mobile machinery (NRMM), generator, and combustion plant emissions air quality impact risk assessment

The Mogden water recycling scheme would employ the use of up to c.65 items of plant consisting of excavators, concrete pump, dumpers, rollers, cranes, generators etc. The exact details on the power rating and emissions standards of the plants are not known at this conceptual design stage.

Therefore, NO_x and PM_{10} emissions data for the NRMM has been derived from the EMEP EEA air pollutant emission inventory guidebook 2019, specific to non-road mobile machinery (1.A.4) based on a power rating of < 130kW and EU Stage IIIA emissions standard.

Details on the % on-time has been provided for the plant and it has been assumed that construction hours would be 8am to 6pm, 7 days a week for the duration (104 weeks) of the construction of the tunnels and shafts.

Using the above assumptions, it has been estimated that the operation of all the plants would result in approximately 0.27 g/s and 4.41 g/s of PM_{10} and NOx, respectively. This exceeds the threshold of 5 mg/s and the risk of air quality impacts is considered to be major. As such detailed modelling would be required to determine the potential air quality impacts at nearby receptors.

8.3.9.1.2 Operation

During the operational phase, it is anticipated that chemical deliveries will be delivered by tankers at the following 25% plant utilisation rate for all sizes of the Mogden water recycling scheme, as detailed in **Table 8-34**.

Table 8-34 Mogden water recycling scheme: expected chemical deliveries per year at 25% utilisation (no. of 30m3 bulk chemical road tankers per year - HGV)

Output (Ml/d)	Ammonium Sulphate & Sodium Hypochlorite	Sulphuric Acid	Anti-Scalant	Sodium Bisulphite	Hydrogen Peroxide (H_2O_2)	Hydrated Lime	Ferric Sulphate	Total HGV per year
50	0.50	2.25	0.50	0.75	1.00	13.25	-	18
100	1.00	4.25	0.75	1.75	2.25	26.75	-	37
200	1.75	8.50	1.50	3.25	4.25	53.25	-	73

It is currently predicted that all sizes of the Mogden water recycling scheme will generate less than 25 HGVs per day, and as such air quality impacts during operation are not considered to be a risk (negligible) (as per IAQM thresholds, see Appendix 4).

8.3.9.2 Impact risk and additional mitigation requirements

The overall human and ecological receptors due to fugitive dust emissions from construction activities; exhaust emissions to air from additional traffic on local roadwork during the construction and operational phase are provided in **Table 8-35**.

After implementation of appropriate medium to high-risk mitigation measures, dust impacts are not anticipated to be significant. No significant air quality impacts are currently anticipated during the operation of the scheme, as such no further operational phase mitigation is indicated.

Table 8-35 Mogden water recycling scheme: summary of air quality initial risk appraisal

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Earthworks, construction of shafts and tunnel (human health and dust impact)	Human receptor	Moderate	A	Medium risk IAQM mitigation measures
Earthworks, construction of shafts and tunnel (dust impact)	Ecological receptor	Major	R	High risk IAQM mitigation measures
Construction traffic (air quality impacts)	Human and Ecological receptor	Minor	G	NA
Construction NRMM (air quality impacts)	Human and Ecological receptor	Major	R	Use of EU Stage VI plants
Operational traffic (air quality impacts)	Human and Ecological receptor	Minor	G	N/A

8.3.9.3 Uncertainties

No information is currently available on the construction plant vehicles (NRMM) and generators during the construction phase for a risk assessment to be completed for this aspect.

Emissions from NRMM are likely to require further evaluation and control. Some additional mitigation for consideration includes:

- Use of electrically driven or low emitting NRMM; and
- Siting of NRMM away from sensitive receptors.

8.3.10 People and communities

During construction, the Mogden water recycling scheme could impact upon the people and communities surrounding the construction areas. Construction activities in close proximity to residential dwellings can adversely impact upon the wellbeing of individuals by increasing traffic, noise, dust and light levels in the local area. Construction activity can also increase fear and feelings of isolation in a community, particularly when road closures and increased congestion leads to reductions in the provision of education, healthcare and community recreational facilities.

There are areas within proximity of the Mogden water recycling construction that rank within the most health deprived 30% of England, particularly around Mogden STW and Hanworth. More deprived communities are likely to experience more substantial effects. In terms of cultural infrastructure, the area of London that most of the Mogden construction will take place in is predominantly residential, without large industry. Construction within the river corridor of the River Crane should provide appropriate screening for many assets, but the following may experience adverse impacts;

- The World Rugby Museum;
- The Crane Community Centre.

8.4 SUMMARY AND GATE 3 LOOKAHEAD

Figure 8-5 and **Figure 8-6** provide a high-level summary of the receptors being considered for the Mogden water recycling scheme. In summary, there are limited operational risks associated with the 50, 100 and 150 Ml/d sized options. However, all require the same infrastructure to be constructed, albeit some variations in plant site layout, which will need refinement at Gate 3.

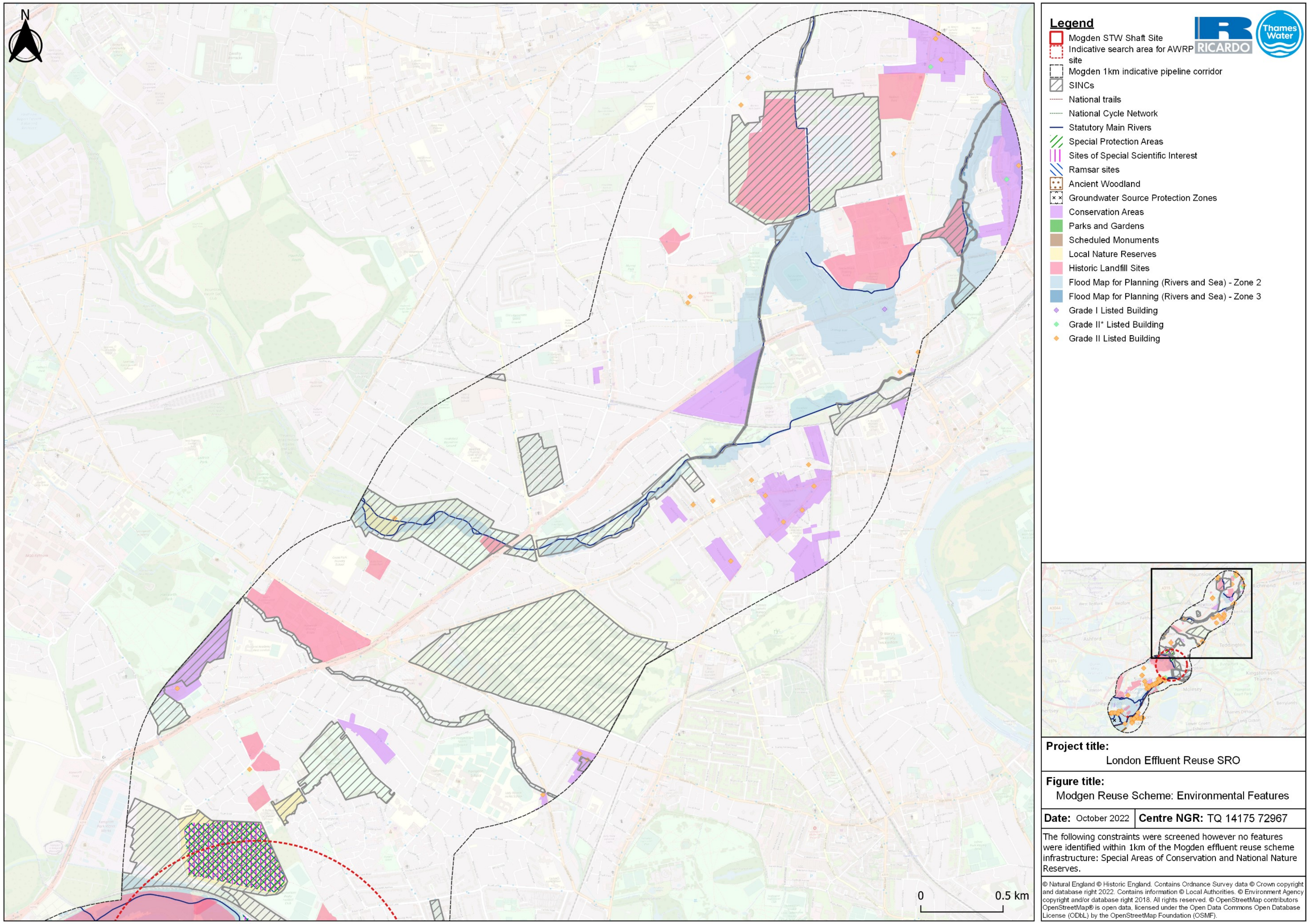
Therefore, a summary of the highest risks (red and amber) associated with the scheme are as follows:

- **Water Quality:** Increases in salinity and decreases in DIN resulting from operation of the scheme.
- **Biodiversity:** loss of priority habitats and area within SINC at AWRP site, and potential for disturbance of bird features of Kempton Waterworks SINC and Kempton Park Reservoirs SSSI.
- **Flood risk:** introduction of new structures within flood zones and increasing areas of impermeable land, therefore flood risk assessment and drainage strategies required.

- **Noise:** construction of trenched pipeline in proximity to residential and school receptors requiring additional mitigation to reduce impact.
- **Soils and contaminated land**: risk of ground gas is high as the two shaft locations (shafts 4 and 9) which may require significant mitigation.
- **Air quality:** impacts to both human and ecological receptors from earthworks, construction of shafts and tunnel (dust impact), construction traffic and NRMM emissions.
- **Heritage:** Impacts to the setting of heritage assets arising from construction.
- **Landscape:** Impacts to the setting of local landscape.
- **Transport:** Impacts to local communities and road users arising from increases in HGV movements.

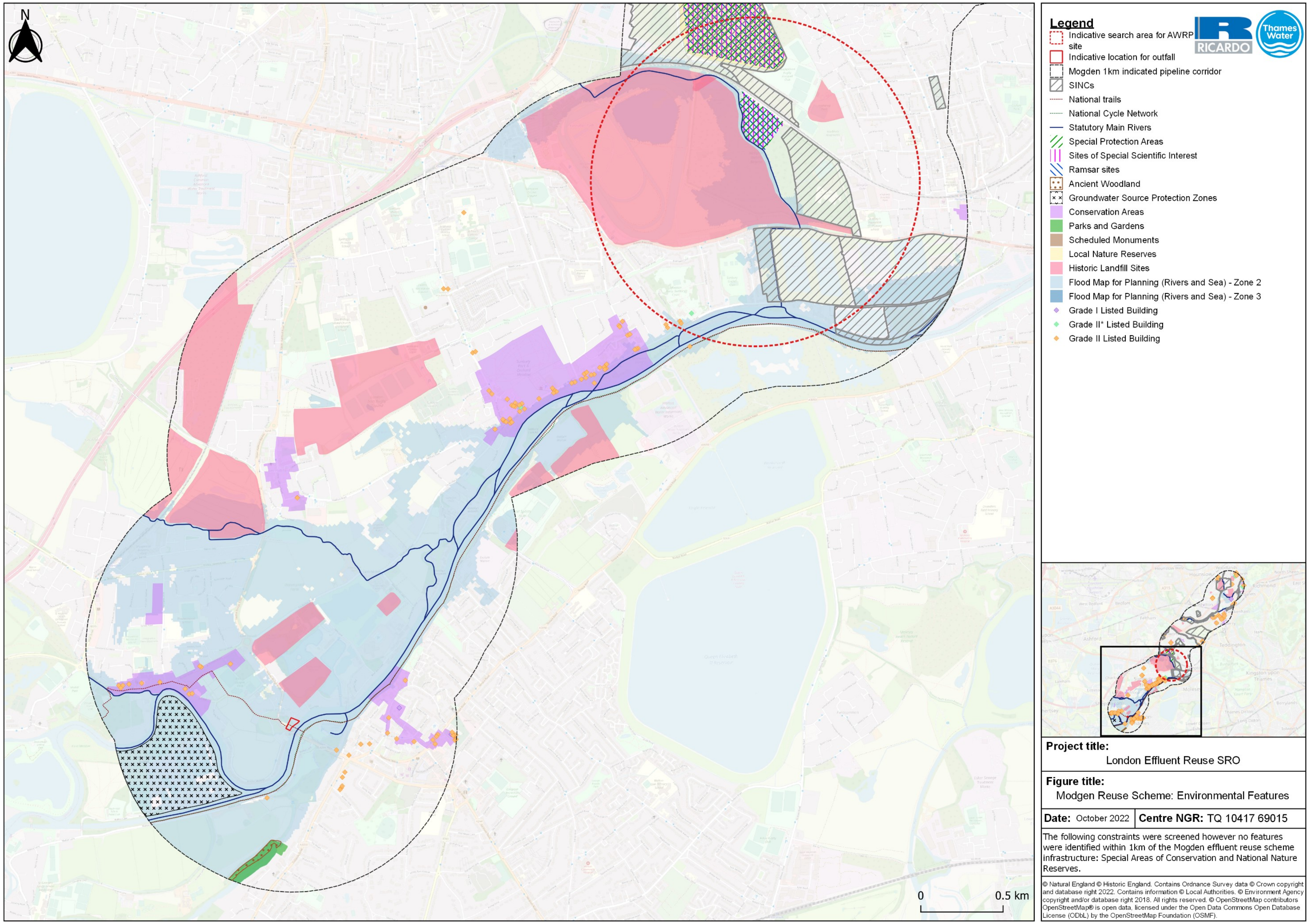
Table 8-36 provides a summary of the data gaps remaining at the end of Gate 2, and the uncertainties, with a lookahead to how these will be addressed for Gate 3.

Figure 8-5 Mogden water recycling scheme: environmental constraints– Mogden STW to Kempton[88]



[88] Figure shows the search area for the conveyance route, not a construction corridor. The pipeline itself is buried but shaft sites will be located within the area demarcated on the figure.

Figure 8-6 Mogden water recycling scheme: environmental constraints– Kempton to Walton Bridge outfall[89]



[89] Figure shows the search area for the conveyance route, not a construction corridor. The pipeline itself is buried but shaft sites will be located within the area demarcated on the figure.

Table 8-36 Mogden water recycling scheme: Gate 3 Lookahead

Environmental Topic Area	Data gaps/uncertainties	Proposed work at Gate 3[90]
WATER		
Physical environment	In the freshwater River Thames the flow changes from flow augmentation associated with the Mogden water recycling scheme is notable in the reach between the Gate 2 Walton Bridge outfall and Thames Water's extant Walton intake. The flow increases, always at exceptionally low - low river flow conditions are assessed as with negligible or very minor impacts on river velocity, general channel wetted habitat, weir pool wetted habitat, fish pass passibility. No additional evidence collection is considered to be required to further verify these assessments.	As engineering design progresses, Gate 2 tools can be re-used to assess variants in outfall velocities or discharge angle for discharge in the 3D Telemac model of the River Thames. The use of water resources modelling at Gate 2 has provided the best available information on likely patterns of scheme use available at the time. However, with WRSE and other Regional Groups WRMP24 Plan reconciliation, the pattern of use of London Effluent Reuse SRO and other SROs will develop. New variants on operating patterns and cumulatives can be readily tested through scenarios using the Gate 2 river and estuary modelling tools. These include variants in standby and ramp-up/ ramp-down patterns within the 1D model of the River Thames.
Water quality	*Freshwater River Thames* In the freshwater River Thames additional olfactory data is required to assess the full suite of determinands as several were added during the Gate 2 process. Further pH data would benefit re-mineralisation design for Mogden water recycling schemes at the point of discharge at Walton Bridge. Continuous sonde data would assist understanding of daily and sub-daily variability in pH *Estuarine Thames Tideway* Dissolved oxygen concentration data for the Beckton Water Recycling Scheme were not available.	Olfaction in the freshwater River Thames will be further assessed for the Mogden water recycling scheme as additional data becomes available, as will pH and ANC. Below is a list of further determinands that lack sufficient data for a comparative olfaction analysis to take place between reference conditions and different flow scenarios; Aluminium (dissolved and total), Chromium (VI) (dissolved), Chromium (total), Selenium (dissolved and total), Silver (dissolved and total), Methiocarb, Oxamyl, Carbophenothion, Chlorpyrifos, Diazinon, Dichlorvos, Fenitrothion, Malathion, Parathion, Flucofuron, Monuron, Sulcofuron, Cyfluthrin, C10-C14 alkyl benzene sulphonic acids, Branched sodium Dodecylbenzene sulfonate, Calcium Dodecylbenzene sulfonate, Linear sodium Dodecylbenzene sulfonate, Sodium tridecylbenzene sulfonate, Triethanolammonium dodecylbenzene sulfonate, 1,6-hexanediamine, Benzalkonium chlorides, Di(hydrogenated tallow)dimethylammonium chloride, Dodecylammonium chloride, Lauryldimethylbenzyl ammonium chloride, Stearyldimethylbenzyl ammonium chloride.
Flood risk	For sites where an FRA and/or Drainage Strategy is required, the following information could be needed to inform the baseline conditions: • EA Product 4 data for detailed flow rates, flood levels and extents from EA hydraulic models; • A topographical survey to show the levels and features at the site; • Existing sewer infrastructure located on-site, including any public sewers that are not linked to the proposed development; • Phase 2 Ground Investigations to assess the ground conditions and groundwater at the site. This may include soakage tests to assess the infiltration rates for drainage, depending on the proposed development at the site.	There are 12 sites that will require an FRA based on the NPPF requirements, including sites larger than 1ha. Out of the remaining sites, there is one site which may require a drainage strategy due to an increase in the impermeable area. This is dependent on the detailed proposals and may require input from the LLFAs regarding their requirements. For sites with no increase in impermeable area, SuDS may still be required depending on the size of the site and the proposals. Confirmation of this should be obtained from the LLFAs. There are two sites which the SFRA maps show have a high risk of groundwater flooding. This may require further assessment with a Ground Investigation to determine the site-specific risk to the proposed development and surrounding area.
BIODIVERSITY		
Fisheries	The EA Ecology and Fish Data Explorer indicates that Sea lamprey and potentially river lamprey have been captured within the freshwater River Thames. These records are subject to ongoing discussion as juvenile lamprey amoecetes are notoriously difficult to identify and recent developments in eDNA would be able to confirm their presence.	Olfaction in the freshwater River Thames will be further assessed for the Mogden water recycling schemes as additional data becomes available. These data will need to be considered further in relation to migratory fish species and any potential disturbance of olfactory cues for migratory fish Records of sea lamprey and river lamprey are inconclusive within the River Thames and River Lee. Future investigations via eDNA of Lampetra sp. and Petromyzon sp. should be carried out within the Thames catchment and existing European smelt eDNA fish monitoring expanded to include twaite shad.
Aquatic ecology	*Aquatic Invertebrates* It is noted that future assessment will need to consider changes in community composition to understand if there are any signification of correlations with inter annual variation in mean river temperatures, with a specific focus on those invertebrate taxa which are considered to be emergent species. *Macrophytes* It is noted that future assessments should also consider changes in community composition to understand if there are any signification correlations with inter annual variation in mean river temperatures.	Further specificity can be added to the aquatic ecology investigations at Gate 3 through additional data and evidence gathering in Reaches E and F or: • Invertebrates, • Macrophytes, and • Diatoms.
INNS	The ability to accurately predict the impact to INNS resulting from changes to the physical environment is limited due to lack of relevant literature. Impacts due to relatively small changes to the physical environment and water quality resulting from the London Effluent Reuse scheme are difficult to predict as in reality the preference of INNS are relatively broad, evident in their ability to dominate in a broad range geographical areas. As such, in reality there are likely to be additional factors at play such as functional niche overlaps and interspecific competition between native and non-native species which are likely to be altered as a result of small-scale changes to hydrology and water quality.	It is recommended that the SAI-RAT tool is reviewed and updated before the Gate 3 assessments to account for wider comments from other users following implementation during Gate 2.
Terrestrial ecology	GiGL protected species data for Teddington DRA and Mogden water recycling scheme were merged, and no spatial information provided. This limited the ability to assess species presence within close proximity of each option. A PEA was not completed for Mogden water recycling scheme components (due to the longer proposed scheme delivery programme). Some UKHab surveys were not completed during the optimal time of year to assess annual flowering plants. Therefore, repeat surveys are recommended during spring and summer.	Protected species data request with specific 2 km and 5 km buffers around the footprint of Mogden water recycling scheme and grid references from GiGL. Ground-based bat roost assessment, hazel dormouse, great crested newts, reptile, bird, water vole, otter, and badger surveys at AWRP and shaft sites where supporting habitat has been identified. Wintering bird surveys are recommended at South West London Waterbodies SPA and Ramsar site to determine the distribution of qualifying features (gadwall and northern shoveler). This can be overlayed with noise impact assessment

[90] This scope will be reviewed once the Environmental Impact Assessment and planning application timescales have been confirmed.

Environmental Topic Area	Data gaps/uncertainties	Proposed work at Gate 3[90]
	Design changes since the UKHab survey at Mogden STW site were undertaken meant that Shaft 1 is now outside of the surveyed area and so, no baseline habitat data was available. The need for more detailed species surveys has been identified for certain taxa at certain sites.	outputs to enable quantification of potential impacts due to construction disturbance. See the Habitats Regulations Assessment Report[91] for more detail. A PEA to be completed for Mogden water recycling. UKHab survey required at Shaft/ Compound 1 to determine the type of habitat present within the area of permanent loss.
Historic environment	At present it is unclear if, and to what extent, there will be any intrusive groundworks associated with the trenchless pipeline sections of the scheme. Further detail would clarify the need for any additional mitigation measures at these sites. Currently unidentified archaeological remains may be present within any trenched and trenchless section, shaft or infrastructure site along the scheme route. The extent and nature of any archaeological remains present is currently unknown.	Further investigation of all sites is likely to be required in advance of any planning application to determine the extent and nature of any affects the proposals may have upon the setting and character of designated heritage assets, and to identify suitable mitigation strategies where required. Further investigation may also be required to determine the potential for any part of the scheme to contain surviving archaeological remains and what the nature of any such remains might be. This investigation is likely to comprise a series of desk-based archaeological and heritage assessment reports, which may be targeted upon those aspects of the scheme identified within this report as posing a potential risk to any aspect of the historic environment. All assessment reports would assist in forming suitable mitigation strategies designed to record any archaeological deposits present within the site and would seek to identify strategies by which potential negative setting and character effects upon designated assets may be reduced to an acceptable level or avoided entirely. Mitigation may involve a series of intrusive archaeological recording and design recommendations. The nature and scope of any archaeological recommendations should be agreed with the Greater London Archaeology Advisory Service (GLAAS) in advance of any construction work commencement.
Landscape and visual effects	In order to take any of the proposals through to EIA (Landscape/Townscape and Visual Impact Assessment in this instance) the final exact locations of the proposed construction compounds, pipeline routes, and the final design and placement of the built elements including dimensions, materials, and any proposed landscaping will be required. The proposed construction methodology and duration will also be required, given it is likely that many of the effects will relate to the construction period rather than to long term operation (for example all underground pipework).	In order to progress to Gate 3 the finalised designs for the three schemes will be required, including exact locations, building materials, access points, vegetation removal, and any soft landscaping/replanting.
Soils and contaminated land	Desk based assessment only using publicly available data sets which often have limited detail on the composition of the waste.	Further assessment to establish composition of waste in existing/historic landfills and risk of encountering contaminated soils, landfill gas and leachate should be undertaken by carrying out site investigations and Envirocheck review where conveyance cannot be re-routed to avoid landfill areas. Phase 1 Preliminary Risk Assessments will be progressed where a desk-based assessment is undertaken, reviewing historical mapping, British Geological Survey data, UXO screening and creating conceptual site models (as required).
Transport	Desk based assessment only using publicly available data sets. Indicative numbers of HGV movements during construction which will require refinement, including consideration of phasing. Operational vehicle numbers are unlikely to be significant, but need to be confirmed and assessed.	Traffic counts may be required at certain locations, and further discussion is required with Transport for London (TfL) to scope the requirements of a future Transport Assessment.
Navigation	The navigational impacts resulting from the lower flow changes proposed within the Mogden water recycling scheme have not been assessed at Gate 2, only the largest 200 Ml/d scheme has been assessed (although this assessed negligible impacts). There is also some uncertainty with the amount of sediment deposition that will occur along the Thames Tideway during each of the Mogden water recycling scheme scenarios. While the changes in SSC and salinity have been modelled, the amount of sediment deposition has not been modelled during Gate 2. Sediment deposition can be affected by a wide range of factors in addition to salinity and SSC, which has not been accounted for in this assessment.	As engineering design progresses, Gate 2 tools can be re-used to assess variants in each of the schemes and the impacts that this would have on navigation. This would be undertaken with bespoke modelling that incorporates any additional information that have arisen as the options progress to Gate 3. The impact of the flow changes for each option will be undertaken, instead of solely modelling the worst-case scenarios. Further scenario modelling at Gate 3 could also include for potential future developments, such as an upgraded/ replacement Thames Barrier; and the inclusion of future climate scenarios. Future climate scenarios would account for sea level change, changes in river flows and changes in London Effluent Reuse scheme operating pattern. Consider construction related impacts when installing intakes and outfalls.
Noise	The baseline assumptions are sufficient for an initial appraisal of risk only. Indicative construction methods, plant numbers and likely noise levels have been used in the calculations which will need to be refined. A critical requirement for Gate 3 is baseline noise surveys at the nearest receptors to the Beckton water recycling shaft and structures sites.	Information on noise and vibration emissions from tunnelling will be required as well as details of potential mechanical operational noise from the structures. Any changes to construction methodology and plant would be required Consultation with the London Boroughs affected by the developments would be required regarding local planning policy on noise and vibration and their criteria for construction noise and vibration. Details of proposed baseline noise surveys would ideally be approved by the local environmental health officers.
Air quality	Extensive baseline NO_2 monitoring data from diffusion tubes and automatic monitors is available in close proximity (within 1km) to the Beckton water recycling scheme. PM_{10} and $PM_{2.5}$ monitoring data is available from automatic monitors within up to 4km of the all the schemes. In addition, Defra background maps, provide background concentrations for the three schemes for all the relevant pollutants of concern. Therefore, it is concluded that suitable baseline data is available to establish baseline condition for future EIA work. The initial appraisal of risk was undertaken using a number of conservative assumptions, and did not include any modelling: - The assessment is based on an unmitigated scheme and does not consider any embedded construction mitigation measures.	Monitoring of $PM_{2.5}$ could potentially be considered nearer the SRO in order to provide data which would be relevant given the expected new $PM_{2.5}$ target. A full air quality assessment will be required to inform Gate 3.

[91] Ricardo Energy and Environment (2022). London Effluent Reuse SRO, Habitats Regulations Assessment. Report for Thames Water Utilities Ltd.

Environmental Topic Area	Data gaps/uncertainties	Proposed work at Gate 3[90]
	- The magnitude of unmitigated dust effects of the relevant sources (earthworks and construction of shafts and tunnels) has been assessed as “large” according to IAQM classifications. - It is assumed that construction activity occurs everywhere, along each pipeline route, at all times for the duration of approximately one year (considered worse case). - The sensitivity of individual receptors has been considered as high. Additional criteria not considered in the assessment at this stage: • History of dust generating activities in the area. • Likely cumulative dust effects from nearby construction sites. • Pre-existing physical screening such as trees or buildings. • Impact of road network used by the construction vehicles. • The influence of the prevailing wind direction. • Local topography	
People and communities	High level assessment only.	Full socio-economic assessment to be progressed for Gate 3. HUDU (Rapid Risk Assessment) / Health Impact Assessment

9 IMPACT RISK ASSESSMENT: TEDDINGTON DIRECT RIVER ABSTRACTION

9.1 INTRODUCTION

Using a RAG based approach (see Section 5.3 for further information), the key risks of the Teddington DRA scheme have been identified under each environmental topic. The approach seeks to understand the mechanisms (activities and pathways) by which activities arising from the scheme might affect the identified receptors, and the likely significance of the impact. Where amber or red risks have been identified, additional mitigation that could be implemented is stated.

9.2 BASELINE, EXISTING EVIDENCE BASE AND RECEPTORS

9.2.1 Water

Refer to ***Annex B.2.1. Physical Environment Assessment Report*** and ***Annex B2.2. Water Quality Assessment Report*** for full details.

9.2.1.1 Physical environment

See Section 7.2.2.1 for a description of the evidence based used for the physical environment assessment.

The potentially impacted reaches are Reaches C – F.

9.2.1.2 Water quality

See Section 7.2.1.2 for a description of the evidence base used for the water quality assessment.

See section 8.2.1.2 for detail on the baseline conditions at the Mogden STW.

9.2.1.3 Flood risk

See Section 7.2.1.3 for the approach to establishing the flood risk baseline data set.

9.2.2 Biodiversity

Refer to ***Annex B.2.3. Fish Assessment Report***, ***Annex B2.4. Aquatic Ecology Assessment Report***, ***Annex B2.5 INNS Report*** and ***B2.6. Terrestrial Ecology Assessment Report*** for full details.

9.2.2.1 Fisheries

A catalogue of the evidence base for the fish topic has been compiled which covers freshwater and estuarine fish species, weir pool and marginal habitat assessment, migratory fish species, olfactory cues and inhibitors and an assessment of European smelt. The baseline is summarised in **Table 9-1**.

Table 9-1 Teddington DRA scheme: summary of fisheries baseline

Reach	Receptor					
	Freshwater Fish	**Weir Pool and Marginal Habitat (including Sunbury Creek)**	**Estuarine Fish (including European eel)**	**Migratory Fish (including European eel)**	**European Smelt**	**Olfactory Inhibitors**
Freshwater River Thames						
C Thames Water Walton Intake to Teddington Weir	EA monitoring programme data records (2010–2021) were supplemented by project-specific fisheries monitoring completed in 2021 and 2022. Baseline data from 33 fisheries surveys across 12 sites indicates that under present conditions, the fish community is diverse, and representative of the dominant habitats associated with a typical slow-flowing glided reach, and characteristic of a lowland river.	Four assessments were conducted in this reach. Three of the four surveys indicated a 'Large' type and in 'Poor' (TR_05) and 'Fairly Poor' (TR_06; TR_08) condition. The fourth assessment found this section to be a 'K' type and in 'Fairly Poor' condition.	N/A	Presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009) across differing life-stages; brown/sea trout (UK BAP Priority species); and Atlantic salmon (Habitats Regulations, 2017; UK BAP Priority species) recorded.	N/A	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 6 sites between 2021-2022.
Estuarine Thames Tideway						
D Teddington Weir to Battersea Park	Data was obtained from EA TraC monitoring records (2010–2021). Baseline data from 70 fisheries surveys across 4 sites indicated that freshwater species dominance was apparent at the most upstream site (i.e., Richmond), with a diverse fish community recorded. Catch abundance was dominated by taxa with a high (roach: 33%) and medium-tolerance (dace: 43%) for environmental disturbance. At the second site (i.e., Kew), 5 km further downstream of Teddington Weir, a community transition is apparent. While freshwater species remain dominant, the catch abundance of roach and dace shifts to 11% and 18%, respectively. Further downstream at Chiswick and Battersea, freshwater species presence is still apparent, but the catch abundance proportion is smaller as the community progresses further toward an estuarine indicative species assemblage. Presence of European bullhead (Habitats Regulations, 2017).	x – No Weir Pool/ River Condition Assessment completed	Data was obtained from EA TraC monitoring records (2010–2021). Baseline data from 70 fisheries surveys across 4 sites indicates that under present conditions, the fish community is predominantly freshwater, but estuarine and marine juvenile species presence is apparent owing to the transitional status of the Upper Tideway. Species assemblages reflect this shift, with representation (<25% annual catch abundance) of marine species at the most upstream location. By Kew, overall annual catch abundance for marine species was still <25%, but, some annual records note a higher marine to freshwater ratio. Flounder was the most frequently captured species, accounting for 32% of catch abundance, with sea bass (17%), common goby (10%) and smelt (4%), also accounting for a large proportion of catch abundance. Further down river, at Chiswick and Battersea, fish assemblages shift to a predominantly marine community, at >75% and >85% of catch abundance, respectively.	Data obtained from EA TraC monitoring records (2010–2021) indicated presence of European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009); and brown/ sea trout (UK BAP Priority species) recorded at the Kew site. Anecdotal historical datasets also note low number presence of adult and juvenile twaite shad (section 5, Wildlife and Countryside Act, 1981; UK BAP Priority species); Atlantic salmon (Habitats Regulations, 2017; UK BAP Priority species), sea lamprey (Habitats Regulations, 2017; UK BAP Priority species); and river lamprey (Habitats Regulations, 2017; UK BAP Priority species) within the tideway.	Data obtained from EA TraC monitoring records (2010–2021) indicated presence of European smelt (UK BAP Priority species) at all 4 sites within the reach.	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 1 site between 2021-2022. Of 53 determinands, 29 were consistently below the LOD, with 2 having no available, and 24 still requiring analysis.
E Battersea Park to Tower Bridge	x - No monitoring programme data available from 2010–2021 to allow for baseline assessment. NRA data available from 1992-1993 at Vauxhall site, provisioning presence/absence indications. Historical presence of 2 high-tolerant disturbance-sensitivity taxa, namely, dace and perch.	x – No Weir Pools present. No River Condition Assessment completed	x - No baseline assessment. NRA data available from 1992-1993 at Vauxhall site, provisioning presence/absence indications. Historical presence of two estuarine species: flounder and bass.	x - No baseline assessment. NRA data available from 1992-1993 at Vauxhall site, provisioning presence/absence indications. Data indicates historical presence of Atlantic salmon (Habitats Regulations, 2017; UK BAP Priority species); and European eel (IUCN red listed: "critically endangered"; Eels Regulations, 2009) recorded.	x – no data available. EA non-statutory monitoring as part of Thames Foreshore events at Tower Bridge has recorded European smelt at this location (see also, Colclough *et al.*, 2002[93]; Gollock *et al.*, 2008[94]; Attrill and Power, 2004[95]).	Data was obtained from Thames Water WFD, EQSD and olfaction analytical suites, with spot sample data conducted at 1 site between 2021-2022. Of 53 determinands, 29 were consistently below the LOD, with 2 having no available, and 24 still requiring analysis.

[93] Colclough, S.R., Gray, G., Bark, A., and Knights, B. Fish and fisheries of the tidal Thames: management of the modern resource, research aims and future pressures. J. Fish. Biol. 60, pp. 1-10, 2002.
[94] Gollock, M., Shaw, A., Pryor, A., Godsall, B., Causon, P., Dutton, C., and Kowalik, R. Aquatic wildlife of the Thames Estuary: Monitoring Results 2007-2008. ZSL, EA, and RWE power. Pp. 10-11, Nov 2008.
[95] Attrill, M.J., and Power, M. Partitioning of temperature resources amongst an estuarine fish assemblage. Estuar. Coast. Shelf. Sci. 61, pp. 725-738, 2004.

Reach	Receptor					
	Freshwater Fish	Weir Pool and Marginal Habitat (including Sunbury Creek)	Estuarine Fish (including European eel)	Migratory Fish (including European eel)	European Smelt	Olfactory Inhibitors
				Further anecdotal historical datasets (see also, Gollock *et al.*, 2008[92]), obtained from a systematic review of open-source data, also note low number presence of adult and juvenile twaite shad (section 5, Wildlife and Countryside Act, 1981; UK BAP Priority species); sea lamprey (Habitats Regulations, 2017; UK BAP Priority species); and river lamprey (Habitats Regulations, 2017; UK BAP Priority species) within the tideway.		

[92] Gollock, M., Shaw, A., Pryor, A., Godsall, B., Causon, P., Dutton, C., and Kowalik, R. Aquatic wildlife of the Thames Estuary: Monitoring Results 2007-2008. ZSL, EA, and RWE power. Pp. 10-11, Nov 2008.

9.2.2.2 Aquatic ecology

The following baseline data has been updated between Gates 1 and 2, and is summarised in **Table 9-2**:

- Aquatic macroinvertebrates freshwater and estuarine
- Marginal habitat assessment
- Plants/diatoms
- Macroalgae, angiosperm and phytoplankton
- Designated and protected sites and species.

The relevant reaches for the Teddington DRA scheme are Reach C on the freshwater River Thames and Reaches D-F on the Thames Tideway. These are shown in **Figure 7-1** (Section 7.2.2).

Table 9-2 Teddington DRA scheme: summary of aquatic ecology baseline

Reach	Receptor					
	Aquatic/estuarine invertebrates	Marginal habitat	Macrophytes	Diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species (within 2km)
Freshwater River Thames						
Reach C Thames Water Walton Intake to Teddington Weir	LIFE data indicates that under present conditions, the invertebrate community in the impacted reach is moderately sensitive to reduced flows. Baseline data suggest that the invertebrate community within the reach from Thames Water Walton Intake to Teddington Weir is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slower flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). Invertebrates of interest were recorded in the freshwater River Thames along this reach including *Stenelmis canaliculata* and *Ephemera lineata*. *Ephemera lineata* is considered Vulnerable by ICUN Red list whilst *Ephemera lineata is* considered Vulnerable by ICUN Red list and Nationally Scarce.	RCA (x4): • TR_05: 'Large' type and Poor condition • TR_06: 'Large' type and Fairly Poor condition • TR_07: 'K' type and Fairly Poor condition • TR_08: 'Large' type and Fairly Poor condition 'K' type rivers are those which typically have a straight/sinuous planform, silt/clay dominated substrate with sand/gravel and are unconfined or partially confined in their valley.	Biological status of the macrophyte community ranges from Poor to Good, based on the calculated EQR values. This suggests that some areas of the reach contain macrophyte community within this reach is in a fairly unimpacted and natural state. Five of the seven sites contain a macrophyte community with biological status of Poor or Bad, which suggests that large sections of the reach contain macrophyte communities that are highly degraded. Mean RMNI scores suggests that the community within this reach is associated with higher nutrient enriched rivers. All sites had a similar number of Algal taxa present, along with similar amounts of functional macrophyte groups	Low percentage of diatoms that are tolerant of slightly saline waters, suggests there has been little influence of saline waters in this reach. Varied mobility of diatoms within the reach. PTV scores across the sites were generally low and diatoms were classed as only being sensitive to organic pollution.	N/A	Twelve designated sites within 2 km: 1 SAC, 3 SSSIs, 1 NNR and 7 LNRs. One site was considered to be hydrologically connected to scheme, Ham Lands LNR, and therefore requires further assessment.
Estuarine Thames Tideway						
Reach D Teddington Weir to Battersea Park	LIFE data: invertebrate community in the impacted reaches are not sensitive to reduced flows. The baseline data suggest that the invertebrate community within the reach from the Teddington Weir to Battersea Park is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slow flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). No other invertebrates of interest were recorded in the estuarine Thames Tideway Teddington Weir to Battersea Park.	x – no River Corridor Assessment completed	N/A	x – no data available	Vaucheria only algal taxon recorded - species are mostly found in freshwater or low salinity estuarine waters while a small number are fully marine. Vaucheria spp. Was noted to be patchily distributed and the percent coverage of the AIH across the survey sites in Reach D was 8.5%. Biological status of the macroalgal community is considered Bad, based on the calculated EQR values (<0). This suggests that the macrophyte community within this reach is in an impacted state.	Sixteen designated sites within 2km; 1 SAC. 4 SSSIs, 1 NNR and 10 LNRs. The following were considered to be hydrologically connected (therefore pathway for impact): • Ham Lands LNR • Isleworth Ait LRN • Syon Park SSSI • Barn Elms Wetland Centre SSSI • Duke's Hollow LNR • Chiswick Eyot LNR • Leg of Mutton Reservoir LNR • Battersea Park Nature Areas LNR
Reach E Battersea Park to Tower Bridge	x – no data available	x – no River Corridor Assessment completed	N/A	Data shows a general low saline tolerance across all sample dates, with only one recording a saline tolerant score, with that being sampled in 2007. This therefore suggests there has been little influence of saline waters in this reach. Diatoms were classed as being either tolerant to moderate or no organic pollution	x – no data available	One designated site, Battersea Park Nature Areas LNR was identified within 2 km of the reach.
Reach F Tower Bridge to 3km seawards of Beckton STW	x – no data available	x – no River Corridor Assessment completed	N/A	x – no data available	No opportunistic algae were recorded. Ulva spp. was recorded on hard substrates, along with *Fucus vesiculosus* on riprap on the upper	Thirteen designated sites were identified within 2 km; 1 SSSI and 12 LNRs.

Reach	Receptor					
	Aquatic/estuarine invertebrates	Marginal habitat	Macrophytes	Diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species (within 2km)
					shore at the estuarine Thames Tideway survey area.	None were considered to be hydrologically connected, therefore no pathway for impact.

9.2.2.3 Invasive Non-native Species

The baseline data/evidence review undertaken for each London Effluent Reuse SRO scheme is set out in Section 7.2.2.3.

The following summary is provided for the INNS baseline for the relevant reaches potentially impacted by the Teddington DRA (Reaches C and F):

- **Reach C – Thames Water Walton Intake to Teddington Weir:** A total of 30 INNS of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most frequently recorded species was Caspian Mud Shrimp, followed by Demon shrimp and Ponto-Caspian Polycheate Worm (*Hypania invalida).*
- **Reach D – Teddington Weir to Battersea Park:** A total of 32 INNS of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most abundant species were aquatic invertebrates, with New Zealand mudsnail being the most frequent, followed by Asian clam and Caspian Mud shrimp.
- **Reach E – Battersea Park to Tower Bridge:** A total of 11 species of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring surveys. The most frequently recorded species was the aquatic invertebrate species New Zealand mudsnail, followed by two terrestrial plant species False acacia and Spanish bluebell.
- **Reach F – Tower Bridge to 3km seawards of Beckton STW:** A total of 20 INNS species of interest were recorded during the baseline period within the NBN atlas and during project specific baseline monitoring survey. The most frequently recorded species were aquatic invertebrates, with the most abundant being New Zealand mudsnail, followed by Chinese mitten crab and red-gilled mudworms *Marenzelleria viridis*.

9.2.2.4 Terrestrial ecology

9.2.2.4.1 Designated sites

The relevant statutory and non-statutory designated sites within 2 km each Teddington DRA scheme components as identified by the desk study undertaken as part of the PEA of the Teddington DRA scheme[96]. A total of three LNRs and thirteen SINCs have been identified within 2km.

9.2.2.4.2 Priority habitats

All indicative shaft compounds for the Teddington DRA conveyance route were subject to UKHab surveys[97].

The UKHab surveys undertaken in Gate 2 identified that the habitats within the site compounds required for the construction of the conveyance route were typically dominated by lower distinctiveness habitats such as other neutral grassland, modified grassland, scrub, and urban habitats (e.g., developed land sealed surface). However, priority habitats were present at four of the shaft compounds. Hedgerows (priority habitat) were recorded at Shaft Compound 4, Shaft Compound 5, and Shaft Compound 6. The priority habitat lowland mixed deciduous woodland was identified at Shaft Compound 4, Shaft Compound 6, and Shaft Compound 7.

The habitats identified at the Teddington discharge location included other neutral grassland, other woodland; broadleaved, bramble scrub, and built linear features. No priority habitats were identified within the survey area for the proposed discharge location.

9.2.2.4.3 Other protected, notable and/or invasive species

The GIGL data request records of protected and notable species within 2km of all infrastructure and construction locations associated with the Teddington DRA. Locations were provided for London invasive non-native species only. The exact locations of the protected and notable species records were not provided by the LERC so where a species is identified within 2 km using a precautionary approach it is assumed to be relevant to all construction locations.

A total of 12 protected and notable plants species were identified within 2km of the Mogden Water recycling scheme including bluebell and meadow clary (*Salvia pratensis*) which are listed under Schedule 8 of the Wildlife and Countryside Act and three NERC Section 41 Priority Species: True Fox (*Carex vulpina*),

[96] Jacobs (2022). London Effluent Reuse SRO, Teddington DRA Conveyance Route: Preliminary Ecological Appraisal. Report for Thames Water Utilities Ltd, 1 – 90. B22849BM/REP/PEA/003.

[97] Jacobs (2021). London Effluent Reuse, Teddington DRA (Burnell Avenue) UK Habitat Classification Survey Report. Report for Thames Water Utilities Ltd, 1 – 17. B22849BM/REP/ECO/004

Cornflower (*Centaura cyanus*), Northern Hawk's beard (*Crepis mollis*), and Greater Water Parsnip (*Sium latifolium*).

9.2.2.4.4 Birds

The coverage of one environmental records centre overlapped with the proposed footprint of Teddington DRA: GiGL. No WeBS core count data was requested for Teddington DRA as no relevant sites with impact pathways within the construction and operational footprint of the works were identified. A PEA and UK Habs surveys were conducted along the conveyance route which have been used to inform the likelihood of bird presence.

9.2.2.5 Summary of receptors

Receptors identified at this initial stage are listed in **Table 9-3**.

Table 9-3 Teddington DRA scheme: summary of ecological receptors

Scheme component	Topic area	Receptor in proximity to scheme components
Mogden STW and Shaft 1	Terrestrial ecology	Designated sites Mogden Sewage Works SINC River Crane at St Margaret's SINC Priority habitats Protected and/or notable species Records: bats, stag beetle, notable invertebrates (large heath, marsh fritillary, white-letter hairstreak, and brown hairstreak), reptiles and common amphibians. PEA: badger, bats, amphibians.
Shaft 2	Terrestrial ecology	Designated sites Isleworth Ait LNR River Crane at St Margaret's (Richmond side) SINC River Crane at St Margaret's SINC River Thames and Tidal Tributaries SINC Protected and/or notable species Records: bats, stag beetle, notable invertebrates (large heath, marsh fritillary, white-letter hairstreak, and brown hairstreak), reptiles and common amphibians. PEA: bats, birds, reptiles, stag beetle, amphibians.
Shaft 3	Terrestrial ecology	Designated sites Moor Mead Recreation Ground SINC River Crane at St Margaret's (Richmond side) SINC Protected and/or notable species Records: bats, stag beetle, notable invertebrates (large heath, marsh fritillary, white-letter hairstreak, and brown hairstreak), reptiles and common amphibians. PEA: Eurasian otter, bats, birds, amphibians.
Shaft 4	Terrestrial ecology	Designated sites Ham Lands LNR Petersham Lodge Wood and Ham House Meadows SINC River Thames and Tidal Tributaries SINC Priority habitats Two priority habitats were identified: lowland mixed deciduous woodland and native hedgerows h2a Protected and/or notable species Records: bats, stag beetle, notable invertebrates (large heath, marsh fritillary, white-letter hairstreak, and brown hairstreak), reptiles and common amphibians. PEA: badger, bats, birds, stag beetle, amphibians.
Shaft 5	Terrestrial ecology	Priority habitats

Scheme component	Topic area	Receptor in proximity to scheme components
		Hedgerow priority habitat was recorded at this site. Protected and/or notable species Records: bats, stag beetle, notable invertebrates (large heath, marsh fritillary, white-letter hairstreak, and brown hairstreak), reptiles and common amphibians. PEA: bats, birds, reptiles, amphibians.
Shaft 6	Terrestrial ecology	Designated sites Ham Lands LNR River Thames and Tidal Tributaries SINC Priority habitats Lowland mixed deciduous woodland and hedgerow were recorded on site, which are both priority habitats. Protected and/or notable species Records: bats, stag beetle, notable invertebrates (large heath, marsh fritillary, white-letter hairstreak, and brown hairstreak), reptiles and common amphibians. PEA: badger, bats, reptiles, European hedgehog, amphibians.
Shaft 7	Terrestrial ecology	Designated sites Ham Lands LNR River Thames and Tidal Tributaries SINC Priority habitats One priority habitat, lowland mixed deciduous woodland was recorded on this site. Protected and/or notable species Records: bats, stag beetle, notable invertebrates (large heath, marsh fritillary, white-letter hairstreak, and brown hairstreak), reptiles and common amphibians. PEA: badger, bats, amphibians.
Teddington outfall and Shaft 8	Terrestrial ecology	Designated sites Ham Lands LNR Royal Park Gate Open Space SINC River Thames and Tidal Tributaries SINC Protected and/or notable species Records: bats, stag beetle, notable invertebrates (large heath, marsh fritillary, white-letter hairstreak, and brown hairstreak), reptiles and common amphibians. PEA: bats, birds, reptiles, stag beetle, European hedgehog, amphibians.
Teddington intake	Terrestrial ecology	Designated sites Ham Lands LNR Royal Park Gate Open Space SINC River Thames and Tidal Tributaries SINC Protected and/or notable species Records: bats, stag beetle, notable invertebrates (large heath, marsh fritillary, white-letter hairstreak, and brown hairstreak), reptiles and common amphibians. PEA: bats, badger. Birds, European hedgehog, amphibians.
Watercourses	Aquatic ecology and INNS	Freshwater River Thames Estuarine Thames Tideway

9.2.3 Historic environment

9.2.3.1 Baseline

The approach to the baseline data collection is set out in Section 7.2.3.1. Figures showing the locations of the receptors discussed in the following sections and their proximity to the conveyance and infrastructure are provided in **Appendix 3**.

9.2.3.1.1 National designations

The Royal Botanic Gardens, Kew, World Heritage Site extends into the Teddington DRA study area to the east of Mogden STW.

There is one Scheduled Monument located within the Teddington DRA study area located at the north of the scheme, east of Mogden STW.

There are 103 Listed Buildings within the study area. These comprise two Grade I listed buildings, 15 Grade II* listed buildings, and 86 Grade II listed buildings. Most of the listed buildings are clustered within the Isleworth Riverside and St. Margaret's Estate Conservation Areas to the north of the scheme, the centre of the Twickenham Riverside Conservation area in the central part of the scheme, and within the Ham Common, Parkley's Estate, and Teddington Lock Conservation Areas to the south of the scheme.

In the central part of the scheme study area are two registered park and gardens comprising the Grade II* listed Ham House and the Grade II listed York House.

9.2.3.1.2 Regional and local designations

Twenty conservation areas are located within the Teddington DRA scheme study area. They are concentrated to the east of Mogden STW and are located regularly along the rest of the study area.

There are 13 APAs located within the study area. The APAs are concentrated within the central and southern parts of the study area.

9.2.3.1.3 Known non-designated heritage assets

There have been 63 previous archaeological investigations undertaken within the Teddington DRA study area, most of which are located to the north of the scheme, to the north-east of Mogden STW.

There are a total of 195 known non-designated heritage assets located across the study area. There are concentrations of non-designated assets located north-east of Mogden STW and at the River Thames near Twickenham.

9.2.3.2 Summary of receptors

Below follows a summary table of designated receptors identified along the route of the Teddington DRA scheme. Receptors are defined as any designated heritage asset located within 100m, or non-designated heritage asset located within 50m, of proposed new infrastructure, trenched pipeline section, or shaft site (including the associated temporary site compound). If shaft locations or infrastructure is not listed in the table, no receptors are found within these distances. A proximity of 0m indicates that the scheme site is located directly within or on a receptor location, or that the receptor is contained within the site area.

Table 9-4 Teddington DRA scheme: summary of historic environment receptors

Scheme Component	OA[98]	Name	Proximity (m)
Shaft 1	98	Mogden Lane [Mogden Sewage Works]; prehistoric findspot	<50
Shaft 3	–	Crane Valley APA	<50
	–	Cole Park Road Conservation Area	50-100
Shaft 4	–	Thames Foreshore and Bank APA	<50
	–	Ham Fields APA	<50
	–	Ham APA	<50
	–	Ham House Conservation Area	<50
	–	Twickenham Riverside Conservation Area	50-100

[98] See Appendix 2 for gazetteer of heritage assets (OA x references) and corresponding figures.

Scheme Component	OA[98]	Name	Proximity (m)
	14	Ham House; registered park and garden	<50
	99	Orleans House (opposite); prehistoric findspot	<50
	100	Orleans House (opposite); prehistoric findspot	<50
	101	Orleans House (opposite); prehistoric findspot	<50
	102	Ham; Roman findspot	<50
	103	Ham [bank of River Thames]; early medieval heritage monument	<50
	104	Ham; early medieval findspot	<50
	105	Ham; early medieval findspot	<50
	106	Thames Foreshore; post-medieval heritage monument	<50
	107	Thames Foreshore; post-medieval heritage monument	<50
	108	Thames Foreshore; post-medieval heritage monument	<50
	109	Riverside Drive [Ham Lands]; prehistoric heritage monument	<50
	125	Ham Street [Ham House]; historic park	<50
Shaft 5	–	Ham APA	<50
	–	Ham Fields APA	<50
	109	Riverside Drive [Ham Lands]; prehistoric heritage monument	<50
Shaft 6	–	Ham Fields APA	<50
Shaft 7	–	Ham Fields APA	<50
	–	Thames Foreshore and Bank APA	50-100
	–	Teddington Lock Conservation Area	50-100
	110	Thames Gate Close [Ham Fields]; early medieval heritage monument	<50
Shaft 8	–	Ham Fields APA	<50
	–	Thames Foreshore and Bank APA	<50
	–	Kingston Thames Riverside APA	50-100
	–	Riverside North Conservation Area	50-100
Teddington intake	–	Kingston Thames Riverside APA	<50
	–	Thames Foreshore and Bank APA	<50
	–	Riverside North Conservation Area	<50
	–	Broom Water Conservation Area	<50

9.2.4 Landscape

9.2.4.1 Baseline

A study area of 500m to either side of the Teddington DRA scheme was applied for the initial appraisal. The study area was informed by desk and an initial site visit. Field survey work was carried out on Weds 6 June 2022 under clear weather conditions. This included visits to the sites and study areas to consider the likely effects of the proposed developments on landscape/townscape character and on views and visual amenity.

The study area has also been informed by an understanding of the topography, vegetation and built development in the surrounding landscape / townscape.

9.2.4.1.1 National designations

Nationally important landscapes (National Parks and Areas of Outstanding Natural Beauty) have protection through law. There are no nationally important landscapes in the study areas for this assessment.

9.2.4.1.2 Local designations

The existing Mogden STW is one of the largest sewage works in the UK, and contains a number of Art Deco infrastructure buildings. The STW is contained by a dense bank of vegetation along the northern, eastern and southern boundaries (see Photo 2, Section 8.2.4.1.2). The Crane River Walk runs through the centre of the existing STW. The proposed development site is within the eastern boundary of the STW. The proposed effluent tertiary treatment at Mogden STW is part of the Mogden Sewage Works SINC. Land to the east, south and west of Mogden STW is designated as Open Space (Other).

The proposed Teddington outfall and intake sites are upstream of Teddington Weir. The sites are open grassland along the River Thames, with mature trees and some vegetation. A number of rights of way cross the sites, including the Thames Path. The outfall site lies within Ham Lands SINC, and is within Metropolitan Open Land (MOL). The intake site is adjacent to the River Thames and tidal tributaries SINC, and within the Kingston upon Thames Northern Riverside Conservation Area.

The pipeline route and shaft sites cross the landscape/townscape between Mogden and Teddington. The pipeline route and shaft sites cross a number of parks and public open spaces, public rights of way, Conservation Areas and SINCs.

Photo 4 Typical view of the Teddington riverbank, with the Thames Path visible on the river bank

9.2.4.2 Summary of receptors

Visual receptors (people) which may be impacted by the proposed development are:

<u>Mogden STW</u>

- Residents to the south of the site on Beaumont Place and Trevor Close.
- Residents to the east of the site on Lynton Close, Hillary Close and Barkside Close
- Recreational users of Redlees Park to the east.

<u>Pipeline</u>

- Local residents and road users.

<u>Discharge and Intake at Teddington</u>

- Local community to the north including Burnell Avenue and Drysart Avenue.
- Local community to the south across the Thames including Broom Water West.

- Recreational users of the River Thames (e.g. rowers, sailors).
- Recreational users of Burnell Avenue Play Space.
- Recreational users of Thames Path.
- Recreational users of The Lensbury Club to the south across the Thames.

9.2.5 Soils and contaminated land

9.2.5.1 Baseline

The approach to the baseline data collection is set out in Section 7.2.5.1. The geology of the shaft locations and conveyance route was analysed through British Geological Survey Geology (BGS)[37]. The identified superficial and bedrock geology are listed in **Table 9-5**.

The historic landfills within 1.5km of the conveyance route and which are intersected by the proposed route are noted in **Table 9-5**.

Table 9-5 Teddington DRA scheme: contaminated land baseline

Location	Close to waste?	Historic landfill / type of waste	Geology	Potential pathway
Mogden STW site	No. Closest 180m south	Ivybridge, last input 1966. Inert and industrial waste with gas control. EAHLD11374	Superficial: Langley Silt Member – clay and silt Bedrock: London Clay Formation – clay, silt and sand	None
Shaft 2	No. Closest 70m south	Crane Avenue Allotments, last input 1961. Waste type unknown. EAHLD11058	Superficial: Kempton Park Gravel Member – sand and gravel Bedrock: London Clay Formation – clay, silt and sand	Yes, via excavation through waste
Shaft 3	No. Closest 390m south	Crane Avenue Allotments, last input 1961. Waste type unknown. EAHLD11058	Superficial: Kempton Park Gravel Member – sand and gravel Bedrock: London Clay Formation – clay, silt and sand	None
Shafts 4 – 7 and Teddington Shaft site	No	-	Shaft 4: Superficial: Alluvium – clay, silt, sand and peat Shafts 5 – 7: Superficial: Kempton Park Gravel Member – sand and gravel Bedrock: London Clay Formation – clay, silt and sand	None
Tunnel between Shaft 2 and Shaft 3	Yes. Tunnel crosses landfill	Crane Avenue Allotments, last input 1961. Waste type unknown. EAHLD11058	Superficial: Kempton Park Gravel Member – sand and gravel Bedrock: London Clay Formation – clay, silt and sand	Yes, via excavation through waste

Further work will be required for Gate 3 to establish what baseline evidence local planning authorities hold, complete the necessary Envirocheck requests and understand the likelihood of needing preliminary site investigations.

9.2.5.2 Summary of receptors

The hydrogeological properties of the main geological strata are listed below based on the Defra MAGIC aquifer designation map[39]. Secondary A and Secondary Undifferentiated Aquifers are vulnerable to leaching of ground contamination as they may be important in supporting local abstractions or providing baseflow to rivers and streams. Groundwater sampling should be undertaken during ground investigation to confirm the risk.

Geology:

Superficial deposits:

- Alluvium – Secondary Undifferentiated
- Langley Silt Member – Unproductive Stratum
- Kempton Park gravel member – Secondary A Aquifer

Bedrock geology:

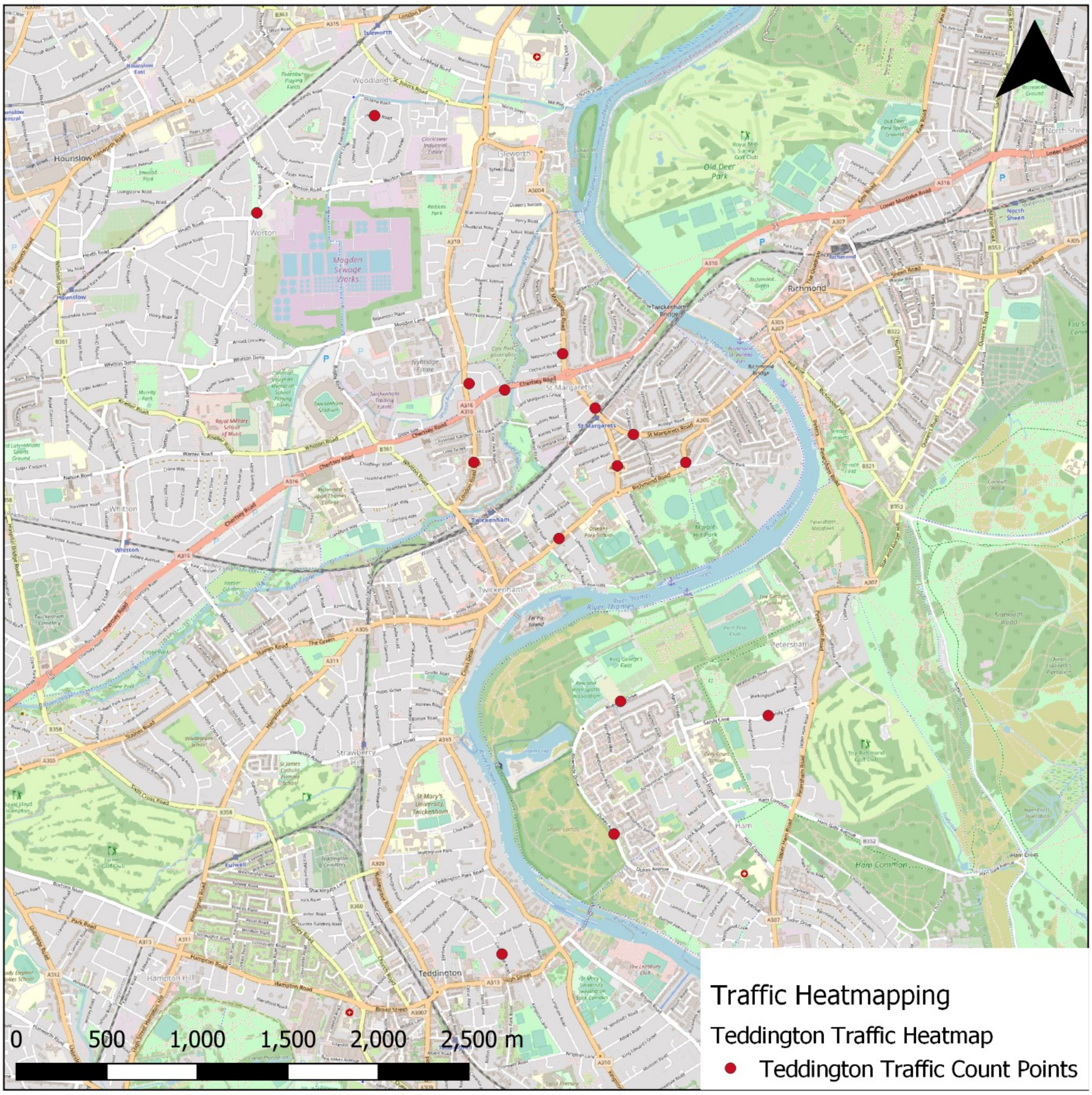
London Clay Formation is an unproductive stratum which acts as a natural sealant preventing leaching of ground contaminants to groundwater. There is a covering of London Clay Formation which will prevent downward migration of contamination and protect the Chalk stratum. Should the proposed conveyance penetrate the base of the London Clay Formation, groundwater sampling and detailed risk assessment should be undertaken to confirm the risk.

Excavating landfill areas as identified in **Table 9-5** will pose a significant ground gas risk and groundwater risk as the landfill condition and engineering is unknown. Therefore, construction workers, nearby occupants and groundwater will be impacted.

9.2.6 Transport

The same approach as outlined for the Beckton water recycling scheme, Section 7.2.6, was applied to the Teddington DRA scheme. A map of traffic count points used to determine relative increases in traffic flows because of the construction of the Teddington DRA Scheme is shown in **Figure 9-1**.

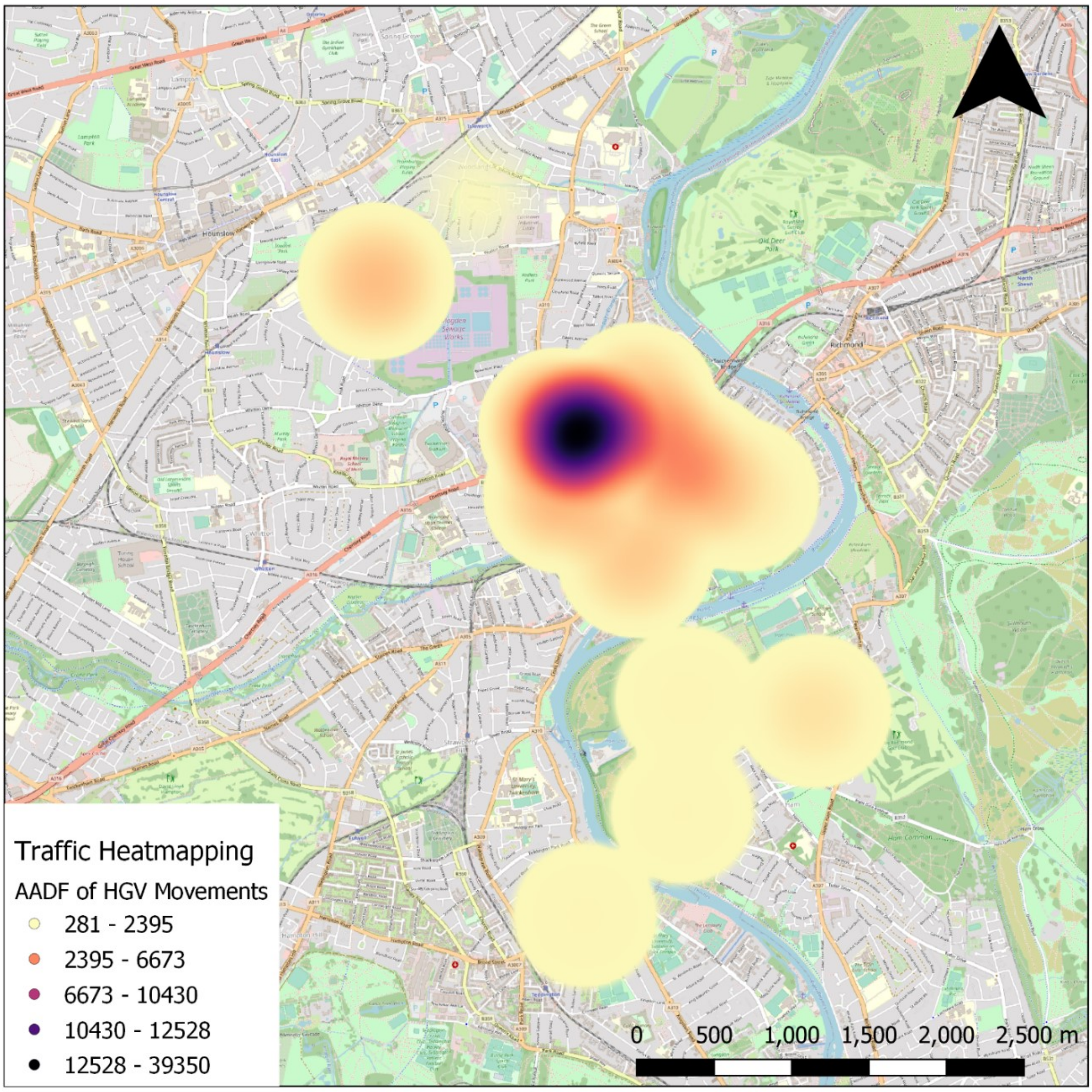
Figure 9-1 Teddington DRA scheme: traffic count points



As these traffic count points are located on roads of different natures, they have very different traffic compositions. A heatmap, showing the relative numbers of HGV movements currently past each of these points, is shown in **Figure 9-2**.

Figure 9-2 clearly shows that within the study area, the A316 around St Margarets has the largest level of HGV movements, with the area to the immediate south-east around the A3004 also has high levels. The A316 is a major artery which runs between Chiswick High Road and the M3, connecting the south of England to London. This may explain the high HGV levels in this area. The residential areas around Petersham, Ham and Teddington have much lower levels of HGV movements as a baseline, with the traffic make-up in those areas much more focused around smaller private cars.

Figure 9-2 Teddington DRA scheme: baseline HGV movements in the construction area



9.2.7 Navigation

No specific baseline survey work has been undertaken at Gate 2 to complete the assessment, rather information on the pathway for impacts has been drawn from the physical environment assessment and consulted on with the PLA.

9.2.8 Noise

9.2.8.1 Baseline

The same approach to establishing a baseline, as outlined for the Beckton water recycling scheme (Section 7.3.8) was applied to the Teddington DRA scheme.

An estimated ambient noise level was assigned to the sensitive receptors nearest to each of the proposed shaft and structure construction sites and to receptors along the sections of trenched pipeline.

At this initial stage of technical studies, baseline night time noise levels have not been considered but may be required at a later stage if night time construction works are likely to be needed.

9.2.8.2 Summary of receptors

Receptors identified at this initial appraisal stage are those nearest to each of the construction site locations. Mapping has been used to identify the nearest receptors and to determine the distance from the construction sites, listed in **Table 9-6**.

Table 9-6 Teddington DRA scheme: noise receptors and estimated distance from construction sites

Construction sites	Nearest Receptors	Closest distance to site (m)
Tertiary Treatment Plant	Hillary Drive, Bankside Close, Lynton Close	50-100
Mogden STW Shaft	Beaumont Place, Trevor Close	50-100
Shaft 2	Crane Avenue, Northcote Road, Haliburton Road	<50
Shaft 3	Moormead Road, Lancaster Place	50-100
Shaft 4	Riverside	150-200
Shaft 5	Riverside Drive	<50
Shaft 6	Breamwater Gardens	100-150
Shaft 7	Locksmeade Road, Tideway Close	<50
Teddington Shaft/Outfall	Burnell Avenue	<50
Thames Lee Tunnel Shaft connection	Northweald Lane, Chivenor Grove, Horsley Drive	<50

9.2.9 Air quality

9.2.9.1 Baseline

The same approach to establishing a baseline, as outlined for the Beckton water recycling scheme (Section 7.3.9) was applied to the Teddington DRA scheme.

All the local authorities within the boundary of the Teddington DRA scheme employ the use of NO_2 diffusion tubes (DT) at a range of locations across their authority and some also employ the use of automatic monitoring (AM) stations which measure (NO_2, PM_{10} and $PM_{2.5}$) [99].

Details of the closest monitoring sites (within 1km for DT and within 3km for AM) which monitor annual mean NO_2, hourly mean NO_2, annual mean PM_{10}, daily mean PM_{10} and annual mean $PM_{2.5}$ are presented in the tables within **Appendix 4**. The findings of the data review are as follows:

- **Annual mean NO_2 concentrations** at the monitoring sites have reduced with each year. Using the pre-covid year of 2019, the annual mean NO_2 concentrations still remain mostly below the National Air Quality Objective (NAQO) of 40 µg/m^3 except at seven sites (within distance 1km of the SRO) in the London Borough of Richmond.[100].
- **NO_2 hourly mean NAQO** was achieved at all the nearby automatic monitors, with a maximum number of hourly exceedances of 200µg/m^3 for five hours at Cromwell Road in 2019. This is much lower than the 18 times a year stipulated in the NAQO. The annual mean NO_2 concentrations at the monitoring sites are less than 60 µg/m^3 at all the DT, and as such it is expected that the hourly mean objective would also be achieved.
- **Annual mean PM_{10} concentrations** at the automatic monitoring sites are within the NAQO of 40 µg/m^3 at all nearby sites with a maximum concentration of 26 µg/m^3 at Cromwell Road in 2019.
- **PM_{10} daily mean NAQO** was achieved at all the nearby automatic monitors with a maximum number of daily exceedances of 50µg/m^3 experienced for 15 days at Cromwell Road in 2019. This is much lower than the 35 times a year stipulated in the NAQO.

[99] NO_2 nitrogen dioxide, PM_{10} Particles, $PM_{2.5}$ Fine Particles, NO_x oxides of nitrogen.

[100] The year 2020 is unlikely to be representative of a typical yearly concentration due to the Covid lockdown restrictions

- **Annual mean $PM_{2.5}$ concentrations** at the nearby automatic monitoring sites are within the NAQO of 25 µg/m^3 at all nearby sites with a maximum concentration of 13 µg/m^3 at Brentford, Great West Road in 2019. However, annual mean $PM_{2.5}$ levels exceed the proposed Environment Act 2021 target of 10µg/m^3 at most of the nearby sites.
- **Background concentrations** are all well within the annual mean NAQOs for all pollutants in 2018 except for the vegetation protection guideline for NOx. $PM_{2.5}$ complies with the NAQO of 25µg/m^3 but is slightly above the proposed Environment Act 2021 target of 10µg/m^3.

9.2.9.2 Summary of receptors

Parts of the schemes are located in close proximity to a mixture of sensitive ecological land uses (i.e. SPA, SSSI, SAC, Ramsar etc), residential areas, watercourses and agricultural land bordered by hedgerows. **Table 9-7** below summarises the locations of the scheme, relevant LAs and nearby sensitive ecological land uses (within 10km for international habitats (SAC, SPA and Ramsar) and 2km for all other habitat types (SSSIs)) and nearest receptors.

Table 9-7 Teddington DRA scheme: air quality - relevant Local Authorities, human and ecological receptors

	Teddington Direct River Abstraction (DRA)
Nearby ecological receptors	**SPA sites** South West London Waterbodies SPA **Ramsar sites** South West London Waterbodies Ramsar **SAC sites** Richmond Park SAC Wimbledon Common SAC **SSSI sites** Richmond Park SSSI Bushy Park and Home Park SSSI Syon Park SSSI
Indicative Nearby human receptors	Properties in the St Margarets area and Twickenham area including Riverside Drive, Dukes Avenue, Dawes Avenue, Drake Avenue, Northcote Road, Sidney Road, Moor Mead Road, Victoria Road, Haggard Road, Lebanon Park, Riverside Drive, Dukes Avenue, Burnell Avenue etc. Schools - Orleans Park School, St Mary's Primary School (juniors)
Local Authority	London Borough of Richmond Tiny section in London Borough of Hounslow Adjacent to Royal Borough of Kingston upon Thames

9.2.10 People and communities

9.2.10.1 Socio-economics

The Teddington DRA scheme covers three LAs in London; London Borough of Hounslow, London Borough of Richmond upon Thames and London Borough of Kingston upon Tames. Current population estimates in these LAs, London and England from the 2021 Census are highlighted in **Table 9-8**.

Table 9-8 Teddington DRA scheme: total population by area[101]

Area	Population
Hounslow	288,000

[101] Office for National Statistics (2021) Census 2021. P01. Available at: https://census.gov.uk/census-2021-results

Area	Population
Richmond upon Thames	195,200
Kingston upon Thames	168,000
London	8,799,800
England	56,489,800

Table 9-9 shows further baseline data on the demographic distribution of population by age and gender in the reaches that will be impacted by the Teddington DRA scheme.

Table 9-9 Teddington DRA scheme: population distribution by age and gender[102]

Area	Female Population	Male Population	Ages 0-19	Ages 20+
Hounslow	145,000	143,100	72,200	216,100
Richmond upon Thames	101,300	93,900	47,200	148,000
Kingston upon Thames	87,000	81,000	40,100	127,900
London	4,531,500	4,268,300	2,085,300	6,714,500
England	28,833,500	27,656,300	13,057,600	43,432,100

Table 9-10 highlights the percentage proportion of ethnic diversity within the assessment area, London and England.

Table 9-10 Teddington DRA scheme: ethnicity per area[103]

Area	White British	All White Other	Mixed Ethnic Groups	Asian/Asian British	Black/African/ Caribbean/ Black British	Other Ethnicity Group
Hounslow	33.58%	16.42%	2.61%	35.07%	5.60%	6.72%
Richmond upon Thames	72.31%	14.36%	3.59%	5.13%	1.54%	3.08%
Kingston upon Thames	62.21%	11.63%	3.49%	13.37%	2.91%	6.40%
London	43.80%	15.57%	3.72%	18.37%	12.49%	6.06%
England	78.74%	6.16%	1.75%	7.95%	3.52%	1.87%

London is a heavily built-up area with typically high population density. **Table 9-11** shows the population density of the local authorities within the Teddington DRA scheme area compared with London and England.

[102] Office for National Statistics (2021) Census 2021. P02. Available at: https://census.gov.uk/census-2021-results

[103] Office for National Statistics (2021) Population estimates by ethnic group and religion, England and Wales: 2019. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/populationestimatesbyethnicgroupandreligionenglandandwales/2019

Table 9-11 Teddington DRA scheme: population density by area[104]

Area	Population Density (number of residents per km^2)	Households
Hounslow	5,150	103,000
Richmond upon Thames	3,401	80,700
Kingston upon Thames	4,509	65,600
London	5,598	3,423,800
England	434	23,435,700

The economic profile of the local authorities that will be impacted during construction and operation of the Teddington DRA scheme are highlighted in **Table 9-12**.

Table 9-12 Teddington DRA scheme: economic profile[105][106][107]

Area	Percentage of people in employment (2020/2021)	Children in low-income families (under 16)	Mean Annual Gross Pay
Hounslow	72.8%	13.8%	£33,890
Richmond upon Thames	75.6%	8.5%	£54,688
Kingston upon Thames	77.8%	11.7%	£45,708
London	74.5%	18.8%	£42,001
England	75.1%	17.0%	£32,049

9.2.10.2 Human health

Life expectancy at birth is one of the main indicators used to determine the status of health and economic development amongst a demographic. The London Borough of Richmond upon Thames has a life expectancy significantly higher than that of the National and Regional average. Under 75 mortality rate and percentage of physically active adults has the ability to measure the fitness and health of a local community profile. The London Borough of Hounslow has a lower percentage of adults that are physically active as well as an above average under 75 mortality rate for the London Local Authorities.

[104] Office for National Statistics (2021) Census 2021. P04. Available at: https://census.gov.uk/census-2021-results

[105] Office for National Statistics (2022) Labour Force Survey. Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/methodologies/labourforcesurveyuserguidance

[106] HMRC (2022) Personal Tax Credits: Child Poverty Statistics. Available at: https://www.gov.uk/government/collections/personal-tax-credits-statistics

[107] Office for National Statistics (2021) Earnings and hours worked, place of residence by local authority. Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/placeofresidencebylocalauthorityashetable8

Table 9-13 Teddington DRA scheme: health and wellbeing[108][109][110]

Area	Life Expectancy at Birth (Male)	Life Expectancy at Birth (Female)	Under 75 mortality rate from all causes (per 100,000)	Percentage of Physically active adults (2020/2021)
Hounslow	79.4%	83.7%	332.2	57.9%
Richmond upon Thames	82.2%	86.4%	236.3	74.0%
Kingston upon Thames	81.7%	85.2%	261.2	68.6%
London	80.3%	84.3%	316.1	64.9%
England	79.4%	83.1%	336.5	65.9%

9.2.10.3 Index of multiple deprivation

The Index of Multiple Deprivation[111] is the official measure of relative deprivation in England which combines information from the seven domains (Income Deprivation; Employment. Deprivation; Education, Skills and Training Deprivation; Health Deprivation and Disability; Crime; Barriers to Housing and Services; and Living Environment Deprivation).

Where each LA ranks nationally based on the average score achieved is highlighted in **Table 9-14**. The average score measure is calculated by averaging the LSOA ranks in each larger area after being weighted by population. A rank of 1 (out of 317) represents the highest average score equating to the highest area of deprivation. Both the London Borough of Richmond upon Thames and London Borough of Kingston upon Thames are ranked in the lowest 25% of the deprived areas nationally with Richmond one of the least deprived areas in the country. The London Borough of Hounslow ranks higher compared to the other local authorities affected by the Teddington DRA scheme.

Also included in **Table 9-14** are the proportion of Lower Layer Super Output Areas (LSOAs) in most deprived 10% nationally. A small proportion (0.7%) of London Borough of Hounslow is in the most deprived 10% nationally.

Table 9-14 Index of Multiple Deprivation [Teddington DRA]

Area	IMD 2019 – Local Authority Rank	IMD 2019 – Proportion of LSOAs in most deprived 10% nationally
Hounslow	95	0.7%
Richmond upon Thames	297	0.0%
Kingston upon Thames	270	0.0%

9.2.10.4 Cultural infrastructure

Table 9-15 shows the cultural infrastructure, within the London Cultural Infrastructure Plan, that is within 500m of a construction site associated with the Teddington DRA scheme. These cultural assets are important for a number of reasons; they support local culture and identity, they support jobs and businesses and they help to maintain London's status as a global centre of culture.

[108] ONS (2021) Life Expectancy Estimates. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/datasets/lifeexpectancyestimatesallagesuk

[109] Office for Health Improvement and Disparities (2021) Mortality Profiles. Available at: https://www.gov.uk/government/statistics/mortality-profile-december-2021

[110] Office for Health Improvement and Disparities (2022) Physical Activity. Available at: https://www.gov.uk/government/statistics/physical-activity-data-tool-january-2022-update

[111] Ministry of Housing, Communities & Local Government (2019) English Indices of Deprivation 2019. Available at: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019

These assets may be impacted by construction in a number of different ways;

- The setting of them could be impacted by construction work nearby, lowering their attractiveness to visitors and the community;
- They may become temporarily more difficult to access due to nearby construction work causing road closures, diversions, or by increasing traffic volume;
- An increase in land purchasing in an area may result in an increase in land value, meaning cultural assets may begin to be displaced;

The majority of cultural assets listed in **Table 9-15** are not anticipated to be impacted by the proposed scheme, due to screening by other buildings. However, due to construction work being within proximity or views of them, adverse impacts cannot be ruled out for the following assets;

- The White Swan pub on Twickenham Riverside;
- The Hawker Centre
- The Royal Oak

Table 9-15 Cultural infrastructure within 500m of the Teddington DRA infrastructure

Name	Type	Ward
Art and Craft Studios	Artist Workspace	Isleworth
The Landmark Arts Centre	Arts Centre & Dance Venue	Teddington
The Bridgelink Centre	Community Centre	Isleworth
Rambert School Studio Theatre	Dance Studio	St Margaret's and North Twickenham
Patchworks	Grassroots Music Venue	Twickenham Riverside
Twickenham Library	Library	Twickenham Riverside
Isleworth Library	Library	Isleworth
Ham House	Museum / Gallery	Ham, Petersham and Richmond Riverside
Orleans House Gallery	Museum / Gallery	Twickenham Riverside
The White Swan	Music Office & Venue, Pub	Twickenham Riverside
The Fox	Music Office & Venue	Twickenham Riverside
The Crown	Music Office & Venue, Pub	Twickenham Riverside
The Royal Oak	Music Office & Venue, Pub	Isleworth
The Hawker Centre	Pub	Tudor
Tide End Cottage	Pub	Teddington
The Turks Head	Pub	St Margaret's and North Twickenham
The Ailsa Tavern	Pub	St Margaret's and North Twickenham
Le Baron	Pub	Twickenham Riverside
The Barmy Arms	Pub	Twickenham Riverside
The Crafty Winger	Pub	Twickenham Riverside
The Brewery Market	Pub	Twickenham Riverside
The Bear	Pub	Twickenham Riverside
Shack 68	Pub	Twickenham Riverside
The William Webb Ellis	Pub	Twickenham Riverside
The Cabbage Patch	Pub	Twickenham Riverside
The Timberyard	Pub	Twickenham Riverside
The Victoria Tavern	Pub	Isleworth
The Mary Wallace Theatre	Theatre	Twickenham Riverside

9.3 ASSESSMENT

9.3.1 Water

Refer to ***Annex B.2.1. Physical Environment Assessment Report*** and ***Annex B2.2. Water Quality Assessment Report*** for full details.

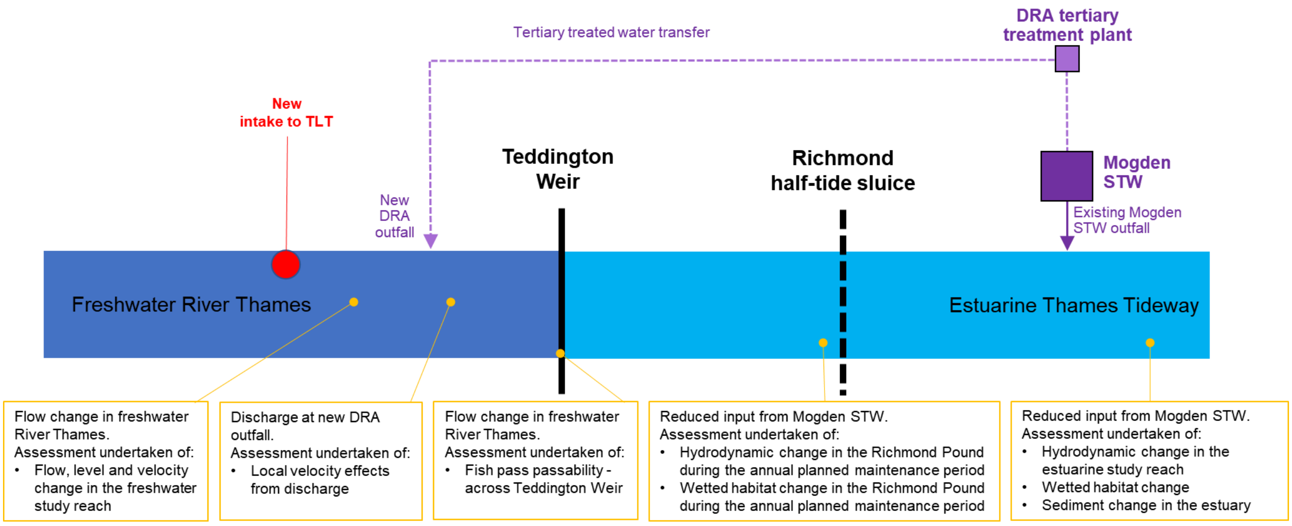
9.3.1.1 Physical Environment

9.3.1.1.1 Activities and pathways for impact

The Physical Environment Assessment for the Teddington DRA scheme considered the following, and is summarised in **Figure 9-3** :

- Flow changes from Teddington DRA scheme;
- Review of Teddington DRA outfall and intake design including screening;
- Wetted habitat change in freshwater River Thames and estuarine Thames Tideway;
- Teddington Weir fish pass and barrier passability;
- Richmond Pound drawdown physical environment assessment;
- Thames Tideway estuarine sediment assessment.

Figure 9-3 Representation of the Teddington DRA study area with conceptualisation of physical environment effects and listing of assessment undertaken for Gate 2



9.3.1.1.2 Impact risk and additional mitigation requirements

The Teddington DRA scheme may lead to up to moderate reduction in flows when compared to the baseline conditions in the ~250m of the River Thames between the intake and outfall. However, these changes are negligible when considering impacts to water level depth and flow velocities. Additionally, the data indicates that there are negligible impacts on fish pass barrier possibility, negligible impacts on the Richmond Pound and on wetted habitat, water level and suspended sediment concentration in the Thames Tideway.

Table 9-16 summarises the potential physical environment impacts for each of the sizes of a Teddington DRA scheme.

Table 9-16 Teddington DRA scheme: summary of potential physical environment impacts

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Flows	Freshwater River Thames: 250m reach	**50 Ml/d** 17% reduction in exceptionally low flows for 250m between intake and	G	Not required

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
	between intake and outfall	outfall (under 300 Ml/d river flow upstream of intake).		
		75 Ml/d 25% reduction in exceptionally low flows for 250m between intake and outfall (under 300 Ml/d river flow upstream of intake).	G	Not required
		100Ml/d 33% reduction in exceptionally low flows for 250m between intake and outfall (300 Ml/d upstream of intake)	G	Not required.
		150Ml/d 50% reduction in exceptionally low flows for 250m between intake and outfall (300 Ml/d upstream of intake)	G	Not required.
	Estuarine Thames Tideway	**50, 75, 100 and 150 Ml/d** Inferred from Mogden water recycling scheme option sizes (200 Ml/d). Changes in minimum (low tide) water levels less than 6cm, with greatest effect centred around Isleworth Ait.	G	Not required.
Outfall design	Freshwater River Thames	**50, 75, 100 and 100 Ml/d** Negligible change in velocities inferred from larger option modelling.	G	Not required.
Wetted habitat	Freshwater River Thames: 250m between intake and outfall	**50, 75, 100 and 150 Ml/d** Negligible change in water level or velocities between intake and outfall modelled. Negligible change in wetted habitat.	G	Not required.
Barrier passability	Freshwater River Thames	**50, 75, 100 and 150 Ml/d** Negligible water level change inferred from larger scheme modelling assessment of negligible	G	Not required.
Richmond Pound drawdown	Freshwater River Thames	**50, 75, 100 and 150 Ml/d** Negligible changes in physical environment within Richmond Pound under all sizes.	G	None required.
Estuarine sediment	Estuarine Thames Tideway	**50, 75, 100 and 150 Ml/d** Negligible changes in suspended solids concentration within the estuary.	G	Not required.

9.3.1.2 Water Quality

9.3.1.2.1 Activities and pathways for impact

The Teddington DRA schemes may lead up to minor changes in the general physico-chemical environment compared to the baseline conditions of the River Thames. The 50 Ml/d scheme will have a negligible impact on WFD chemicals, EQSD chemicals and Olfactory water quality. The 75Ml/d, 100Ml/d and 150Ml/d scheme induces some minor changes in the physico-chemical environment.

9.3.1.2.2 Impact risk and additional mitigation requirements

Table 9-17 summarises the potential water quality impacts for each of the sizes of a Teddington DRA scheme.

Table 9-17 Teddington DRA scheme: summary of potential water quality impacts

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Water temperature	Freshwater River Thames	**50 Ml/d** Maximum change 0.7°C	G	Not required.
		75 Ml/d Maximum change 1.1°C	G	Not required.
		100Ml/d Maximum change 1.5°C	G	Not required.
		150Ml/d Maximum change 2.2°C	G	Not required.
	Estuarine Thames	**50Ml/d** Negligible impacts	G	Not required.
		75Ml/d Negligible impacts	G	Not required.
		100Ml/d Negligible impacts	G	Not required.
		150Ml/d Negligible impacts	G	Not required.
General physico-chemical	Freshwater River Thames	**50 Ml/d** DO: No change Ammoniacal Nitrogen: No change BOD: Minor impacts under A82 and M96. Suspended solids: Positive impacts under A82 and M96. Total phosphorus: Minor impacts under A82 and M96. ANC: No indication that ANC is affected by scheme in operation. pH: No significant difference.	G	Not required.
		75 Ml/d: DO: No change Ammoniacal Nitrogen: No change BOD: Minor impacts under A82 and M96. Suspended solids: Positive impacts under A82 and M96. Total phosphorus: Minor impacts under A82 and M96. ANC: No indication that ANC is affected by scheme in operation. pH: No significant difference	G	Not required.
		100Ml/d DO: No change Ammoniacal Nitrogen: No change BOD: Minor impacts under A82 and M96. Suspended solids: Positive impacts under A82 and M96. Total phosphorus: Minor impacts under A82 and M96. ANC: No indication that ANC is affected by scheme in operation. pH: No significant difference	G	Not required.
		150Ml/d	G	Not required.

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
		Dissolved oxygen: Negligible impacts Ammoniacal Nitrogen: Minor impacts under A82 and M96. BOD: Positive impacts under A82 and M96. Suspended solids: Positive impacts under A82 and M96. Total phosphorus: Minor impacts under A82 and M96. ANC: No indication that ANC is affected by scheme in operation. pH: No significant difference.		
	Estuarine Thames	**50Ml/d** Estuarine Thames DO: Negligible impacts inferred from Mogden effluent Reuse scheme at 200 Ml/d modelling DIN: Decrease in concentration during scheme on period, average 58.6 µMol/l (A82) and 51.7 µMol/l (M96).	G	Not required.
		75Ml/d DO: Negligible impacts inferred from Mogden effluent Reuse scheme at 200 Ml/d modelling DIN: Decrease in concentration during scheme on period, average 55.6 µMol/l (A82) and 48.5 µMol/l (M96).	G	Not required.
		100Ml/d DO: Negligible impacts inferred from Mogden effluent Reuse scheme at 200 Ml/d modelling DIN: Decrease in concentration during scheme on period, average 52.5 µMol/l (A82) and 45.3 µMol/l (M96).	G	Not required.
		150Ml/d DO: Negligible impacts inferred from Mogden effluent Reuse scheme at 200 Ml/d modelling DIN: Decrease in concentration during scheme on period, average 46.4 µMol/l (A82) and 38.8 µMol/l (M96).	G	Not required.
WFD chemicals	Freshwater River Thames	**50 Ml/d** 8 determinands decreased to be below the standard. 11 continued to exceed standards under the A82 scenario and 3 new pressures exceeded standards. The same occurs in the M96 scenario with 3 additional pressures.	G	Not required.
		75 Ml/d 8 determinands decreased to be below the standard. 11 continued to exceed standards under the A82 scenario and 3 new pressures exceeded standards. The same occurs in the M96 scenario with 3 additional pressures.	G	Not required.
		100Ml/d 8 determinands decreased to be below the standard. 11 continued to exceed standards under the A82 scenario and 3 new pressures exceeded standards. The same occurs in the M96 scenario with 3 additional pressures.	G	Not required.
		150Ml/d	G	Not required.

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
		8 determinands decreased to be below the standard. 11 continued to exceed standards under the A82 scenario and 3 new pressures exceeded standards. The same occurs in the M96 scenario with 3 additional pressures.		
	Estuarine Thames	**50Ml/d** Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.
		75Ml/d Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.
		100Ml/d Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.
		150Ml/d Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.
EQSD chemicals	Freshwater River Thames	**50 Ml/d** Only one determinand exceeds standard under reference conditions and there is one additional pressure under A82 scenario. The changes remained the same under the M96 scenario.	G	Not required.
		75 Ml/d Only one determinand exceeds standard under reference conditions and there is one additional pressure under A82 scenario. The changes remained the same under the M96 scenario.	G	Not required.
		100Ml/d Only one determinand exceeds standard under reference conditions and there is one additional pressure under A82 scenario. The changes remained the same under the M96 scenario.	G	Not required.
		150Ml/d Only one determinand exceeds standard under reference conditions and there is one additional pressure under A82 scenario. The changes remained the same under the M96 scenario.	G	Not required.
	Estuarine Thames	**50Ml/d** Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.
		75Ml/d Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.
		100Ml/d Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.
		150Ml/d Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Olfactory water quality	Freshwater River Thames	**50 M/d** A82 and M96 both have 10 exceedances with two new pressures and one reduced pressure compared to the reference conditions.	G	Not required.
		75 Ml/d A82 and M96 both have 10 exceedances with two new pressures and one reduced pressure compared to the reference conditions.	G	Not required.
		100Ml/d A82 and M96 both have 10 exceedances with two new pressures and one reduced pressure compared to the reference conditions	G	Not required.
		150Ml/d A82 and M96 both have 10 exceedances with two new pressures and one reduced pressure compared to the reference conditions.	G	Not required.
	Estuarine Thames	**50Ml/d** Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate	G	Not required.
		75Ml/d Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate	G	Not required.
		100Ml/d Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.
		150Ml/d Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.	G	Not required.
Richmond Pound Drawdown	/	Negligible impacts inferred from Mogden water recycling scheme at every deployable output scenario.	G	Not required.

9.3.1.3 Flood risk

9.3.1.3.1 Activities and pathways for impact

The same activities and pathways for impact, as identified for the Beckton water recycling scheme in Section 7.3.1.3.1 are applicable to the Teddington DRA scheme.

9.3.1.3.2 Impact risk and additional mitigation requirements

Further definition has been applied to the RAG criteria, relevant to each type flooding. This is provided in **Appendix 5**.

9.3.1.3.2.1 Construction

Without mitigation, the construction related impacts have the potential to have an Amber RAG rating at sites where there is a high flood risk or where the construction phase would displace floodwater elsewhere by increasing surface water runoff or taking up floodplain storage. Best practice flood risk construction measures, as outlined in Section 7.3.1.3.2 should be employed.

9.3.1.3.2.2 Operation

Flood Zones

Out of the 11 sites assessed, three sites are classified as having a red RAG rating and five sites are classified as having an amber RAG rating. The sites with a red or amber rating are shown in **Table 9-18**.

Table 9-18 Teddington DRA scheme: flood zone RAG results

Assessment	Sites
Red	Shaft 2
	Shaft 4
	Teddington intake
Amber	Shaft 3
	Shaft 6
	Shaft 7
	Shaft 8
	Discharge at River Thames

Surface Water

Out of the 11 sites, nine sites are classified as having a red RAG rating and two sites are classified as having an amber RAG rating. The reason these sites were classified as red or amber is due to the proposed development potentially introducing significant impermeable areas to the site (increase of more than 0.2ha) or some impermeable areas to the site (increase of 0.005ha to 0.2ha) respectively. The sites are shown in **Table 9-19**. Additional mitigation requirements as outlined in Section 7.3.1.3 will be required for those sites identified as red/amber RAG.

Table 9-19 Teddington DRA scheme: surface water RAG results

Assessment	Sites
Red	Shaft 2
	Shaft 3
	Shaft 4
	Shaft 5
	Shaft 6
	Shaft 7
	Teddington Intake
	Discharge at River Thames
	Tertiary Treatment Plant site
Amber	Shaft 1
	Shaft 8

Two sites (Tertiary Treatment Plant Site and Mogden Teddington RWT Tunnel Pipejack Site 2 Permanent Site) also contained areas classified as having a medium surface water flood risk in the Environment Agency surface water maps. No sites were located in a Critical Drainage Area or contained areas classified as having a high surface water flood risk in the Environment Agency surface water maps.

Other Flood Sources

Out of the 11 sites, four sites are classified as having a red RAG rating and three sites are classified as having an amber RAG rating. The red and amber ratings are all linked to groundwater flood risk. The sites with a red or amber rating are shown in **Table 9-20**. Additional mitigation requirements as outlined in Section 7.3.1.3 will be required for those sites identified as red/amber RAG.

Table 9-20 Teddington DRA scheme: other flood sources RAG results

Assessment	Sites
Red	Shaft 2
	Shaft 3
	Shaft 5
	Shaft 6
Amber	Shaft 1
	Shaft 7
	Shaft 8

River Flows

The Teddington DRA options (50, 75, 100 and 150 Ml/d) do not proposed any increases in river flows. Therefore, the change in River Thames flows as a result of the Teddington DRA scheme has a green RAG rating for flood risk.

9.3.2 Biodiversity

Refer to ***Annex B.2.3. Fish Assessment Report***, ***Annex B2.4. Aquatic Ecology Assessment Report***, ***Annex B2.5 INNS Report*** and ***B2.6. Terrestrial Ecology Assessment Report*** for full details.

9.3.2.1 Fisheries

The purpose of fish assessment report is to identify the source of greatest potential magnitude of change that a London Effluent Reuse SRO might cause within that reach, and then assess the potential for change to the fish community present within that reach and also in relation to any migratory species present or moving through the reach.

9.3.2.1.1 Activities and pathways for impact

The Teddington DRA scheme fish assessment has covered the following sections:

- Freshwater fish.
- Weir pool/marginal habitat (including Sunbury creek).
- Estuarine fish (including European eel).
- Migratory fish (including European eel).
- European smelt.
- Olfactory cues.

Impact pathways resulting from implementation of the Teddington DRA scheme are summarised below:

- Increased velocities and the resulting impact on the upstream and/or downstream migration of Atlantic salmon, sea trout, shad, smelt, lamprey and European eel.
- Increased velocities and the resulting impact on the local migration of coarse fish and brown trout to spawning areas.
- Loss/decrease in habitat quantity and quality due to changes in hydraulics (i.e., increased velocity and depth) resulting in increased competition for space.
- Loss of juvenile and adult habitats within margins due to increase wetted width and velocities, including habitats for lamprey ammocoetes.
- Risk of displacement of juvenile fish due to increased flows.

- Changes in water quality could have a direct impact on fish populations (e.g., mortality as a result of localised dissolved oxygen sags).
- Changes in the availability of food (biofilm, macrophytes, macroinvertebrates) due to increased flows and changes in water quality.

9.3.2.1.2 Impact risk and additional mitigation requirements

The potential changes in flow are not considered to be of a magnitude to affect the fish communities within the freshwater River Thames or Estuarine Thames Tideway. The potential changes in flows are also not likely to result in impacts to migratory species associated with the Estuarine Thames Tideway.

Water quality and temperature changes within the freshwater River Thames are likely to result in changes to the freshwater fish community. Impacts to temperature are not likely to exceed the thermal tolerances of species present but may result in impacts to the behaviour of fish species particular at or close to the discharge location where temperatures are highest, although these impacts are likely to be dependent upon the ambient temperature in the wider River Thames.

Species tolerant of warmer climates may show increased success compared to species indicative of colder climates, this may lead to changes to the community structure downstream of the discharge outfall. There are no predicted impacts upon temperature within the Upper Tideway and thus no predicted impacts upon the estuarine fish community.

Impacts to dissolved oxygen are not likely to affect fish communities in the freshwater River Thames or Estuarine Thames Tideway, similarly ammonia is not likely to impact the freshwater and estuarine fish population. A number of WFD and EQSD priority substances have been identified as likely to exceed standards during operation, however the extent to which these chemicals will impact the freshwater or estuarine fish community is not yet understood. However, several olfactory inhibitors have been highlighted including dissolved copper, cypermethrin, permethrin, pirimicarb and dissolved zinc which may impact olfaction in the estuarine Thames Tideway. Further work is therefore required at Gate 3 to resolve this issue.

9.3.2.2 Aquatic ecology

9.3.2.2.1 Activities and pathways for impact

9.3.2.2.1.1 Construction

An assessment of construction related impacts has not been completed at Gate 2, the focus has been around determining where the operational impacts are significant, thereby confirming the size of the scheme to be progressed to Gate 3. Construction impacts are considered to be manageable with best practice construction techniques and a suite of standard mitigation measures which will be confirmed as part of the Gate 3 work.

9.3.2.2.1.2 Operation

In summary, the aquatic ecology assessment has considered changes to:

- Aquatic invertebrates across Reach C in the freshwater River Thames and Reaches D, E and F in the estuarine Thames Tideway.
- Marginal habitats across Reach C in the freshwater River Thames.
- Macrophytes across Reach C in the freshwater River Thames.
- Diatoms across Reach C in the freshwater River Thames and Reach E in the estuarine Thames Tideway.
- Macroalgae, Angiosperm and Phytoplankton across Reaches D, E and F in the estuarine Thames Tideway.
- Designated and protected sites and species across Reach C in the freshwater River Thames and Reaches D, E and F in the estuarine Thames Tideway.

9.3.2.2.2 Impact risk and uncertainties

For the scheme size 50 Ml/d, negligible impacts are predicted across all receptors (inferred from the assessment of the larger scheme sizes), therefore **Table 9-21** includes a summary of the risks anticipated for the 75 - 150 Ml/d sizes.

There is no macroinvertebrate, macroalgae or diatom data to complete an assessment for Reaches E (Battersea Park to Tower Bridge) and F (Tower Bridge to 3km seawards of Beckton STW). There are no data available to make an assessment on diatoms within Reach D. However, in these Thames Tideway reaches, the physical environment and water quality assessments have shown that no impact pathway exists.

.

Table 9-21 Teddington DRA scheme: summary of potential aquatic ecology impacts

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Reach C - Thames Water Walton Intake to Teddington Weir				
Velocities and flows	Macroinvertebrates, macrophytes	Under very low flows a moderate reduction in flow is modelled for 250m of the reach, which may impact the invertebrate community which are somewhat sensitive to reduced flows. Given the relatively short area of likely impact within this section of the freshwater River Thames, the associated changes in flow are not considered to be significant enough to result in a noticeable or measurable change in the invertebrate community, as the community's preferred habitats of a generally uniform, slow and deep nature will be retained.	G	None required.
	Diatoms	Though there is a reduction in velocities within the lower section of the reach (i.e. the DRA intake), any impact within the 250m between the intake and outfall is likely to be short-term reversible and is not likely to have an overall impact on the reach's diatom communities.	G	None required.
Wetted width	Marginal habitat	In summary, there is a predicted moderate (25%) reduction in exceptionally low flows for 250m between the intake and outfall locations. Negligible changes in velocity, water level, wetted habitat.	G	None required.
Temperature	Macroinvertebrates, macrophytes	There is a possibility that during operation temperatures may increase by up to 0.98°C, with higher temperature in the immediate vicinity of the outfall. the potential changes in temperature will likely not impact on availability, quantity and quality of habitat within the reaches.	G	None required.
	Diatoms	Potential change in temperatures is not considered likely to be outside the preferred thermal range for the diatom communities within the River Thames and will likely be within the inter annual variations that would be observed under reference conditions.	G	None required.
Oxygen saturation	Macroinvertebrates, macrophytes, diatoms	No impacts on dissolved oxygen saturation are expected within this reach.	G	None required.
pH	Macroinvertebrates	Minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the communities.	G	None required.
Reach D – Teddington Weir to Battersea Park				
Velocities and flows	Macroinvertebrates	No impacts on flow or velocity are expected within this reach.	G	None required.
Temperature	Macroinvertebrates	It is noted that there would be temperature changes in the estuarine Thames Tideway as consequence of a Teddington DRA scheme associating with less discharge of final effluent from Mogden STW. These temperature reductions are unlikely to have any impacts on the invertebrate communities.	G	None required.
Oxygen saturation	Macroinvertebrates	There would be dissolved oxygen changes in the estuarine Thames Tideway as consequence of a Teddington DRA scheme associating with less discharge of final effluent from Mogden STW. Though the increases in dissolved oxygen may result in a general improvement in biological fitness overall, the minor increases of a maximum of 1% are not likely to result in impacts to the invertebrate community within the estuarine Thames Tideway.	G	None required.
Dissolved inorganic nitrogen	Macroinvertebrates	It is predicted that there will be decrease in DIN in the estuarine Thames Tideway, this is not expected to negatively impact the invertebrate community as the community has been determined to be tolerate to a wide range of nutrient conditions.	G	None required.
	Macroalgae, angiosperm and phytoplankton	Decreases in DIN re predicted for the estuarine Thames Tideway, this is not expected to impact the macroalgal community as the community has been determined to be in an impacted state. However, the reduction in DIN may increase the presence of more sensitive macroalgal species. It is also considered that a reduction in DIN will not negatively impact the phytoplankton community, which is in an unimpacted state, as DIN reductions are likely to increase the fitness of the community.	G	None required.
Reach E Battersea Park to Tower Bridge				
Velocities and flows	Diatom	No impacts on flow or velocity are expected within this reach.	G	None required.
Temperature	Diatom	No impacts on flow or velocity are expected within this reach.	G	None required.
Oxygen saturation	Diatom	No impacts on flow or velocity are expected within this reach.	G	None required.
Dissolved inorganic nitrogen	Diatom	Significant decreases in DIN are predicted for the estuarine Thames Tideway, this is not expected to impact the diatom community as the community has been determined to be tolerant to a moderate to low organic pollution. However, the reduction in DIN may increase the presence of more sensitive diatom species during scheme on periods.	G	None required.
Change in water quality and levels	Designated sites	No potential impacts identified.	G	None required.

9.3.2.3 Invasive Non-native species

Changes in velocity and flow, and water quality within the freshwater River Thames due to the Teddington DRA schemes may cause some changes in conditions that could affect distribution of INNS, including changes in dissolved oxygen, temperature, ammonia, BOD, suspended solids and pH. However, these changes are minor, and it is unlikely that they will cause widespread changes in distribution of INNS within the River Thames. The potential effects on INNS are predicted to be greater for the larger scheme variants when compared to the smaller options.

The SAI-RAT assessment found the 150 Ml/d scheme to have the greatest risk involving the transfer of INNS between the River Thames and Lee Valley Reservoirs when compared to the other new options of the Teddington DRA scheme. This is solely down to the increased volume when compared to the other options, as all other variables within the SAI-RAT calculator remain the same for each of the new Teddington DRA scheme options.

The current 195 Ml/d TLT transfer that is in operation between the Thames and Lee was also assessed using the SAI-RAT tool, and it was found to have the highest risk score when compared to any of the new Teddington DRA scheme options. This is again due to higher volumes of water being transferred, and due to it being in year-round, continuous, variable flow operation compared to the occasional frequency of operation of the Teddington DRA schemes.

9.3.2.4 Terrestrial ecology

9.3.2.4.1 Activities and pathways for impact

9.3.2.4.1.1 Construction Impacts

The construction activities associated with the 150 Ml/d Teddington DRA would include the following activities that have potential to result in biophysical changes to important terrestrial ecological features:

- Construction of TTP at Mogden STW. Note that the TTP is proposed for construction within the footprint of existing storm tanks in Mogden STW.
- Construction of temporary site compounds (2500 m²) and permanent reception shafts at Mogden STW and temporary site compounds and intermediate shafts along conveyance route (including vegetation removal, earthworks, provision for compound drainage and SuDS, and creating areas of hardstanding). Note that pipe jacking will be used to install the 1.8 m internal diameter pipeline.
- Construction of temporary access routes (including vegetation removal, earthworks, and associated drainage)
- Construction discharge/ outfall upstream of Teddington Weir and abstraction/ intake upstream of the treated effluent discharge location along the River Thames (including removal of bank vegetation, earthworks and associated drainage).
- Permanent fencing and enclosed kiosk at the new intake to enclose mechanical and electrical equipment increasing the footprint of the proposed intake.

The activities listed above have the potential to result in the following effects:

- Habitat loss or degradation (both temporary and permanent) - It is assumed that all areas of temporary habitat loss will be re-instated to the current baseline condition following completion of the construction phase of the scheme.
- Habitat fragmentation (temporary).
- Management changes to habitats (leading to habitat degradation).
- Disturbance of individuals or groups of animals via noise, vibration and visual disturbance.
- Direct injury or mortality of individual animals and plants.
- Pollution e.g., sediment mobilisation, dust, hydrocarbons (habitat degradation and injury/mortality to species).
- Impacts from water level changes (a cause of habitat loss, degradation and/or injury/mortality to species).

9.3.2.4.1.2 Operational Impacts

The operational activities associated with the Teddington DRA would include the following activities that have potential to result in biophysical changes to important terrestrial ecological features:

- Operational changes to flow regime in the River Thames.
- Operation and maintenance of new infrastructure including the conveyance route and within the existing Mogden STW site.

The activities listed above have the potential to result in the following effects:

- Management changes to habitats (leading to habitat degradation).
- Disturbance of individuals or groups of animals via noise, vibration, and visual disturbance.
- Direct injury or mortality of individual animals and plants.
- Impacts from water level changes (a cause of habitat loss, degradation and/or indirect injury/mortality to species).

9.3.2.5 Impact risk and additional mitigation requirements

The construction of the Teddington DRA scheme including the construction of a TTP at Mogden STW, conveyance route and intake and outfall will result in the direct loss of lower distinctiveness habitats including neutral grassland, modified grassland, scrub and urban habitats. No direct impact pathways were identified to statutory designated sites; however, a number of non-statutory sites were identified within 2 km of the scheme. These included Mogden Sewage Works SINC, River Thames and Tidal Tributaries SINC, River Crane at St Margaret's SINC and Ham Lands LNR. Hedgerow priority habitat was also recorded at Shaft/ Compound 4, Shaft/ Compound 5, and Shaft/ Compound 6 and lowland mixed deciduous woodland priority habitat was identified at Shaft/ Compound 4, Shaft/ Compound 6 and Shaft/ Compound 7. Hedgerows and deciduous woodland could support birds and bats as foraging, roosting and nesting habitat, plus provide commuter routes through the landscape. Species records received within 2 km of the Teddington DRA scheme include bats, birds, reptiles, amphibians, hedgehog and stag beetle. As the locations of species records were not provided by GiGL, the search areas for the Teddington DRA scheme and Mogden water recycling scheme overlapped, so it is not possible to determine which options the records are in relation to.

Temporary and permanent habitat loss would occur within the footprint of compounds and shafts respectively. Where possible, the removal of woodland and scrub should be avoided when considering the footprint of compounds and shafts. Hard standing and modified grassland is present in the footprint of a number of compounds and shafts, which has low ecological value. However, where compounds and shafts are located close to ecological receptors, additional mitigation measures should be implemented to avoid impact pathways to supporting habitat.

Table 9-22 Summary of potential terrestrial ecology impacts from Teddington DRA scheme: construction

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Habitat loss – temporary and permanent	Priority and local value habitats	Fencing of retained adjacent habitats to reduce the potential for works encroachment.	Loss of 0.039 ha of the priority habitat lowland mixed deciduous woodland.	R	Compensation for loss of priority habitat and area of SINC.
Disturbance to protected and notable species	Bat	Construction best practice relating to control of dust and pollution prevention. Avoidance of mature trees, woodland, and hedgerows through scheme design where possible to minimise potential impacts. Fencing of retained adjacent habitats to reduce the potential for works encroachment. Avoidance of night-time working adjacent to suitable habitats.	Direct impacts (Shaft 1, Shaft 2, Shaft 4, Shaft 5, Shaft 6, Shaft 7, intake/outfall, Mogden STW): • loss, damage and/or disturbance of potential bat roosts. • temporary and permanent loss of foraging or commuting habitats within site compound and permanent infrastructure. Indirect impacts: • disturbance of foraging bats through noise and/or lighting during construction activities.	Uncertain – more data needed[112]	Avoidance of night-time working adjacent to bat roosts (where identified through further surveys) and high value foraging habitats. Lighting of shaft compounds should be designed to minimise light spill on to adjacent high value habitats.
	Badger		Direct impacts (Shaft 1, 4, 6, 7, intake/outfall): • damage or disturbance of badger setts during construction works. • accidental injury or mortality due to presence of excavations and/or plant/ vehicle movements.	Uncertain – more data needed	Fencing of site compounds to prevent badger access to exposed excavations and encroachment of works into retained habitats
	Stag beetle		Suitable habitats (woodland, mature trees, hedgerows) were identified at Shaft 1, 2, 6, 7, intake/outfall). Direct impacts: • loss or disturbance of larval habitats which include rotting standing trees, stumps or logs. • injury or mortality of larvae and/or adults (May to September) during site clearance. • temporary and permanent loss of supporting habitats within site compound and permanent infrastructure footprint. Indirect impacts:	Uncertain – more data needed	Deadwood suitable for priority invertebrate species should be translocated to retained habitats, and habitats within the areas of temporary loss re-instated on a like-for-like basis.

[112] Insufficient baseline data to confirm whether species/group present or not.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
			• disturbance of populations through additional artificial lighting attracting night flying insects such as moths. • habitat degradation from pollution including accidental spills and dust.		
	Reptiles		Suitable habitats (woodland, rough grassland, scrub, hedgerows) were identified at Shaft 1, 2, 6, 7, intake/outfall. Direct impacts: • loss or disturbance of supporting habitats. • injury or mortality during site clearance and construction. Indirect impacts: • habitat degradation from pollution including accidental spills and dust.	Uncertain – more data needed	Site clearance in areas containing suitable reptile hibernation features should not be undertaken during the hibernation period (October to March inclusive). The clearance should be supervised by a suitably experienced ecologist following a precautionary working method statement (PWMS).
	Riparian mammals (water vole and otter)		Direct impacts (intake and outfall): • loss or disturbance of supporting habitats. • injury or mortality during site clearance. Indirect impacts: • habitat degradation from pollution including accidental spills.	Uncertain – more data needed	Site clearance should be undertaken under supervision of an Ecological clerk of Works (ECoW). In areas containing suitable hibernation features should not be undertaken during the hibernation period (October to March inclusive).
	European hedgehog		Suitable habitats (woodland, rough grassland, scrub, hedgerows and parkland) were identified at Shafts 1, 2, 6, and 7, intake/outfall. Direct impacts: • loss or disturbance of supporting habitats (e.g. grassland, scrub, woodland, parkland). • injury or mortality during site clearance Indirect impacts: • habitat degradation from pollution including accidental spills and dust.	Uncertain – more data needed	Avoidance of scrub, woodland, and hedgerows through scheme design where possible to minimise potential impacts. Site clearance in areas containing suitable hibernation features should not be undertaken during the hibernation period (October to March inclusive).
	Amphibians		Records of common toad and great crested newts were identified within 2 km of the Teddington DRA scheme. No ponds or suitable breeding waterbodies were identified within the Shaft Compounds	Uncertain – more data needed	Potential need for exclusion fencing and trapping programmes if great crested newt present.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
			Direct • permanent loss of supporting habitat within the footprint of the shaft. Indirect • habitat degradation from pollution including accidental spills and dust.		Sensitive clearance of vegetation.
Disturbance to birds	Birds	Screening and noise dampening equipment should be used to minimise noise disturbance and dust emissions. • Measures will be taken to protect any temporary exposure of bare soil from runoff during heavy rainfall events. • All vehicles and any chemical/ oil storage will be fully bunded to prevent any accidental pollution within supporting habitat.	Suitable terrestrial habitats have been identified at all sites. Direct • loss of potential breeding habitat could occur and destruction of nests if present. Indirect • noise, vibration and visual disturbance and exposure to pollution (air, dust, lubricants, detergents, cement, fuel).	A	Any vegetation clearance required should be undertaken outside of the breeding bird season (March –August inclusive).

9.3.3 Historic environment

9.3.3.1 Activities and pathways for impact

9.3.3.1.1 Construction

The setting of designated heritage assets is likely to be affected by construction works associated with the scheme. However, these effects are anticipated to be temporary, only affecting the asset settings for the duration of the construction phase of the project.

There is the potential for known and currently unknown archaeological deposits to be disturbed or removed by construction activities associated with the scheme. Intrusive groundworks may truncate or destroy any archaeological remains present within the footprint of temporary and permanent compounds, shaft sites, and in the location of any new infrastructure.

The proposed pipelines associated with the scheme are all anticipated to be tunnelled. As tunnelled pipelines will be located at a much lower depth than any surviving archaeological deposits, it is unlikely that these pipelines will have any affect upon archaeological deposits present within the scheme route.

9.3.3.1.2 Operation

It is possible that the operation of shaft sites and new infrastructure may affect the setting of nearby designated heritage assets. It is anticipated that the extent and nature of any such effects will be fully investigated, and mitigation strategies identified as part of future heritage statement assessment reports.

It is unlikely that the operation of any element of the scheme will have further effects upon non-designated archaeological remains following construction.

It is unlikely that below-ground pipelines, once constructed, will have any effect upon the setting of nearby designated heritage asset receptors.

9.3.3.2 Impact risks and additional mitigation requirements

9.3.3.2.1 Construction

The construction phase of the Teddington DRA scheme has the potential to temporarily affect the settings of a registered park and garden and six conservation areas. The construction phase may also permanently affect the setting and character of two of these conservation areas.

Several elements of the scheme are located within APAs, and the scheme has an overall potential to contain as-yet unidentified archaeological deposits. All such remains are likely to be affected by the construction phase of the scheme. The impact risk appraisal, and requirements for additional mitigation, during the construction phase is provided in **Table 9-23**.

9.3.3.2.2 Operation

The operation of the Teddington DRA scheme has the potential to permanently affect the setting and character of a conservation area and the setting of a registered park and garden. The effect of the scheme upon the conservation area may pose significant constraints upon the scheme.

It is considered unlikely that there are any risks to archaeological deposits associated with the operation of the scheme. Any such risks are thought to be limited to the construction phase of the project only. The impact risk appraisal, and requirements for additional mitigation, during the operation phase is provided in **Table 9-24**.

Table 9-23 Teddington DRA scheme: summary of historic environment initial risk appraisal and additional mitigation requirements during construction

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Construction of shafts.	Registered park and garden. Conservation areas. APAs. Known non-designated heritage assets. Unknown non-designated heritage assets.	N/A	Construction of shaft sites could cause adverse impacts upon the following heritage assets: Potential temporary negative effect upon setting of grade II* registered park and garden, Ham House (OA 14). Potential temporary negative effect upon setting of Cole Park Road Conservation Area. Potential temporary negative effect upon settings of Ham House and Twickenham Riverside Conservation Area. Potential temporary negative effect upon setting of Teddington Lock Conservation Area. Potential temporary negative effect upon setting of Riverside North Conservation Area. Six shaft sites are located directly within 4 Archaeological Priority Areas. Permanent disturbance to, or loss of, known and unknown paleoenvironmental and archaeological remains at all shaft sites and associated temporary compounds.	A	Employment of best archaeological practice strategies during construction phase. This could include archaeological desk-based assessment, heritage assessment, and intrusive archaeological recording action.
Construction of new infrastructure site at Mogden STW.	Unknown non-designated heritage assets.	N/A	Construction of new infrastructure could cause adverse impacts upon the following heritage assets: Permanent disturbance or loss of known and unknown Paleoenvironmental and archaeological remains at new infrastructure site.	A	Employment of best archaeological practice strategies during construction phase. This could include archaeological desk-based assessment, heritage assessment, and intrusive archaeological recording action.
Construction of new infrastructure site at proposed Teddington intake location.	Conservation areas. APAs. Unknown non-designated heritage assets.	N/A	Potential permanent negative effect upon setting and character of Riverside North Conservation Area. Potential temporary negative effect upon setting of Riverside North and Broom Water Conservation Areas. Site is located directly within an Archaeological Priority Area.	A	Employment of best archaeological practice strategies during construction phase. This could include archaeological desk-based assessment, heritage assessment, and intrusive archaeological recording action.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Construction of tunnel sections.	No receptors identified.	N/A	No risks identified.	G	No additional mitigation required.

Table 9-24 Summary of initial risk appraisal and additional mitigation requirements during operation: historic environment

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Operation of shafts.	Registered park and garden. Conservation area.	N/A	Potential permanent negative effect upon setting of grade II* registered park and garden, Ham House (OA 14). Potential permanent negative effect upon setting of Ham House Conservation Area.	G	Full heritage assessment of potential effects to designated asset settings to assist identification of suitable mitigation.
Operation of new infrastructure site at Mogden STW.	No receptors identified.	N/A	No risks identified.	G	No additional mitigation required.
Operation of new infrastructure site at proposed Teddington intake location.	Conservation area.	N/A	Potential permanent negative effect upon setting and character of Riverside North Conservation Area.	R	Significant mitigation measures may be required. Initial full heritage assessment of potential effects to designated asset setting and character to assist identification of suitable mitigation.
Operation of tunnel sections.	No receptors identified.	N/A	No risks identified.	G	No additional mitigation required.

9.3.3.3 Uncertainties

One red RAG rating has been identified at the Teddington Intake feature location of the scheme which is located directly within the Riverside North Conservation Area. Further investigation will be required to determine the nature and extent of potential negative effects upon the setting and character of the conservation area, and to assist with the identification of suitable mitigation strategies.

Further mitigation may be required at a shaft site where the shaft is located directly within the Ham House Conservation Area. The potential effects of a shaft at this location require further investigation.

Currently unidentified archaeological remains may be present within any shaft or infrastructure site along the scheme route. The extent and nature of any archaeological remains present is currently unknown.

9.3.4 Landscape and visual amenity

9.3.4.1 Activities and pathways for impact

9.3.4.1.1 Construction

Construction activities and works that could result in landscape/townscape and visual effects are:

- Vegetation clearance, earthworks and soil preparation to prepare for construction activities.
- Presence and movement of plant, machinery and construction traffic within and around the site.
- Presence of tall plant and machinery (including cranes if used) on the skyline.
- Establishment of construction compound(s) and welfare facilities.
- Presence of hoarding/ safety fencing around the boundary of demolition or construction areas.
- Presence of lighting to light construction activities after dark.
- Formation of landform, drainage and soft landscaping activities.

9.3.4.1.2 Operation

Key aspects of the completed proposed development that could result in landscape/townscape and visual effects are:

- New tertiary treatment plant at Mogden STW.
- Presence of permanent access hatch at shaft sites.
- New discharge and intake structures at Teddington.
- Any security lighting to sites and structures, if considered essential.

9.3.4.2 Impact risks and additional mitigation requirements

The most severe impact of the proposed development on landscape/townscape and visual receptors is considered to be from the construction and operation of the Teddington abstraction intake structure, which will impact on the local character and the visual amenity of the local community and recreational users. The construction of the Teddington outfall structure is also considered to have a large impact on the local character and visual amenity of the local community and recreational users. These construction activities will impact the same receptors, which may increase the severity. It is considered that other landscape/townscape and visual receptors will have a lower level of impact, assuming that the suitable mitigation measures identified are undertaken.

Further assessment will be required during winter months when deciduous vegetation is leafless. This may highlight potential for higher levels of effect. Some uncertainty regarding effects in winter months will remain, until this work can be done.

Note that this is a preliminary assessment based upon limited project information and knowledge of the construction methodologies and duration proposed. A full landscape/townscape and visual impact assessment will be required as part of the EIA, once detailed designs and construction methods are available.

9.3.4.3 Uncertainties

A detailed design for the outfall and intake structures at Teddington will enable a more precise assessment to be undertaken, including identifying specific representative viewpoints. This includes an understanding of exact location, vegetation removal, any proposed soft landscaping, and the plans to divert the Thames Path.

In all locations, avoiding mature trees and minimising vegetation removal and ensuring replacement planting will help reduce levels of effect.

Similarly careful and appropriate restoration of grassed and paved areas, ensuring a match with local character and materials, will help reduce levels of effect.

Table 9-25 Teddington DRA scheme: summary of landscape and visual amenity initial risk appraisal and additional mitigation requirements during construction

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Construction of shafts and trenchless tunnel sections - site clearance, compound hoardings, tall plant and machinery, spoil heaps, movement of site traffic, digging shafts, placing access hatch, constructing telemetry kiosks.	Local character of the sites. Local residents, recreational users, pedestrians and motorists.	Minimise loss of vegetation through design and sensitive location of construction compounds and tunnel sections, utilising existing hardstanding where possible, and avoiding public rights of way and paths. Replace any vegetation removed as a result of construction with suitable native species. Replace any trees removed at a rate of at least two to one (note that local authorities may have specific tree replacement policies). If pavements are impacted, use locally appropriate materials to repair, as set out in Local Authority Design Guides. Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting).	Construction of shafts and trenchless tunnel sections will result in unavoidable direct impacts on the local character of the sites and pipeline route due to changes to the physical and perceptual characteristics during construction. Only the immediate character areas are likely to be affected. The timescales will be relatively short and partially reversible (e.g., once hoardings and machinery are removed). Construction activities will be noticeable for the local community, although a certain level of construction activities is accepted in urban areas. Again, the timescales will be relatively short and the effects relating to construction of the shafts will be partially reversible (e.g., hoardings and machinery removed). Construction of tunnel sections will be via pipejack and therefore will result in minimal impacts to the local landscape/townscape and visual amenity of local communities.	G	Particular attention will need to be given to the location of the shafts and construction compounds and tunnel sections for the following locations: For site compounds that lie within recreation grounds, minimise size of construction compound, and reroute paths, and avoid cutting down mature trees. Avoid existing paths where possible. For site compounds that lie within the Conservation Areas, the design guidelines within the Conservation Area Appraisal should be followed. Use existing hardstanding for construction compounds and shaft access. Avoid diverting the public rights of way and National Trails. Where telemetry kiosks are placed by the access hatches in parks , there should be careful consideration of the position so that they do not appear out of place in a generally open undeveloped space. Kiosks could be placed next to existing small infrastructure e.g., lampposts, parking meters, signposts.
Construction of Tertiary Treatment Plant at Mogden STW - site clearance, compound hoardings, tall plant and machinery, spoil heaps, movement of site traffic, construction of a number of buildings with maximum height of 10m, and access road.	Local landscape/townscape of the site. Residents to the south of the site on Beaumont Place and Trevor Close. Residents to the east of the site on Lynton Close, Hillary Close and Barkside Close and recreational users of Redlees Park.	Minimise loss of vegetation through design and sensitive location of construction compounds. Retain bank of vegetation surrounding Mogden STW. Replace any vegetation removed as a result of construction with suitable native species. Replace any trees removed at a rate of at least two to one (note local authorities may have specific tree replacement policies). Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting).	The Mogden STW dominates this townscape character area, and one of the key features is the "*dense, slightly raised bank of vegetation [which] wraps around the majority of the site's perimeter*". The impacts of construction will be relatively short, and the effects relating to construction will be partially reversible. Views of construction activities will largely be screened by the dense vegetation surrounding the site (less so in winter). The construction works will be seen in the context of the existing Mogden STW. Some views of tall plant and machinery may be seen above the vegetation, and an increase in traffic due to construction. A certain level of construction is expected in London, and works will be relatively short and the effect relating to construction will be partially reversible (e.g., machinery removed).	G	No additional mitigation recommended.
Discharge to River Thames at Teddington Weir - site clearance, compound hoarding, site traffic.	Local character of the site. Local community to the north including Burnell Avenue and Drysart Avenue. Recreational users of Thames Path and the River Thames (e.g., rowers). Local community to the south across the Thames including Broom Water West and recreational users of The Lensbury Club.	Minimise loss of vegetation through design and sensitive location of construction compound. Avoid removal of mature tree specimens. Replace any trees removed at a rate of at least two to one (note local authorities may have specific tree replacement policies). Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting).	The semi-rural character with a sense of openness, views and vistas along the River Thames and riverside open spaces, accessed via the Thames Path are valued features of this character area. Construction will alter the open, undeveloped character of this landscape, and introduce hoarding and machinery into the landscape. The local community and recreational users will have clear views of construction works, albeit some will be screened by existing vegetation, which will be out of place in the open landscape and interrupt views of the River Thames. The Thames Path may be diverted during the construction works. A certain level of construction is expected in London, and works will be relatively short and the effects of the construction partially reversible (e.g., hoarding and machinery removed).	A	Site construction compounds away from the existing benches, and maintain access along the National Trails where possible.
Abstraction from the River Thames -site clearance, compound hoarding, site traffic.	Local character of the site. Local community to the north including Burnell Avenue and Drysart Avenue. Recreational users of Thames Path and the River Thames (e.g., rowers). Local community to the south across the Thames including Broom Water West and recreational users of The Lensbury Club.	Minimise loss of vegetation through design and sensitive location of construction compound. Avoid removal of mature tree specimens. Replace any trees removed at a rate of at least two to one (note local authorities may have specific tree replacement policies). Sensitive use of lighting after dark (including type of luminaires, direction of lights and hours of lighting). Use direction of existing informal paths across the open space south of Burnell Avenue where possible.	The connection to the river, trees and sound of river life and public open space are valued features of the local landscape, and result in an established high-quality character. Construction will alter the open, undeveloped character of this landscape, and introduce hoarding and machinery. The local community and recreational users will have clear views of construction works, albeit some will be screened by existing vegetation (less so in winter), which will be out of place in the open landscape and interrupt views of the River Thames. The Thames Path will be diverted during the construction works. A certain level of construction is expected in London, and works will be temporary and semi-reversible (e.g., hoarding and machinery removed). However, construction will have a	R	Site construction compounds away from the existing benches and maintain access along the Thames Path where possible. Use materials in keeping with the local character of the site, considering colour and reflection potential, including the materials of the access path, to minimise visual impact.

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
			significant impact on local views, with few options for mitigation.		

Table 9-26 Teddington DRA scheme: summary of landscape and visual amenity initial risk appraisal and additional mitigation requirements during operation

Activity and impact	Receptor	Embedded Mitigation	Effect	RAG Rating	Additional mitigation
Permanent access hatch at shafts - metal access hatches set into the ground; telemetry kiosks will be placed at some access hatches	Local character of the sites. Local residents, recreational users, pedestrians and motorists.	N/A	The permanent access hatch will result in unavoidable direct impacts on the immediate site. This will be a small change, and will be seen in context with other urban ground-level infrastructure e.g. manhole covers and drain covers. The change in visual amenity for local communities, recreational users, pedestrians and road users will be very small, and barely perceptible in most cases.	G	No additional mitigation required.
Completed tunnel sections	Local character of the sites. Local residents, recreational users, pedestrians and motorists.	N/A	Once in operation the tunnel sections will be imperceptible in the landscape/townscape and to visual receptors.	G	No additional mitigation required.
Tertiary Treatment Plant at Mogden STW – up to eight buildings with a maximum height of 10m, and access road.	Local townscape of the site. Residents of Beaumont Place and Trevor Close. Residents of Lynton Close, Hillary Close and Barkside Close and recreational users of Redlees Park.	N/A	Development will result in direct, unavoidable impacts on the landscape character of the site. The new development will be in keeping with the existing structures at Mogden STW, and therefore the change to the character will be very small. There will not be any views of the new tertiary treatment plant for local residents or recreational users of Redlees Park due to the mature boundary vegetation surrounding the existing STW (greater levels of effect in winter months).	G	No additional mitigation required.
Discharge to River Thames at Teddington Weir	Local character of the site. Local communities in Burnell Avenue and Drysart Avenue. Recreational users of Thames Path and the River Thames (e.g. rowers). Local community in Broom Water West and recreational users of The Lensbury Club.	N/A	The discharge outfall structure will result in unavoidable direct impacts on the immediate site. This will be a very small change, and will be seen in context of other urban ground-level infrastructure e.g. manhole covers. The change in visual amenity for local communities and recreational users will be very small, and barely perceptible for most people.	G	No additional mitigation required.
Abstraction from the River Thames - screens, permanent fenced enclosure and access road.	Local character of the site. Local community in Burnell Avenue and Drysart Avenue. Recreational users of Thames Path and the River Thames (e.g. rowers). Local community in Broom Water West and recreational users of The Lensbury Club.	N/A	The intake structure will be a large change to the open character of the riverside, and will introduce a permanent structure. Views for the local community and recreational users will be permanently altered, and will impact on the existing open views of the undeveloped riverside. There is existing river infrastructure close to the site, for example Teddington weir. Intake structures are not uncommon across the whole stretch of the River Thames.	R	Additional mitigation requirements to be considered further at Gate 3. The design of the structure, materials and colour palette will need careful consideration to minimise the impact.

9.3.5 Soils and contaminated land

9.3.5.1 Impact risk, pathways and uncertainties

There is a low risk to human health during construction as shallow ground contamination from former activities and current uses may come into contact with construction workers. There is a risk of dermal contact, ingestion and inhalation of potential ground contamination. The risk is low as construction workers should be asbestos awareness trained, provided with personal protective equipment (PPE), and adopt good hygiene measures.

There is a risk to human health during construction as dust from stockpiles and bare earth surfaces could be inhaled and or ingested. Therefore, a Construction Environmental Management Plan (CEMP) should be prepared, detailing measures to prevent mobilisation of dust or surface run-off from stockpiles to off-site receptors.

The risk to Secondary A and Secondary Undifferentiated aquifers would be medium and should be assessed further by groundwater sampling during ground investigation to confirm the risk.

The risk of ground gas is high as the conveyance route intersects one landfill for Teddington DRA scheme. Further assessment to establish composition of waste in existing/historic landfills and risk of encountering contaminated soils, landfill gas and leachate should be undertaken by carrying out site investigations and Envirocheck review where conveyance cannot be re-routed to avoid landfill areas.

It is recommended that a Phase 1 Preliminary Risk Assessment, where a desk-based assessment is undertaken, reviewing historical mapping, British Geological Survey data, UXO screening and creating conceptual site models.

9.3.6 Transport

9.3.6.1 Activities and pathways for impact

The construction phase of the Teddington DRA scheme will require HGV movements, as spoil will need to be transported off-site, and materials will need to be transported to site. The summary of HGV movements required for construction of the Teddington DRA scheme has been taken from the relevant CDR. Depending on whether a 50 Ml/d or a 75 Ml/d scheme is adopted, different volumes of HGV movements would be needed. Estimated HGV movements for any schemes larger than 75 Ml/d are currently not available.

Operational movements are considered to be less significant with c. 28 HGV movements required per year for chemical delivery. Key infrastructure is also located within existing Thames Water owned sites, and therefore subject to existing vehicle movements for personnel. This will be revisited for Gate 3 when further information on operational movements is available.

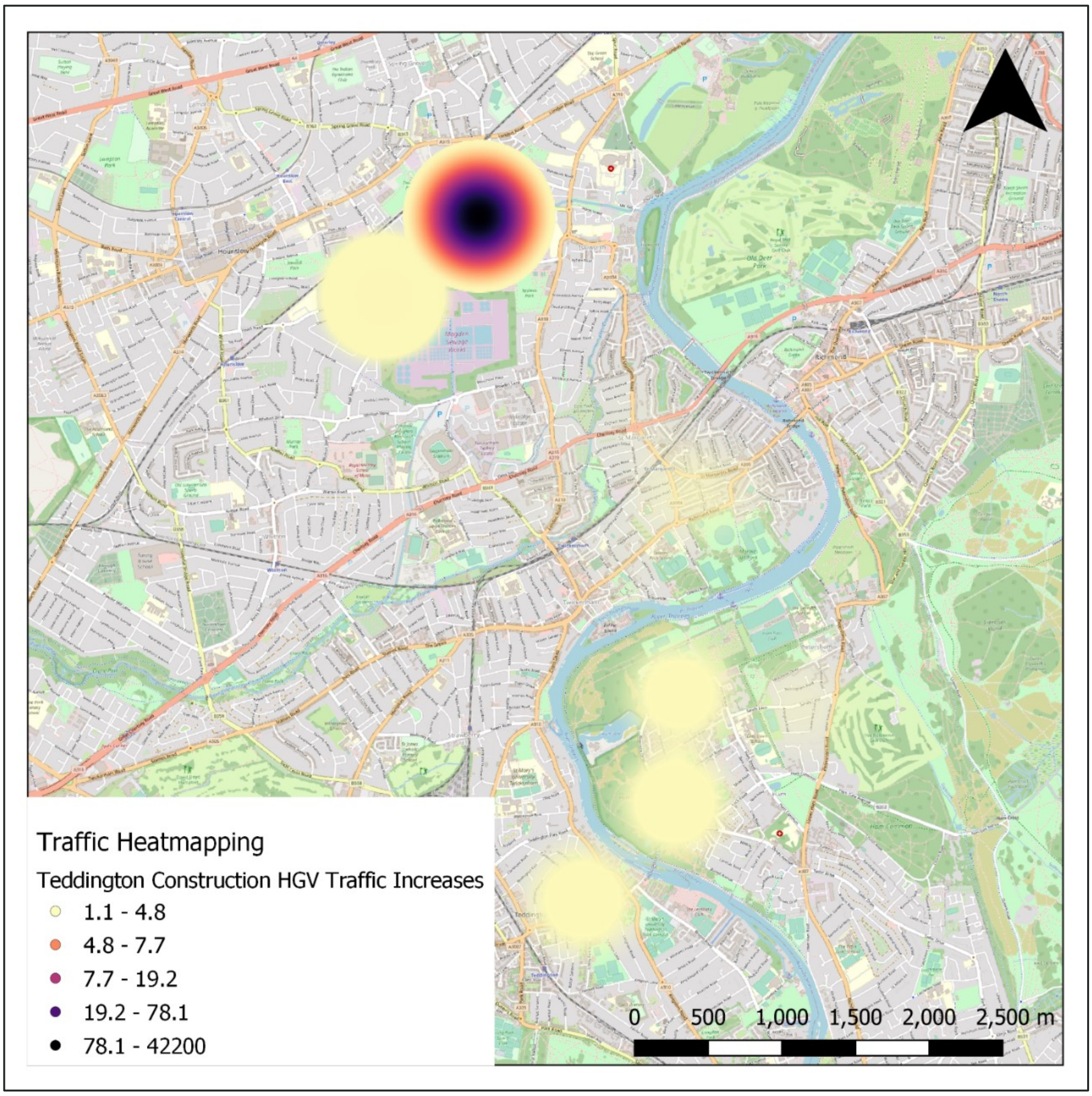
The vehicle movements associated with these site compounds have the potential to adversely impact upon the road networks surrounding them. Traffic increases, particularly increases in Heavy Goods Vehicles (HGVs) can adversely impact upon a local area in a range of ways;

- Severance – the effect of perceived division that can occur in a community when it becomes separated by a major artery (for example, a road becoming much more congested and therefore more difficult to cross);
- Driver Delay – this can occur at any point in the road network, although it is only likely to be significant when, as a baseline, the traffic is predicted to be close to the capacity of the system.
- Pedestrian Delay – A change in the volume or composition of traffic may affect the ability of an individual to cross a road.
- Pedestrian Amenity – the relative pleasantness of a journey. It is affected by both traffic volume and composition.
- Fear and Intimidation – this is dependent upon the volume of traffic, HGV composition, proximity of traffic to people and proximity of traffic to people (e.g., footway width).
- Accidents and Safety – Increases in traffic levels increase in turn the likelihood of a traffic collision in any one part of road. This effect is exacerbated at junctions.

Data from the CDR has been used to establish an approximate increase in HGV movements over the baseline to determine the relative HGV increases as a result of the Teddington DRA scheme construction, as shown in

Figure 9-4. Construction of the Teddington DRA scheme would result in relatively low changes over the majority of the study area, particularly to the south, reflecting the low numbers of HGV movements that would be required to construct the conveyance aspect of the scheme. To the north of the Mogden STW, much larger HGV increases are identified due to the construction of the tertiary treatment plant. Relative increases of HGV movements are almost negligible around the Twickenham area of the scheme, reflecting both the low increases and high baseline of HGV movements in that area.

Figure 9-4 Teddington DRA scheme: potential HGV increases (as a % of baseline AADF) during construction



9.3.6.2 Impact risk and additional mitigation requirements

The overall risk rating for the potential transport impacts on pedestrians and road user receptors due to HGV movements from construction activities are provided in **Table 9-27**.

Table 9-27 Teddington DRA scheme: summary of transport initial risk appraisal and additional mitigation requirements during construction

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
All shaft and infrastructure construction sites	Users of the surrounding road and pedestrian network	**Severance** – perceived division in a community when it becomes separated by a road becoming more congested and difficult to cross;	G	Schedule traffic movements to take place outside of peak

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
		Driver Delay –significant when the traffic is close to the capacity of the system. **Pedestrian Delay** – The ability of an individual to cross a road. **Pedestrian Amenity** – relative pleasantness of a journey. **Fear and Intimidation** – dependent upon the volume of traffic, HGV composition, proximity of traffic to people and of traffic to people. **Accidents and Safety** – Increases in traffic levels increase the likelihood of a collision in any one part of road.		traffic times or anti-social hours. Appropriately time traffic movements to ensure there is no build-up of HGVs around construction sites. The production of a traffic management plan and a construction logistics plan.

9.3.7 Navigation

Refer to ***Annex B.2.7. Navigation Assessment Report*** for full details.

The PLA have particular concerns about any limitation on the ability of vessels of various draughts to navigate in the upper Tideway around low water when a London Effluent Reuse SRO is in operation.

No bespoke modelling has been undertaken for the Teddington DRA scheme. The modelling undertaken for the Mogden water recycling scheme presents a scenario with a greater impact than the Teddington DRA scheme, as lower flow changes will occur for the Teddington DRA schemes (max size of up to 150 Ml/d, compared to the 200 Ml/d modelled for the Mogden water recycling scheme).

Therefore, the Mogden water recycling navigation assessment should be referred to as a proxy for the worst-case navigation impacts of the Teddington DRA scheme (see Section 8.3.7). This shows that the scheme will have a negligible effect on water level changes impacting navigation, a minor / negligible impact on the low water navigational restrictions around the shoals, and a negligible effect on the sedimentation effects on navigation.

9.3.8 Noise

9.3.8.1 Activities and pathways for impact

At this initial appraisal stage, potential causes of noise effects have focussed on the noise from construction plant which are likely to generate the greatest increase over baseline. At later stages, vibration from construction and tunnelling activities, construction traffic as well as operational noise sources[113], will be assessed in more detail when information becomes available during Gate 3.

9.3.8.1.1 Construction

The approach to calculating the construction noise levels is provided in **Appendix 4.**

The assessment used the methodology of BS5228-1:2009. Under this approach, the adverse impact threshold is determined at a dwelling using the existing ambient noise level, rounded to the nearest 5dB for the appropriate period (day, evening or night). This result is used to determine the assessment category: A, B or C, which then defines the adverse noise impact threshold,

The predicted construction noise level is then compared to the appropriate noise impact threshold level to determine whether or not the threshold is exceeded. If the threshold is exceeded, a significant effect is likely to occur. However, other factors should be taken into account in assessing the overall significance. These include the duration of the works, the quality of the sound insulation of the receptor building façade, ambient noise levels at particularly noisy or quiet locations and the number of residents likely to be affected.

[113] Information on the noise levels generated by the plant and equipment, and infrastructure within which the plant will be housed, was not available at Gate 2. It is considered that the design of the new structures could ensure that operational effects are negligible.

Such information is not currently available thus the initial assessment of significant effects has concentrated on two factors. Firstly, whether the BS5228 threshold level is likely to be exceeded and secondly, identifying receptors where the baseline noise levels are likely to be exceeded by more than 10dB. The assessment is shown in **Table 9-28**.

Table 9-28 Teddington DRA scheme: number of receptor properties where significant construction noise effects are likely to occur

Construction sites	Highest Construction Noise @ 10m	At Nearest Receptors			BS5228 ABC Threshold	Estimated No. of Properties	
		Estimated distance from works	Construction noise level^	Baseline LAEQ			
	dB(A)	m	dB(A)	dB(A)	dB(A)	Above Threshold	<10dB above Baseline
Tertiary Treatment Plant	87	77	62	47	65	0	85
Mogden STW Shaft	81	72	57	47	65	0	0
Shaft 2	81	40	62	50	65	0	14
Shaft 3	81	64	58	50	65	0	0
Shaft 4	81	157	50	53	65	0	0
Shaft 5	81	30	64	50	65	0	12
Shaft 6	81	109	53	50	65	0	0
Shaft 7	81	33	64	47	65	0	10
Teddington Shaft/Outfall	81	58	59	53	65	0	0
Thames Lee Tunnel Shaft	81	22	67	50	65	4	15

^Includes noise attenuation by 2m site hoarding at shaft and structure sites

The initial assessment showed that the BS5228 ABC threshold was likely to be exceeded at just 4 properties while the construction noise level was likely to exceed the baseline level by 10dB or more, at 136 properties. This simplified assessment has been undertaken due to the limited accuracy of the baseline data. When more reliable data has been collected, it may be that the high number of receptors affected by the Tertiary Treatment Plant construction, will be reduced due the location of the works relative to any one receptor. However, there may be increased effects at locations close to the structure sites due to longer construction periods.

9.3.8.1.2 Operation

It is understood that shafts, once completed, would be capped, with occasional maintenance access required. This would result in negligible noise effects at the nearest receptors. Operational noise levels from the Tertiary Treatment Plant and the outfall structure at Teddington are not expected to be significant but due to the uncertainty of baseline noise levels and mechanical plant associated with the structures, further assessment will be required at a later stage.

9.3.8.2 Impact risk and additional mitigation requirements

9.3.8.2.1 Overview

The potential risk of significant noise effects during construction and operation of the scheme is summarised below in **Table 9-29**, based on limited baseline data and lack of detail on some construction methods, including pipejacking equipment and operational noise from mechanical plant. The assessment is therefore based on limited data and professional judgement from similar projects.

Vibration effects during construction and operation are not expected to be significant but this will be verified at a later stage of the scheme development.

9.3.8.2.2 Construction

The initial assessment has shown that construction noise effects are possible at receptors close to the shaft sites. At the sites of the Treatment Plant and Outfall structure, noise effects are not expected to be significant, but this will be verified when more baseline data is available. Similarly, vibration effects of tunnelling are considered to be negligible but will be assessed when more information is available.

Table 9-29 Teddington DRA scheme: summary of noise initial risk appraisal and additional mitigation requirements during construction

Activity and impact	Receptor	Best Practice[114]	Effect	RAG Rating	Additional mitigation
Construction of shafts	Residential	BPM (Best Practicable Means)	Moderate Significance at some sites	A	Acoustic site hoardings
Construction of structures	Residential	BPM (Best Practicable Means)	Moderate Significance	A	Acoustic site hoardings
Tunnelling	Residential/ School	BPM (Best Practicable Means)	Not Significant	G	Not required
Vibration	Residential	BPM (Best Practicable Means)	Not Significant	G	Not required

9.3.8.2.3 Operation

Operational noise effects from the shaft sites are not likely to occur as the sites are effectively sealed. Noise effects from the outfall structure and tertiary treatment plant are considered unlikely but will be further assessed when more detailed information on baseline noise levels and mechanical plant are available. A summary is provided in the table below.

Table 9-30 Teddington DRA scheme: summary of noise initial risk appraisal and additional mitigation requirements during operation

Activity and impact	Receptor	Best Practice	Effect	RAG Rating	Additional mitigation
Shafts	Residential	No operational noise	Not Significant	G	Not required
Mechanical plant at Treatment Plant	Residential	Adequate screening/enclosures for mechanical plant	Not expected to be significant	G	Not required
Mechanical plant at Outfall structure	Residential	Adequate screening/enclosures for mechanical plant	Not expected to be significant	Uncertain – more information needed	
Vibration	Residential	Operational vibration unlikely	Not Significant	G	Not required

9.3.9 Air quality

9.3.9.1 Activities and pathways for impact

9.3.9.1.1 Construction

9.3.9.1.1.1 Fugitive construction dust impact risk assessment

Human Receptors

Using the methodology provided in **Appendix 4**, the risk of dust impacts due to where earthworks and construction of shafts and tunnels at the nearby human receptors can be classified as moderate as the maximum risk (amber) occurs for those receptors (>100) within 20m of the construction activities. However,

[114] Refer to Section 7.3.8.2.2.1 for Best Practicable Means.

the dust risk can be mitigated using the medium risk dust mitigation measures available from the IAQM dust guidance.

For the receptors which are over 50m away from the construction site, the risk is expected to be minor (i.e., dust risk can be mitigated with suitable best practice low risk dust mitigation measures available from the IAQM dust guidance).

Ecological Receptors

There are no ecological sites within 20m or 50m of Teddington DRA.

9.3.9.1.1.2 Traffic emissions air quality impact risk assessment

During the construction phase, it is anticipated that the construction of the seven tunnels and the eight shafts would progress for a duration of 82 weeks. This is equivalent to 1.5 years assuming that each of the activities are undertaken sequentially and not ongoing at the same time. It is anticipated that this will involve an approximate total of 9,500 vehicle movements. Even assuming that the entire construction occurred in one year, this would be equivalent to 26 HDVs per day. Although there are receptors within 20m of the route as this corresponds to only marginally above 25 HDVs per day, the risk of air quality impacts is likely to be minor.

9.3.9.1.1.3 Non-road Mobile Machinery (NRMM), generator, and combustion plant emissions air quality impact risk assessment

The Teddington DRA scheme would employ the use of up to c.70 plant consisting of excavators, concrete pump, dumpers, rollers, cranes, generators etc. The exact details on the power rating and emissions standards of the plants are not yet known. Therefore, NO_x and PM_{10} emissions data for the NRMM has been derived from the EMEP EEA air pollutant emission inventory guidebook 2019 specific to non-road mobile machinery (1.A.4) based on a power rating of < 130kW and EU Stage IIIA emissions standard.

Details on the % on-time has been provided for the plants and it has been assumed that construction hours would be 8am to 6pm, seven days a week for the duration (82 weeks) of the construction of the tunnels and shafts.

Using the above assumptions, it has been estimated that the operation of all the plants would result in approximately 0.29 g/s and 4.72 g/s of PM_{10} and NO_x, respectively. This exceeds the threshold of 5 mg/s and the risk of air quality impacts is considered to be major. As such detailed modelling would be required to determine the potential air quality impacts at nearby receptors.

The exact location of the plants are not yet known at this stage to determine whether there are receptors within 500m, however based on the route location there are receptors within 500m of the route.

9.3.9.1.2 Operation

During the operational phase, it is anticipated that chemical deliveries will be delivered by tankers at the following 25% plant utilisation rate for all Teddington DRA options, as detailed in **Table 9-31**. The maximum scheme sizes of 100 and 150Ml/d have not been developed by the engineers for Gate 2, as hydrological modelling was required to confirm acceptability of sizes greater than 75Ml/d. This will be developed in the next design stage for Gate 3.

Table 9-31 Teddington DRA Scheme: expected chemical deliveries per year at 25% utilisation (no. of 30m³ bulk chemical road tankers per year - HGV)

Output (Ml/d)	Ammonium Sulphate & Sodium Hypochlorite	Sulphuric Acid	Anti-Scalant	Sodium Bisulphite	Hydrogen Peroxide (H_2O_2)	Hydrated Lime	Ferric Sulphate	Total HGV per year
50	-	-	-	-	-	-	18	18
75	-	-	-	-	-	-	27	27

All the Teddington DRA scheme sizes are currently estimated to generate less than 25 HGVs per day, and as such air quality impacts are deemed negligible (as per IAQM guidance, see Appendix 4).

9.3.9.2 Impact risk and additional mitigation requirements

The overall risk rating for the potential air quality impacts on human and ecological receptors due to fugitive dust emissions from construction activities; exhaust emissions to air from additional traffic on local roadwork during the construction and operational phase are provided in **Table 9-32**. No information is currently available on the construction plant vehicles (NRMM) and generators during the construction phase for a risk assessment to be completed for this aspect.

Table 9-32 Teddington DRA scheme: air quality initial risk appraisal

Activity and impact	Receptor	Effect	RAG Rating	Additional mitigation
Earthworks, construction of shafts and tunnel (dust impact)	Human receptor	Moderate	A	Medium risk IAQM mitigation measures
Construction traffic (air quality impacts)	Human receptor	Minor	G	N/A
Construction NRMM (air quality impacts)	Human and Ecological receptor	Major	R	Use of EU Stage VI plants
Operational traffic (air quality impacts)	Human receptor	Minor	G	Use of Euro VI HGVs

9.3.9.3 Uncertainties

No information is currently available on the construction plant vehicles (NRMM) and generators during the construction phase for a risk assessment to be completed for this aspect.

Emissions from NRMM are likely to require further evaluation and control. Some additional mitigation for consideration includes:

- Use of electrically driven or low emitting NRMM; and
- Siting of NRMM away from sensitive receptors.

9.3.10 People and communities

During construction, the Teddington DRA scheme could impact upon the people and communities surrounding the construction areas. Construction activities in close proximity to residential dwellings can adversely impact upon the wellbeing of individuals by increasing traffic, noise, dust and light levels in the local area. Construction activity can also increase fear and feelings of isolation in a community, particularly when road closures and increased congestion leads to reductions in the provision of education, healthcare and community recreational facilities.

There are areas within proximity of the Teddington DRA construction that rank within the most health deprived 30% of England, around Mogden STW. More deprived communities are likely to experience more substantial effects. In terms of living environment (another deprivation indicator that may be impacted by construction), large areas surrounding the construction areas, particularly around Mogden STW and Marble Hill Park, are in the most deprived 20% of England in terms of the living environment.

In terms of cultural infrastructure, the majority of cultural assets listed in Table 9-15 are not anticipated to be impacted by the proposed scheme, due to screening by other buildings. However, due to construction work being within proximity or views of them, adverse impacts cannot be ruled out for the following assets;

- The White Swan pub on Twickenham Riverside;
- The Hawker Centre
- The Royal Oak

The Teddington DRA Scheme would not cause adverse impacts on people or communities during its operation. Beneficial impacts would be felt by increasing the resilience of the municipal water supply, meaning demand management measures would theoretically be less likely.

9.4 SUMMARY AND GATE 3 LOOKAHEAD

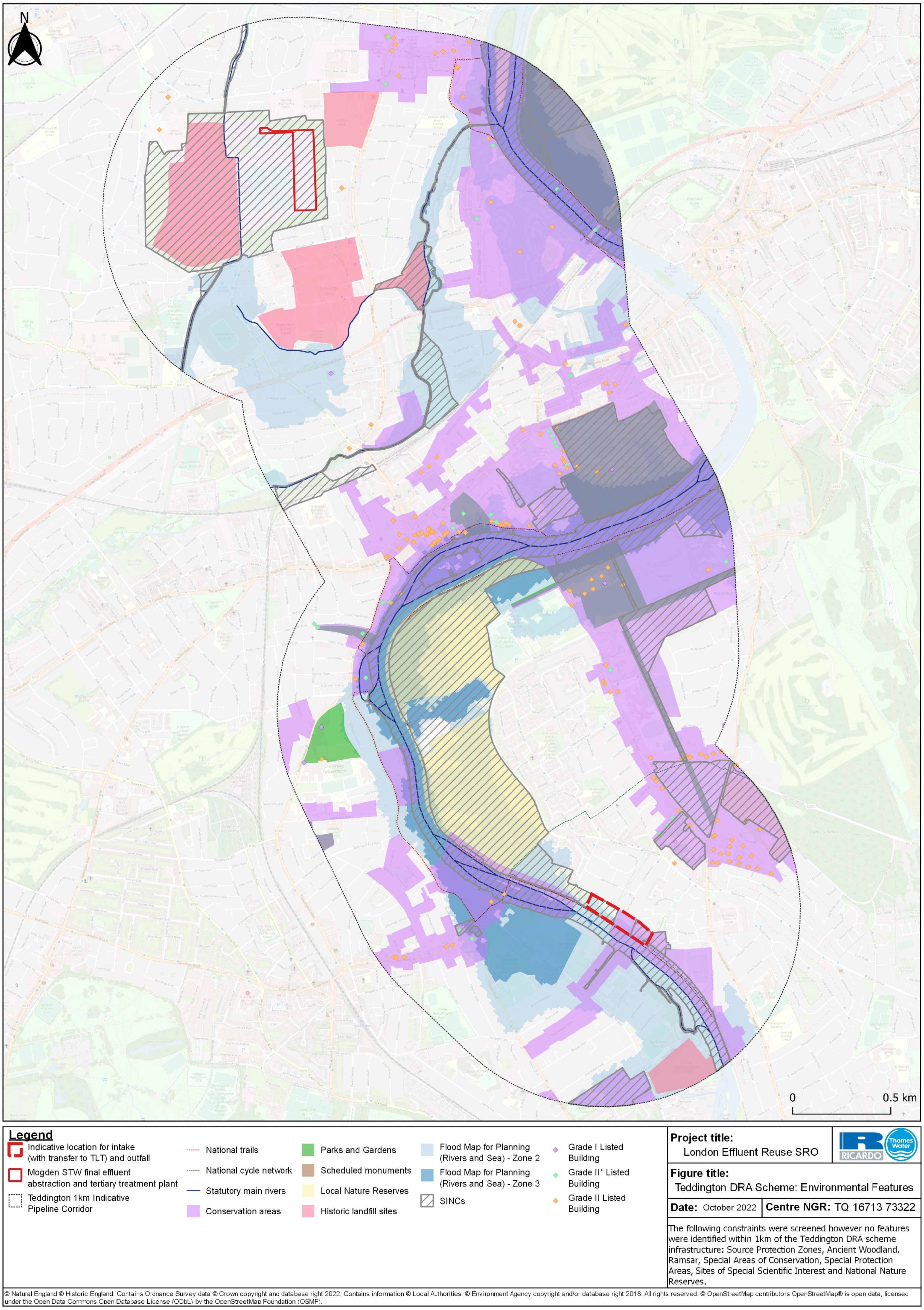
Figure 9-5 provides a high level summary of the receptors being considered for the Teddington DRA scheme. In summary, there are limited operational risks associated with the 50 to 150 Ml/d sized options. However, all require the same infrastructure to be constructed, albeit some variations in plant site layout at Mogden STW, which will need refinement at Gate 3.

Therefore a summary of the highest risks (red and amber) associated with the scheme are as follows:

- **Biodiversity:** loss of priority habitats and area within SINC at AWRP site, and potential for disturbance of bird features of Kempton Waterworks SINC and Kempton Park Reservoirs SSSI.
- **Flood risk:** introduction of new structures within flood zones and increasing areas of impermeable land, therefore flood risk assessment and drainage strategies required.
- **Noise:** construction of trenched pipeline in proximity to residential and school receptors requiring additional mitigation to reduce impact.
- **Soils and contaminated land:** risk of ground gas is high as the two shaft locations (shafts 4 and 9) which may require significant mitigation.
- **Air quality:** impacts to both human and ecological receptors from earthworks, construction of shafts and tunnel (dust impact), construction traffic and NRMM emissions.
- **Historic environment**: potential permanent negative effect upon setting and character of Riverside North Conservation Area (intake and outfall location).
- **Landscape and visual amenity:** permanent change in the open character of the riverside as a result of the intake structure, with views for the local community and recreational users permanently altered, and will impact on the existing open views of the undeveloped riverside. However, intake and outfall structures are not uncommon across the whole stretch of the River Thames, but the design and landscaping of the area will need careful consideration to Gate 3.

Table 9-33 provides a summary of the data gaps remaining at the end of Gate 2, and the uncertainties, with a lookahead to how these will be addressed for Gate 3.

Figure 9-5 Teddington DRA scheme: environmental constraints[115]



[115] Figure shows the search area for the conveyance route, not a construction corridor. The pipeline itself is buried but shaft sites will be located within the area demarcated on the figure.

Table 9-33 Teddington DRA scheme: Gate 3 Lookahead

Environmental Topic Area	Data gaps/uncertainties	Proposed work at Gate 3[116]
WATER		
Physical environment	In the freshwater River Thames the flow changes from flow reduction associated with the Teddington DRA schemes is exclusively in the ~250m reach between the Gate 2 intake and outfall locally upstream of Teddington Weir. The flow reductions, always at exceptionally low - low river flow conditions are assessed as with negligible impacts on river level, river velocity or wetted habitat. The outfall plume is modelled with negligible effects on river velocities. With no net flow change downstream of the outfall there are on impacts downstream of any plume. No additional evidence collection is considered to be required to further verify these assessments.	As engineering design progresses, Gate 2 tools can be re-used to assess variants in outfall velocities or discharge angle for discharge in the 3D Telemac model of the River Thames. The use of water resources modelling at Gate 2 has provided the best available information on likely patterns of scheme use available at the time. However, with WRSE and other Regional Groups WRMP24 Plan reconciliation, the pattern of use of London Effluent Reuse SRO and other SROs will develop. New variants on operating patterns and cumulatives can be readily tested through scenarios using the Gate 2 river and estuary modelling tools. These include variants in standby and ramp-up/ ramp-down patterns within the 1D model of the River Thames.
Water quality	*Freshwater River Thames* In the freshwater River Thames additional olfactory data is required to assess the full suite of determinands as several were added during the Gate 2 process. Continuous sonde data would assist understanding of daily and sub-daily variability in pH	Olfaction in the freshwater River Thames will be further assessed for the Teddington DRA scheme as additional data becomes available, as will pH and ANC. Below is a list of further determinands that lack sufficient data for a comparative olfaction analysis to take place between reference conditions and different flow scenarios; Aluminium (dissolved and total), Chromium (VI) (dissolved), Chromium (total), Selenium (dissolved and total), Silver (dissolved and total), Methiocarb, Oxamyl, Carbophenothion, Chlorpyrifos, Diazinon, Dichlorvos, Fenitrothion, Malathion, Parathion, Flucofuron, Monuron, Sulcofuron, Cyfluthrin, C10-C14 alkyl benzene sulphonic acids, Branched sodium Dodecylbenzene sulfonate, Calcium Dodecylbenzene sulfonate, Linear sodium Dodecylbenzene sulfonate, Sodium tridecylbenzene sulfonate, Triethanolammonium dodecylbenzene sulfonate, 1,6-hexanediamine, Benzalkonium chlorides, Di(hydrogenated tallow)dimethylammonium chloride, Dodecylammonium chloride, Lauryldimethylbenzyl ammonium chloride, Stearyldimethylbenzyl ammonium chloride.
Flood risk	For sites where an FRA and/or Drainage Strategy is required, the following information could be needed to inform the baseline conditions: • EA Product 4 data for detailed flow rates, flood levels and extents from EA hydraulic models; • A topographical survey to show the levels and features at the site; • Existing sewer infrastructure located on-site, including any public sewers that are not linked to the proposed development; • Phase 2 Ground Investigations to assess the ground conditions and groundwater at the site. This may include soakage tests to assess the infiltration rates for drainage, depending on the proposed development at the site.	There are 12 sites that will require an FRA based on the NPPF requirements, including sites larger than 1ha. Out of the remaining sites, there is one site which may require a drainage strategy due to an increase in the impermeable area. This is dependent on the detailed proposals and may require input from the LLFAs regarding their requirements. For sites with no increase in impermeable area, SuDS may still be required depending on the size of the site and the proposals. Confirmation of this should be obtained from the LLFAs. There are two sites which the SFRA maps show have a high risk of groundwater flooding. This may require further assessment with a Ground Investigation to determine the site-specific risk to the proposed development and surrounding area.
BIODIVERSITY		
Fisheries	The EA Ecology & Fish Data Explorer indicates that Sea lamprey and potentially river lamprey have been captured within the Upper Lee catchment and freshwater River Thames. These records are subject to ongoing discussion as juvenile lamprey amoecetes are notoriously difficult to identify and recent developments in eDNA would be able to confirm their presence. Discussions with the Environment Agency have indicated that the recent findings of the juvenile twaite shad within the Middle and Lower Thames Tideway mean that shad species should be considered further within the LRU fish monitoring programme. As such, twaite shad eDNA was added to the last two months of the Gate 2 surveys and consideration for twaite shad should form part of future London Effluent Reuse monitoring.	Underwater noise Olfaction in the freshwater River Thames will be further assessed for the Teddington DRA Schemes as additional data becomes available. These data will need to be considered further in relation to migratory fish species and any potential disturbance of olfactory cues for migratory fish. Records of sea lamprey and river lamprey are inconclusive within the River Thames catchment. Future investigations via eDNA of Lampetra sp. and Petromyzon sp. should be carried out within the Thames catchment and existing European smelt eDNA fish monitoring expanded to include twaite shad.
Aquatic ecology	*Aquatic Invertebrates* It is noted that future assessment will need to consider changes in community composition to understand if there are any signification of correlations with inter annual variation in mean river temperatures, with a specific focus on those invertebrate taxa which are considered to be emergent species. *Macrophytes* It is noted that future assessments should also consider changes in community composition to understand if there are any signification correlations with inter annual variation in mean river temperatures.	Further specificity can be added to the aquatic ecology investigations at Gate 3 through additional data and evidence gathering in Reaches E and F or: • Invertebrates, • Macrophytes, and • Diatoms.
INNS	The ability to accurately predict the impact to INNS resulting from changes to the physical environment is limited due to lack of relevant literature. Impacts due to relatively small changes to the physical environment and water quality resulting from the Teddington DRA scheme are difficult to predict as in reality the preference of INNS are relatively broad, evident in their ability to dominate in a broad range geographical areas. As such, in reality there are likely to be additional factors at play such as functional niche overlaps and interspecific competition between native and non-native species which are likely to be altered as a result of small-scale changes to hydrology and water quality.	It is recommended that the SAI-RAT tool is reviewed and updated before the Gate 3 assessments to account for wider comments from other users following implementation during Gate 2.
Terrestrial ecology	GiGL protected species data for Teddington DRA and Mogden water recycling schemes were merged, and no spatial information provided. This limited the ability to assess species presence within close proximity of each option. Some UKHab surveys were not completed during the optimal time of year to assess annual flowering plants. Therefore, repeat surveys are recommended during spring and summer.	Protected species data request with specific 2 km and 5 km buffers around the footprint of Teddington DRA and grid references from GiGL. Badger, ground-based bat roost assessment, reptile, great crested newt, otter, and breeding bird surveys (with particular interest in red kite) at Mogden STW and Shaft/ Compound sites where supporting habitat has been identified.

[116] This scope will be reviewed once the Environmental Impact Assessment and planning application timescales have been confirmed.

Environmental Topic Area	Data gaps/uncertainties	Proposed work at Gate 3[116]
	The need for more detailed species surveys has been identified for certain taxa at certain sites.	Site walkover at Ham Lake to determine if there is potential to support qualifying gadwall and northern shoveler of the South West London Waterbodies SPA. UKHab survey required at Shaft/ Compound 1 to determine the type of habitat present within the area of permanent loss.
Historic environment	Further mitigation may be required at shaft site 4 where the shaft is located directly within the Ham House Conservation Area. The potential effects of a shaft at this location require further investigation. Currently unidentified archaeological remains may be present within any shaft or infrastructure site along the scheme route. The extent and nature of any archaeological remains present is currently unknown.	Further investigation of all sites is likely to be required in advance of any planning application to determine the extent and nature of any affects the proposals may have upon the setting and character of designated heritage assets, and to identify suitable mitigation strategies where required. Further investigation may also be required to determine the potential for any part of the scheme to contain surviving archaeological remains and what the nature of any such remains might be. This investigation is likely to comprise a series of desk-based archaeological and heritage assessment reports, which may be targeted upon those aspects of the scheme identified within this report as posing a potential risk to any aspect of the historic environment. All assessment reports would assist in forming suitable mitigation strategies designed to record any archaeological deposits present within the site and would seek to identify strategies by which potential negative setting and character effects upon designated assets may be reduced to an acceptable level or avoided entirely. Mitigation may involve a series of intrusive archaeological recording and design recommendations. The nature and scope of any archaeological recommendations should be agreed with the Greater London Archaeology Advisory Service (GLAAS) in advance of any construction work commencement.
Landscape and visual effects	In order to take any of the proposals through to EIA (Landscape/Townscape and Visual Impact Assessment in this instance) the final exact locations of the proposed construction compounds, pipeline routes, and the final design and placement of the built elements including dimensions, materials, and any proposed landscaping will be required. The proposed construction methodology and duration will also be required, given it is likely that many of the effects will relate to the construction period rather than to long term operation (for example all underground pipework).	In order to progress to Gate 3 the finalised designs for the three schemes will be required, including exact locations, building materials, access points, vegetation removal, and any soft landscaping/replanting.
Soils and contaminated land	Desk based assessment only using publicly available data sets which often have limited detail on the composition of the waste.	Further assessment to establish composition of waste in existing/historic landfills and risk of encountering contaminated soils, landfill gas and leachate should be undertaken by carrying out site investigations and Envirocheck review where conveyance cannot be re-routed to avoid landfill areas. Phase 1 Preliminary Risk Assessments will be progressed where a desk-based assessment is undertaken, reviewing historical mapping, British Geological Survey data, UXO screening and creating conceptual site models (as required).
Transport	Desk based assessment only using publicly available data sets. Indicative numbers of HGV movements during construction which will require refinement. Operational vehicle numbers are unlikely to be significant, but need to be confirmed and assessed.	Traffic counts may be required at certain locations, and further discussion is required with Transport for London (TfL) to scope the requirements of a future Transport Assessment.
Navigation	The navigational impacts resulting from the lower flow changes proposed within the Teddington DRA scheme have not been assessed at Gate 2. There is also some uncertainty with the amount of sediment deposition that will occur along the Thames Tideway during each of the London Effluent Reuse scenarios. While the changes in SSC and salinity have been modelled, the amount of sediment deposition has not been modelled during Gate 2. Sediment deposition can be affected by a wide range of factors in addition to salinity and SSC, which has not been accounted for in this assessment.	As engineering design progresses, Gate 2 tools can be re-used to assess variants in each of the schemes and the impacts that this would have on navigation. This would be undertaken with bespoke modelling that incorporates any additional information that have arisen as the options progress to Gate 3. The impact of the flow changes for each option will be undertaken, instead of solely modelling the worst-case scenarios. Further scenario modelling at Gate 3 could also include for potential future developments, such as an upgraded/ replacement Thames Barrier; and the inclusion of future climate scenarios. Future climate scenarios would account for sea level change, changes in river flows and changes in London Effluent Reuse scheme operating pattern. Consider construction related impacts when installing intakes and outfalls.
Noise	The baseline assumptions are sufficient for an initial appraisal of risk only. Indicative construction methods, plant numbers and likely noise levels have been used in the calculations which will need to be refined. A critical requirement for Gate 3 is baseline noise surveys at the nearest receptors to the Teddington DRA shaft and structures sites.	Information on noise and vibration emissions from tunnelling will be required as well as details of potential mechanical operational noise from the structures. Any changes to construction methodology and plant would be required Consultation with the London Boroughs affected by the developments would be required regarding local planning policy on noise and vibration and their criteria for construction noise and vibration. Details of proposed baseline noise surveys would ideally be approved by the local environmental health officers.
Air quality	Extensive baseline NO_2 monitoring data from diffusion tubes and automatic monitors is available in close proximity (within 1km) to the Teddington DRA scheme. PM_{10} and $PM_{2.5}$ monitoring data is available from automatic monitors within up to 4km of the all the schemes. In addition, Defra background maps, provide background concentrations for the three schemes for all the relevant pollutants of concern. Therefore, it is concluded that suitable baseline data is available to establish baseline condition for future EIA work. The initial appraisal of risk was undertaken using a number of conservative assumptions, and did not include any modelling: - The assessment is based on an unmitigated scheme and does not consider any embedded construction mitigation measures. - The magnitude of unmitigated dust effects of the relevant sources (earthworks and construction of shafts and tunnels) has been assessed as "large" according to IAQM classifications. - It is assumed that construction activity occurs everywhere, along each pipeline route, at all times for the duration of approximately one year (considered worse case). - The sensitivity of individual receptors has been considered as high.	Monitoring of $PM_{2.5}$ could potentially be considered nearer the SRO in order to provide data which would be relevant given the expected new $PM_{2.5}$ target. A full air quality assessment will be required to inform Gate 3.

Environmental Topic Area	Data gaps/uncertainties	Proposed work at Gate 3[116]
	Additional criteria not considered in the assessment at this stage: • History of dust generating activities in the area. • Likely cumulative dust effects from nearby construction sites. • Pre-existing physical screening such as trees or buildings. • Impact of road network used by the construction vehicles. • The influence of the prevailing wind direction. • Local topography	
People and communities	High level assessment only.	Full socio-economic assessment to be progressed for Gate 3. HUDU (Rapid Risk Assessment) / Health Impact Assessment.

10 ASSESSMENT OF CUMULATIVE EFFECTS

10.1 SCHEME SPECIFIC EFFECTS (INTRA-EFFECTS)

The cumulative effects and in-combinations assessment draw on the proposed approach outlined in the SRO Cumulative effects methodology note (see Section 5.4). Using a receptor based approach as detailed in Section 5, an initial view on the potential interrelationships between effects (scheme specific effects) is provided within **Table 10-1**.

Potentially, local communities (including schools) could be affected by multiple environmental effects during the construction of the project (see **Table 10-1**). Biodiversity could also be impacted by the loss of SINC habitat across multiple sites, and construction effects at multiple sites. Further assessment will be required during Gate 3 to establish cumulative effects on specific receptors, and develop the assessment further, alongside refined construction programmes to understand where phases would overlap.

Table 10-1 Intra-effects cumulative assessment matrix

Receptor type	Receptor	Potential cumulative effects	Mitigation
Residential	Local Communities within the Greater London Authority	Visual – potential for visual effects during construction. Noise – potential for noise during construction. Vibration – potential for vibration during construction. Air Quality – potential for dust and emissions during construction.	No additional mitigation is likely to be required beyond standard good practice construction measures.
Biodiversity	Local designated sites	Loss of SINC habitats across boroughs	Additional compensation for the combined permanent loss of habitats within the SINCs, and potential loss of connectivity, may be required.
Biodiversity	International, National and Local designated sites	Visual – potential for visual effects to habitats during construction. Noise – potential for noise during construction at multiple sites supporting bird populations. Vibration – potential for vibration during construction. Air Quality – potential for dust and emissions during construction.	No additional mitigation is likely to be required beyond standard good practice construction measures. Construction programmes currently suggest shaft construction would not be simultaneous. However, construction at the larger sites (e.g. AWRP, intakes and outfalls) are likely to overlap and therefore additional consideration of impacts to mobile species will be required e.g. timing to avoid construction at multiple sites in proximity to wintering bird populations.

10.2 CONCLUSIONS OF REGIONAL PLAN AND WRMPS (INTER-SRO EFFECTS)

The cumulative assessment follows the proposed approach outlined in the in-combination assessment note, originally presented to the NAU for comment by the Thames Water SRO teams in February 2022. The latest version of the note was circulated on 5 April 2022, with a subsequent meeting with the NAU leads to formally agree its adoption for the SRO process[117].

As described, where appropriate, the SRO cumulative effects assessments will refer to the cumulative effects assessments undertaken for Regional Plans and Water Company WRMPs and acknowledge that the outcome of such assessments will need to be updated as SROs detailed designs develop and as part of the EIA-stage

[117] Mott Macdonald (April 2022), Gate 2 Environmental Appraisal, Cumulative effects methodology.

cumulative effects assessment. The conclusions of the Regional Plan and WRMPs are not available at the time of drafting this IEA.

It is assumed that the Regional Plan and WRMP24 assessments have concluded no significant in-combination and cumulative effects at a plan level. This SRO specific cumulative effects assessment looks in further detail at the sites and surrounding area in terms of local and site-specific information including large development allocations within Local Plans and larger planning applications.

The latest conclusions of the WRSE Regional Plan and WRMP24 water resources modelling reconciliations suggest that the London Effluent Reuse SRO will be built out in the following order:

- Teddington DRA scheme – construction c.2027 for operation by c.2030/31
- Beckton water recycling scheme – paused until c.2040.
- Mogden water recycling scheme – not currently required within the WRSE and WRMP24 modelling.

As such, the in-combination assessment has been proportionate and focussed on the Teddington DRA scheme, as that scheme will be built out within the timescale of the currently submitted local authority planning applications. Larger Nationally Significant Infrastructure Projects (NSIPs) and Local Plan allocations have been considered for the Beckton water recycling scheme and Mogden water recycling schemes as these have longer planning timescales, whilst the assessment has gone further for Teddington DRA scheme by reviewing major planning applications on the relevant council's website.

Note that the in-combination assessments will be revisited at Gate 3 based on refinement of the scheme design and to incorporate all relevant plans and projects at the time of writing.

10.3 INTER-SRO IN-COMBINATION EFFECTS

A 1km ZoI has been used to reflect the overarching guidance produced for the Regional Plan, WRMP24 and SRO process, and to initially capture a search area for developments and plans. The Beckton water recycling scheme is located within six London boroughs: Enfield, Haringey, Waltham Forest, Redbridge, Newham and, Barking and Dagenham. The Mogden water recycling scheme is within Hounslow, Richmond upon Thames and Spelthorne. The Teddington DRA scheme is within Hounslow, Richmond upon Thames, and Kingston upon Thames.

Planning applications, including NSIPs, and Local Plan allocations within these boroughs were assessed to determine whether any within the ZoI cause impacts to the same European sites, and therefore could cause an in-combination effect which would require additional mitigation. Further assessment will be required as each scheme progresses through Gate 3 and the planning and Environmental Impact Assessment stage.

10.3.1 Planning Inspectorate's Programme of Projects

10.3.1.1 Southampton to London Pipeline Project[118]

The Southampton to London Pipeline (SLP) project is replacing 90km of the underground fuel pipeline between Boorley Green, Hampshire and the West London Terminal storage facility in Hounslow.

Construction works to install the replacement pipeline began in late 2021 and are estimated to be completed in 2023.

As such, no in-combination effects are anticipated, with the earliest London Effluent Reuse SRO scheme commencing in c.2027.

10.3.1.2 River Thames Scheme[119]

A new river channel is to be built in two sections between Egham Hythe in Runnymede and Shepperton in Spelthorne; capacity improvements to existing river structures (including at Sunbury, Molesey and Teddington Weirs and Desborough Cut); new green open spaces; habitat creation and enhancement; active travel provision and associated development.

---

[118] Southampton to London Pipeline Project (slpproject.co.uk)
[119] https://www.riverthamesscheme.org.uk/

Planning applications have been submitted, and the ZoI overlaps with the Mogden water recycling scheme and Teddington DRA scheme. There are no European sites which would be affected by any changes in flow or water quality during the operational phases of both schemes.

However, construction of the River Thames Scheme is estimated to commence in 2027, which would overlap with the earliest London Effluent Reuse SRO scheme commencing; currently considered to be the Teddington DRA scheme. However, given the locality of both schemes, the same European sites are not affected.

If Mogden water recycling scheme were to be selected for earlier construction, albeit considered unlikely on the basis of the water resource modelling, in-combination impacts from traffic emissions on the South West London Waterbodies SPA and Ramsar would need to be considered further.

10.3.1.3 North London Heat and Power Project[120]

The current EcoPark in Edmonton will reach capacity in 2025, as such the redevelopment of the park to include an Energy Recovery Facility (ERF), generating electricity using residual waste as a fuel and capable of an intended electrical output of around 70 MW, is underway.

The scheme is within the ZoI of the Beckton water recycling scheme, and there could result in in-combination effects on the Lee Valley SPA and Ramsar during construction. However, construction of the ERF commenced in 2019, and with the facility due to be operational in 2025, there is unlikely to be any overlap with the Beckton water recycling scheme.

10.3.2 Transport and Works Act (TWA) applications and decisions

There are currently no Transport and Works Act (TWA) applications and decisions associated with the zone of influence, hence no-combination impacts are expected

10.3.3 Local Planning Authority land allocations (from Local Plan) and planning applications: Teddington DRA scheme

Table 10-2 identifies the latest planning applications and Local Plan allocations which need to be considered for an in-combination effect with the Teddington DRA scheme. Only large existing and emerging Local Plan allocations e.g. 500 or more dwellings and large Town and Country Planning applications, where an EIA is required, have been considered[121]. Further refinement of the in-combination assessment will be required at Gate 3. The results of the cumulative effects assessment is presented in **Table 10-3**. At this stage there are no significant cumulative effects identified with other developments or plans. This assessment will need to be reviewed during Gate 3.

---

[120] http://northlondonheatandpower.london/

[121] Mott Macdonald (April 2022), Gate 2 Environmental Appraisal, Cumulative effects methodology.

Table 10-2 Schedule of developments for inter cumulative effects assessment: Teddington DRA scheme

No.	Application reference	Planning Authority	Applicant and brief description	Closest distance from scheme boundary and orientation	Planning status	Overlap in temporal scope?	Scale and nature of development likely to have a significant effect?	Potential receptors affected	Other factors	Progress to cumulative assessment?
1 - Teddington	N/A	London Borough of Hounslow	Isleworth – 174 Twickenham Road: This site has been identified through the London SHLAA 2013 as it has a potential housing capacity during the plan period.	450m to the north east	Land Allocation	N – This is not likely; however, this cannot be certain as no planning applications have currently been accepted for this site.	N	Twickenham Trading Estate Historic Landfill site, Mogden Sewage Works SINC, Flood Zone 2, Hounslow AQMA	None	N
2 - Teddington	N/A	London Borough of Hounslow	Isleworth – Swan Court: The mixed-use allocation is based on a floorspace ratio of 50:50 residential to office use. This site has been identified through the London SHLAA 2013 as it has a potential housing capacity during the plan period. Proposals for the site should also include an element of office floorspace.	900m to the north east	Land Allocation	N – This is not likely; however, this cannot be certain as no planning applications have currently been accepted for this site.	N	Hounslow AQMA, River Thames SINC, Kew Royal Botanical Gardens World Heritage Site, Listed Building (Upper Square, grade II)	None	N
3 - Teddington	N/A	London Borough of Hounslow	Isleworth – Rugby Road: The mixed-use allocation is based on a floorspace ratio of 50:50 residential to	500m to the west	Land Allocation	N – This is not likely; however, this cannot be certain as no planning	N	Hounslow AQMA, Redlees Park Historic Landfill site	None	N

No.	Application reference	Planning Authority	Applicant and brief description	Closest distance from scheme boundary and orientation	Planning status	Overlap in temporal scope?	Scale and nature of development likely to have a significant effect?	Potential receptors affected	Other factors	Progress to cumulative assessment?
			commercial uses. The site has been identified through the London SHLAA 2013 as it has a potential housing capacity during the plan period. Proposals for light industrial uses (B1b/c) should safeguard the residential amenity in the remaining areas of the site.			applications have currently been accepted for this site.				
4 - Teddington	N/A	London Borough of Hounslow	Isleworth – Nazareth House: This site has planning permission for residential with large proportion for care home provision. Residential development will enable the preservation and enhancement of the listed buildings on site.	720m to the north east	Land Allocation	N – This is not likely; however, this cannot be certain as no planning applications have currently been accepted for this site.	N	Hounslow AQMA, Flood Zone 2, Kew Royal Botanical Gardens World Heritage Site	None	N
5 - Teddington	22/1168/FUL	London Borough of Richmond upon Thames	Richmond upon Thames College: Alterations and extension to existing Sports Hall including associated landscaping within the Tech Hub Development Zone to replace Tech Hub	920m to the west	In Progress (Decision due: 22/07/2022)	Y – A decision is yet to be made on the development. By the time the application is approved there is a	N	Twickenham Junction Rough SINC, Richmond AQMA	None	N

No.	Application reference	Planning Authority	Applicant and brief description	Closest distance from scheme boundary and orientation	Planning status	Overlap in temporal scope?	Scale and nature of development likely to have a significant effect?	Potential receptors affected	Other factors	Progress to cumulative assessment?
			building as defined under application 15/3038/OUT, and erection of Sports Hall with associated car parking, landscaping, and other works within the Main College Development Zone including erection of STEM building as approved under application 19/2517/RES.			possibility it's construction timescale could overlap with the London Effluent Reuse scheme.				
6 - Teddington	Not validated	London Borough of Richmond upon Thames	Ham Close: The demolition of the existing buildings on-site and phased mixed-use development comprising 452 residential homes (Class C3) up to six storeys a Community / Leisure Facility (Class F2) of up to four storeys in height, a "Makers Lab" (sui generis) of up to two storeys together with basement car parking and site wide landscaping.je	400m to the east	Consultation stage	Y – consultation began back in 2015 and is expected to come to an end in 2022. A timetable has not yet been set for this development.	Y	Richmond AQMA, Ham House Gardens, Ham Lands LNR, River Thames SINC	None	Y

Table 10-3 Cumulative effects assessment matrix: Teddington DRA scheme

No.	Application Reference	Planning Authority	Applicant and brief description	Potential for cumulative effects with the scheme	Potential mitigation
6 - Teddington	Not validated	London Borough of Richmond upon Thames	Ham Close: The demolition of the existing buildings on-site and phased mixed-use development comprising 452 residential homes (Class C3) up to six storeys a Community/Leisure Facility (Class F2) of up to four storeys in height, a "Makers Lab" (sui generis) of up to two storeys together with basement car parking and site wide landscaping.	The development is located 400m east of the scheme. The construction programme of the development remains unknown as it is currently at the consultation stage. Therefore, there is a possibility that construction may overlap with the Teddington schemes construction. The closest element of the Teddington scheme to the development is the pipeline which will not be visible to the nearby residential receptors (452 residential homes) and will not have any operational noise impacts on nearby residential receptors. The development has not predicted any other significant adverse residual effects, and it is considered unlikely that when combined with the scheme, the reported effects would result in significant cumulative effects. When operational the Teddington scheme is likely to help increase water security for the development's residential properties.	No additional mitigation has been identified above the measures which would be included within a Construction Environmental Management Plan. In-combination air quality issues on Richmond Park SAC are considered low risk (site does not have an air quality objective).

11 CONCLUSIONS AND NEXT STEPS

This IEA report catalogues the set of environmental assessment of the London Effluent Reuse SRO through RAPID Gate 2. This IEA summarises the environmental assessments undertaken.

The Gate 2 IEA has revisited the three options considered in Gate 2, informed by a more detailed conceptual design produced by the team engineers; notably the refinement of the conveyance routes and associated infrastructure (e.g., shaft locations), to identify if any of the elements could lead to a significant adverse impact on receptors within the Zone of Influence of the scheme.

This IEA had an aim of summarising the baseline for a number of environmental topics, and predicting potential impacts that may need to be considered during future environmental assessment stages, such as an EIA, or non-statutory environmental assessments to support a future planning application.

The use of water resources modelling at Gate 2 has provided the best available information on likely patterns of scheme use available at the time. However, with WRSE and other Regional Groups WRMP24 Plan reconciliation, the pattern of use of London Effluent Reuse SRO and other SROs will develop. New variants on operating patterns and cumulative issues can be readily tested through scenarios using the Gate 2 river and estuary modelling tools. These include variants in standby and ramp-up/ ramp-down patterns within the 1D model of the River Thames.

The current assessments show that the operational impacts of the London Effluent Reuse SROs on the freshwater River Lee, freshwater River Thames and estuarine Thames Tideway are minimal, considering baseline conditions. As discussed above, further refinement to design and the operating patterns may further reduce those impacts identified.

Gate 2 has considered the potential impacts arising from the land-based infrastructure to a greater detail than that at Gate 1. Desk-based assessments have been undertaken for a variety of key topic areas, using the conceptual design reports and indicative construction programmes, to provide an understanding of risk associated with the various scheme components. Further refinement of locations, construction techniques and periods, and the testing the effectiveness of mitigation proposed will need to be undertaken as part of the Gate 3 work ahead of any planning application.

The WRSE Regional Plan modelling suggests that the Teddington DRA scheme is required by c 2030/31 and therefore a planning application, most likely Town and Country Planning, will be required to be prepared in the near future. As such, a greater range of environmental topic areas than those identified below (e.g. noise – airborne and underwater, potentially daylight and sunlight, odour) will need to be considered as part of any EIA. The scope of any EIA assessment, and supporting baseline surveys and modelling work, will be discussed with the regulators and local planning authorities in due course.

To support a future planning application, the engineering design will need to progress to greater detail. Gate 2 tools can be re-used to assess variants in outfall velocities or discharge angle for discharge in the 3D Telemac model of the River Thames. A 2D hydrodynamic model of the Enfield Island Loop locally between Rifle Weir and the Lee Diversion Channel may assist with detailed design of a Beckton water recycling outfall.

APPENDIX 1 EMBEDDED MITIGATION MEASURES

Table A1 Embedded mitigation measures proposed for London Effluent Reuse SRO schemes

Environmental topic	Mitigation reference	Mitigation
Air quality	AQ1	SRO will implement best practice pollution and dust/odour control measures during construction activities. Incorporating requirements of Health and Safety at Work Act for construction workers
Air quality	AQ2	Locate machinery and dust causing activities away from sensitive receptors.
Air quality	AQ3	Erect solid screens or barriers around site (as required). Especially when directly adjacent to a sensitive receptor.
Air quality	AQ4	Keep site fencing, barriers and scaffolding clean using wet methods.
Air quality	AQ5	Ensure there is an adequate water supply on the site for dampening.
Air quality	AQ6	Store materials with the potential to produce dust away from site boundaries where reasonably practicable.
Air quality	AQ7	Use or remove loose (potentially dusty) materials from site as soon as possible.
Air quality	AQ8	Use appropriate techniques to avoid runoff/mud which can cause dust once dry.
Air quality	AQ9	Where possible, use design/ prefabrication to reduce the need for grinding, sawing and cutting on site.
Air quality	AQ10	Cutting, grinding or sawing equipment to be fitted or used in conjunction with suitable dust suppression techniques such as water sprays or local extraction.
Air quality	AQ11	All dust control equipment to be in good condition and maintenance recorded.
Air quality	AQ12	Ensure that any crushing or grinding plant used on the site has an appropriate permit or exemption issued by the Environment Agency, and is maintained according to the permit or exemption,
Air quality	AQ13	Ensure that any plant identified above is operated in accordance with the conditions set out in the permit and a copy of the permit is held on site.
Air quality	AQ14	Use enclosed rubble chutes and conveyors where reasonably practicable or use water to suppress dust emissions from such equipment.
Air quality	AQ15	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
Air quality	AQ16	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out.
Air quality	AQ17	Ensure slopes on stockpiles are no steeper than the natural angle of repose of the material and maintain smooth profile.
Air quality	AQ18	Establish and ensure compliance with a maximum speed limit on site.
Air quality	AQ19	Sheet the sides and top of all vehicles carrying waste and other dusty materials.
Air quality	AQ20	Screen buildings, where dust producing activities are taking place, with debris screens or sheeting.
Air quality	AQ21	Ensure mixing of cement, bentonite, grout and other similar materials takes place in enclosed areas remote from site boundaries and potential receptors (i.e., locate westward, away from Whitewall Drain).
Air quality	AQ22	Ensure vehicles working on site have exhausts positioned such that the risk of re-suspension of ground dust is minimised
Air quality	AQ23	Sheet or otherwise enclose loaded bins and skips.
Air quality	AQ24	Ensure no burning of waste materials takes place on site.
Air quality	AQ25	Ensure water suppression is used during demolition operations.

Environmental topic	Mitigation reference	Mitigation
Air quality	AQ26	Bag and remove biological debris (such as birds' nests and droppings) or damp down such material prior to demolition. Sheet, seal or damp down unavoidable stockpiles of excavated material held on site, where required.
Air quality	AQ27	Avoid double handling of material wherever reasonably practicable. Provide and ensure the use of wheel cleaning facilities near the site exit wherever there is a potential for carrying dust or mud off the site.
Air quality	AQ28	Clean the public highway using wet sweeping methods when necessary.
Air quality	AQ29	Avoid dry sweeping of large areas.
Air quality	AQ30	Ensure all vehicles carrying loose or potentially dusty material to or from the site are fully sheeted.
Biodiversity	BD1	London Re-use to deploy dust suppression techniques around construction areas to avoid the potential effects on sensitive habitats within 500m of the construction area.
Biodiversity	BD2	Identification and removal of invasive species on site in advance of construction and commissioning.
Biodiversity	BD3	Best practice biosecurity measures will be followed, as recommended by the GB Non-Native Species Secretariat to guard against any potential for spreading invasive and non-native species during construction
Biodiversity	BD4	Construction Environmental Management Plan with risk assessment for pollution incidents and introduction/ spread of INNS and a response plan if either occurred
Biodiversity	BD5	Works will be conducted in adherence to EA Pollution Prevention Guidelines; now archived
Climate Change	CC1	London Re-use will incorporate an appropriate allowance for climate change into the design of water treatment infrastructure.
Landscape and visual	LV1	Temporary lighting will be strategically located for safe construction requirements and where possible, will be directional to minimise increase in light levels and light spill.
Landscape and visual	LV2	The water reuse site at Beckton STW is well screened from the adjacent roads and the surrounding land use is generally industrial. Tree and scrub removal will be required during construction, however the existing screening to the boundary of the site is to be retained and enhanced as required.
Land quality	LQ1	Soil will be stored separately and will be stored for the minimum time practicable to prevent any deterioration in quality.
Land quality	LQ2	Subsoil and different superficial deposits will be stored separately to prevent mixing and will be reinstated in reverse order of excavation
Land quality	LQ3	Stockpiling must be completed in the driest condition possible to reduce compaction.
Land quality	LQ4	Once stockpiles are completed, the area should be cordoned off with secure fencing.
Land quality	LQ5	Soil storage periods should be as short as possible. Soil bunds that will be left throughout spring months to be seeded.
Land quality	LQ6	Soil stabilising methods to be introduced to reduce the risk of erosion, the creation of leachate and potential water quality issues.
Land quality	LQ7	Soils will not be stockpiled close to surface water features.
Land quality	LQ8	Stockpiled soils will be stored on an appropriate impermeable surface material and covered to reduce the risk of windblown dust, surface water run-off and to reduce the risk of overland migration of silt and sediment to surface waters.
Land quality	LQ9	Stockpiled soils will be protected by appropriate measures, for example, membranes, spraying or seeding.
Land quality	LQ10	If heavy rainfall occurs during soil stripping operations, work must cease to avoid damaging the soil moisture content.

Environmental topic	Mitigation reference	Mitigation
Land quality	LQ11	Topsoil stripping will be restricted to the width of the permanent and temporary elements of the Scheme, thereby minimising disturbance to the integrity of the biomass.
Land quality	LQ12	Any vegetative growth higher than 150 mm should be cut and removed from the land surface prior to topsoil stripping.
Land quality	LQ13	Appropriate geotextile membranes, wooden matting or aluminium trackways will be used over particularly sensitive areas.
Land quality	LQ14	In peaty and soft saturated clay soils, where the use of geotextile membranes is not appropriate, wheeled vehicles may be fitted with low ground pressure bearing pneumatic tyres to allow a greater distribution of weight.
Land quality	LQ15	A winged tine subsoiler should be used to loosen the soil to a depth of 450mm below the surface of the subsoil, using a tine spacing no greater than 900 mm. Soil compaction may be so severe that it is necessary for subsoil loosening to initially be undertaken with shallower and closer spaced tines. This should be followed by progressively deeper phases until tines at 450mm depth can thoroughly loosen the soil, such that the loosened layers overlap at depth.
Land quality	LQ16	Management of weeds should be undertaken March-September. All topsoil bunds to be dressed off.
Land quality	LQ17	Storage of topsoil should not be above 2m.
Material resources and waste	MW1	London Re-use will prepare and implement a Materials Management Plan (MMP) that will seek to maximise the reuse of excavated non-waste materials during pipeline construction earthworks, where practicable and feasible.
Traffic and Transport	TT1	Construction delivery routes will be agreed with the local planning authority and contractors be provided with details of these in the CEMP. Lengths of haul routes from existing roads to compounds and working areas will be minimised.
Water resources	WR1	London Re-use will ensure that the Project is compliant with the flood risk standards outlined in the National Planning Policy Framework wherever practicable, including requirements for climate change.
Water resources	WR2	London Re-use will deploy groundwater control techniques which may include dewatering from excavations, lakes and tunnels; physical exclusion (e.g., utilising a slurry cut-off wall, ground freezing or grouting); pumping from sumps or wells (including well-points) to intercept the groundwater before reaching excavations, lakes and tunnels (resulting in a drawdown of the water table).
Water resources	WR3	Spill kits will be located within the vicinity of fuel and chemical storage areas.
Water resources	WR4	Prevent fuelling and maintenance of plant in, over, or adjacent to a watercourse.
Water resources	WR5	Drip trays must be used for all non-mobile machinery. All chemical storage containers must be stored with bunding, where it must hold 110% of the capacity of the container.
Water resources	WR6	Storage areas will be located 10m away from watercourses, open drains, gullies and permeable surfaces.
Water resources	WR7	Storage areas will be located 50m away from wells, springs and boreholes.
Water resources	WR8	Plant will be regularly checked for leaks and will be regularly maintained.
Water resources	WR9	All discharges to groundwater and surface water must be prior agreed with the Environment Agency or Internal Drainage Board. No silty water to be pumped directly into any watercourse but to be allowed to settle out (for example, in settlement lagoons) or filtered (for example using straw bales to filter out coarse particles, or mechanical filtering) prior to discharge.

Environmental topic	Mitigation reference	Mitigation
Water resources	WR10	Where settlement or filtering is not practicable or effective, alternative disposal options will be considered for example, discharge onto a grassed area (with consent from the landowner and following Environment Agency consultation), and discharge to foul sewer (with consent from the local sewerage undertaker).
Water resources	WR11	If clean water is discharged into a watercourse, a baffle will be fitted to the discharge point to prevent disturbance of the watercourse bed
Water resources	WR12	Watercourses will be protected from contaminated surface water run-off by using French drains, cut off ditches, grips, silt fences or bunds round the edge of watercourses. Numerous small, passive mitigation measures will be installed in preference to one large treatment system to prevent large-scale water build-up.
Water resources	WR13	Existing and new surface water drains will be kept clear of silt or weed build-up.
Water resources	WR14	Roads and hard surfaces will be kept clean, to prevent a build-up of mud and sediment that could contaminate surface water
Water resources	WR15	Treated effluent will be compliant with WFD water quality standards before discharge to Lockwood Reservoir and River Lee Diversion

APPENDIX 2 SEA MATRICES

APPENDIX 3 HISTORIC ENVIRONMENT GAZETTER

Gazetteer of heritage assets

Abbreviations

LB	Listed building	EVT	Previous archaeological event	MON	Monument	PLA	Place
BLD	Historic building	PK	Park	FS	Find spot		

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
1	n/a	1000194	WANSTEAD PARK	LB II*	Post-medieval	540938	187347	https://historicengland.org.uk/listing/the-list/list-entry/1000194
2	n/a	1065618	THE COPPERMILLS (WATERBOARD STORES)	LB II	Post-medieval	535080	188296	https://historicengland.org.uk/listing/the-list/list-entry/1065618
3	n/a	1293606	THE FERRY BOAT INN	LB II	Post-medieval	535017	189362	https://historicengland.org.uk/listing/the-list/list-entry/1293606
4	n/a	1079455	RETORT HOUSE AND KING GEORGE PUMPING STATION	LB II	Modern	537301	197931	https://historicengland.org.uk/listing/the-list/list-entry/1079455
5	n/a	1079456	PUMP HOUSE AT KING GEORGE PUMPING STATION	LB II	Modern	537286	197892	https://historicengland.org.uk/listing/the-list/list-entry/1079456
6	n/a	1260607	SLUICE GATES AND FLANKING WALLS AT INTAKE FROM THE LEA NAVIGATION TO KING GEORGE PUMPING STATION	LB II	Modern	537318	197898	https://historicengland.org.uk/listing/the-list/list-entry/1260607
7	n/a	1260935	WATER TOWER HOUSE AT KING GEORGE PUMPING STATION	LB II	Modern	537281	197873	https://historicengland.org.uk/listing/the-list/list-entry/1260935
8	n/a	1358747	WEIR WITH INLET PIPES AT KING GEORGE PUMPING STATION AND ADJACENT TO KING	LB II	Modern	537276	197851	https://historicengland.org.uk/listing/the-list/list-entry/1358747

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
			GEORGE RESERVOIR					
9	n/a	1079487	RAILINGS TO EAST OF WEST RANGE OF OFFICES ATTACHED TO MACHINE SHOP, ROYAL ORDNANCE FACTORY	LB II	Post-medieval	537224	198422	https://historicengland.org.uk/listing/the-list/list-entry/1079487
10	n/a	1240468	MACHINE SHOP AND ATTACHED RANGE TO WEST AT ROYAL ORDNANCE FACTORY	LB II	Post-medieval	537266	198471	https://historicengland.org.uk/listing/the-list/list-entry/1240468
11	n/a	1358721	4-14, GOVERNMENT ROW	LB II	Post-medieval	537172	198514	https://historicengland.org.uk/listing/the-list/list-entry/1358721
12	n/a	1240831	MOGDEN HOUSE	LB II	Post-medieval	515922	175060	https://historicengland.org.uk/listing/the-list/list-entry/1240831
13	n/a	1261018	GARVIN HOUSE	LB II*	Post-medieval	516147	175588	https://historicengland.org.uk/listing/the-list/list-entry/1261018
14	n/a	1000282	HAM HOUSE	LB II*	Post-medieval	517353	172904	https://historicengland.org.uk/listing/the-list/list-entry/1000282
15	n/a	1250281	RIVERSIDE HOUSE	LB II	Post-medieval	516877	173341	https://historicengland.org.uk/listing/the-list/list-entry/1250281
16	n/a	1250280	ORLEANS HOUSE THE OCTAGON ROOM AND SERVICE WING ADJOINING	LB I	Post-medieval	516906	173379	https://historicengland.org.uk/listing/the-list/list-entry/1250280
17	n/a	1080790	HAM HOUSE STABLES	LB II	Post-medieval	517084	173008	https://historicengland.org.uk/listing/the-list/list-entry/1080790
18	n/a	1391392	TEDDINGTON FOOTBRIDGE	LB II	Post-medieval	516750	171462	https://historicengland.org.uk/listing/the-list/list-entry/1391392
19	n/a	1358439	THE COTTAGE AND GARDEN WALLS	LB II	Post-medieval	517617	171621	https://historicengland.org.uk/listing/the-list/list-entry/1358439

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
20	n/a	1051027	25-30, LANGHAM HOUSE CLOSE	LB II*	Modern	517541	171772	https://historicengland.org.uk/listing/the-list/list-entry/1051027
21	n/a	1033381	19-24, LANGHAM HOUSE CLOSE	LB II*	Modern	517578	171814	https://historicengland.org.uk/listing/the-list/list-entry/1033381
22	n/a	1051033	DRYDEN COURT AND SCULPTURE TO NORTH	LB II	Modern	517810	171624	https://historicengland.org.uk/listing/the-list/list-entry/1051033
23	n/a	1377697	HAWKE HOUSE	LB II	Post-medieval	510347	168852	https://historicengland.org.uk/listing/the-list/list-entry/1377697
24	n/a	1295032	WALLS AND RAILINGS TO FRONT OF HAWKE HOUSE	LB II	Post-medieval	510330	168845	https://historicengland.org.uk/listing/the-list/list-entry/1295032
25	n/a	1188038	THE OLD MANOR HOUSE	LB II	Post-medieval	508858	166954	https://historicengland.org.uk/listing/the-list/list-entry/1188038
26	n/a	1192307	POST AT NGR TQ 09506642	LB II	Post-medieval	509502	166431	https://historicengland.org.uk/listing/the-list/list-entry/1192307
27	n/a	1030249	GATE PIERS TO THE FORMER MOUNT FELIX	LB II	Post-medieval	509578	166399	https://historicengland.org.uk/listing/the-list/list-entry/1030249
28	n/a	1263644	PAIR OF GATE PIERS APPROXIMATELY 20 METRES TO SOUTH-WEST OF 42A	LB II	Post-medieval	509703	166468	https://historicengland.org.uk/listing/the-list/list-entry/1263644
29	n/a	1377448	CLOCK TOWER AND STABLE BLOCK TO THE FORMER MOUNT FELIX	LB II	Post-medieval	509650	166466	https://historicengland.org.uk/listing/the-list/list-entry/1377448
30	n/a	1030139	OATLANDS DRIVE	LB II	Post-medieval	509554	166296	https://historicengland.org.uk/listing/the-list/list-entry/1030139
31	n/a	1030056	3, OATLANDS DRIVE	LB II	Post-medieval	509538	166265	https://historicengland.org.uk/listing/the-list/list-entry/1030056
32	n/a	1365886	ASHLEY COTTAGE	LB II	Post-medieval	509537	166212	https://historicengland.org.uk/listing/the-list/list-entry/1365886

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
33	n/a	1030138	DOWER HOUSE	LB II	Post-medieval	509531	166200	https://historicengland.org.uk/listing/the-list/list-entry/1030138
34	n/a	1365887	ASHLEY HOUSE	LB II	Post-medieval	509524	166190	https://historicengland.org.uk/listing/the-list/list-entry/1365887
35	n/a	1030078	POST AT NGR TQ 09086614	LB II	Post-medieval	509080	166140	https://historicengland.org.uk/listing/the-list/list-entry/1030078
36	ELO10980	n/a	Jenkins Lane [Beckton Sewage Treatment Works], London, IG11: Evaluation	EVT	n/a	544520	182200	n/a
37	ELO12340	n/a	Jennings Lane/Eric Clarke Lane/Royal Docks Road [Beckton Sewage Treatment Works], Creakside Backwater, Beckton, Newham: Watching Brief	EVT	n/a	545184	182511	n/a
37	ELO13382	n/a	Jennings Lane/Eric Clarke Lane/Royal Docks Road [Beckton Sewage Treatment Works], Creakside Backwater, Beckton, Newham: Watching Brief	EVT	n/a	545184	182511	n/a
38	ELO17564	n/a	Thames Gateway Water Treatment Plant Distribution Pipeline London Boroughs of Redbridge, Newham and Waltham Forest: Archaeological Watching Brief	EVT	n/a	542246	542246	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
39	ELO7534	n/a	River Road, (8), Barking, IG11: Watching Brief	EVT	n/a	545314	182738	n/a
40	ELO4461	n/a	River Road (BARDAG Site) Barking: Watching Brief	EVT	n/a	545453	182926	n/a
40	ELO4463	n/a	River Road [BARDAG Sports Ground] London Borough of Barking and Dagenham: Evaluation	EVT	n/a	545455	182926	n/a
41	ELO18936	n/a	Kingsbridge Road [Land at Abbey Wharf] Barking London: Archaeological Test Pitting	EVT	n/a	544886	183012	n/a
42	ELO2553	n/a	FORMER ICON WARNE WORKS, GASCOIGNE ROAD, DAGENHAM	EVT	n/a	544520	183140	n/a
43	ELO19767	n/a	Thamesmead Marshes/Jenkins Lane [Thames Gateway Bridge] Thamesmead West/ Beckton Greater London: Watching Brief	EVT	n/a	544050	182885	n/a
44	ELO17549	n/a	Ive Farm Lane, Leyton, London Borough of Waltham Forest, E10 5HL: Archaeological Evaluation	EVT	n/a	537285	186665	n/a
45	ELO7167	n/a	Marsh Lane, Leyton, Waltham Forest, (Assessment and Geotechnical Watching Brief)	EVT	n/a	537006	186736	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
46	ELO18501	n/a	Ive Farm Lane, Leyton, London, E10 5HL: Archaeological Excavation	EVT	n/a	537323	186644	n/a
46	ELO18501	n/a	Ive Farm Lane, Leyton, London, E10 5HL: Archaeological Excavation	EVT	n/a	537306	186613	n/a
47	ELO18903	n/a	Hale Wharf Tottenham N17 London Borough of Haringey: Geoarchaeological watching brief	EVT	n/a	534850	189628	n/a
47	ELO20150	n/a	Forest Road [Hale Road] Tottenham Hale London: Archaeological watching Brief	EVT	n/a	534849	189631	n/a
48	ELO11579	n/a	Forest Road, London, E17: Watching Brief	EVT	n/a	535058	535058	n/a
49	ELO19027	n/a	Ferry Lane [Anthology Works] London Borough of Haringey: Watching Brief	EVT	n/a	534570	189493	n/a
50	ELO3301	n/a	Ferry Lane, [Ferry Lane Wharf], Haringey, N17: Evaluation	EVT	n/a	534804	189271	n/a
51	ELO2409	n/a	Meridian Way, [Tesco Stores], Edmonton, Enfield, Evaluation	EVT	n/a	535050	192050	n/a
52	ELO18371	n/a	Willoughby Lane and Meridian Way [Meridian Water Site], Upper Edmonton, Enfield, N18: Watching Brief	EVT	n/a	535003	191908	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
52	ELO18361	n/a	Willoughby Lane and Meridian Way [Meridian Water Site], Upper Edmonton, N18: Watching Brief	EVT	n/a	535017	191907	n/a
53	ELO3388	n/a	Lorry Park (former) Glover Drive, Meridian Way Evaluation	EVT	n/a	535245	191785	n/a
53	ELO18779	n/a	Edmonton [Tottenham Ikea extension], London: Archaeological Evaluation	EVT	n/a	535242	191759	n/a
54	ELO16618	n/a	Glover Drive [The IKEA superstore], Edmonton, Enfield: Excavation	EVT	n/a	535369	191749	n/a
54	ELO7161	n/a	Glover Drive [The IKEA superstore], Edmonton, Enfield: Evaluation	EVT	n/a	535393	191727	n/a
54	ELO3348	n/a	Glover Drive [Meridian Point] Enfield: Evaluation	EVT	n/a	535400	191799	n/a
55	ELO12314	n/a	Pickett's Lock Way/Meridian Way/Ardra Road [Deephams Sewage Works], Edmonton, Enfield: Geoarchaeological Deposit Model	EVT	n/a	535894	193601	n/a
55	ELO14846	n/a	Pickett's Lock Lane [Deephams Sewage Treatment Works], Enfield, N9	EVT	n/a	535885	193610	n/a
55	ELO15589	n/a	Pickett's Lock Lane/Meridian Way	EVT	n/a	535894	193601	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
			[Deephams Sewage Treatment Works], Edmonton, Enfield: Trial Trenching					
55	ELO17100	n/a	Pickett's Lock Lane [Deephams Sewage Treatment Works], Lower Edmonton, Enfield: Archaeological Investigations	EVT	n/a	535891	193614	n/a
56	ELO11404	n/a	Pickett's Lock Lane [Deephams Sewage Works], London, N9: Watching Brief	EVT	n/a	535750	193674	n/a
56	ELO12315	n/a	Pickett's Lock Lane/Meridian Way/Ardra Road [Deephams Sewage Works], Edmonton, Enfield: Watching Brief	EVT	n/a	535708	193709	n/a
57	ELO17101	n/a	Pickett's Lock Lane [Deephams Sewage Treatment Works], Edmonton, Enfield: Watching Brief	EVT	n/a	535966	193860	n/a
58	ELO14242	n/a	East Duck Lees Lane [Ponders End Industrial Estate], Ponders End, Enfield: Geoarchaeological fieldwork & deposit model	EVT	n/a	536503	196020	n/a
58	ELO18707	n/a	Ponders End [Enfield Distribution Park] London Borough of Enfield: Archaeological Evaluation	EVT	n/a	536501	196020	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
58	ELO9288	n/a	Montagu Road [Land Opposite Nos 307-435] Edmonton Green, Greater London: Evaluation and Excavation	EVT	n/a	535418	193678	n/a
59	ELO16752	n/a	Mollison Avenue [Prince of Wales Wetland], Enfield Lock, Enfield, EN3: Pre-determination Evaluation	EVT	n/a	536936	198226	n/a
60	ELO9263	n/a	Brancroft Way, [Enfield Energy Centre], Enfield, EN3, Evaluation	EVT	n/a	536873	197833	n/a
60	ELO9264	n/a	Brancroft Way, [Enfield Energy Centre], Enfield, EN3, Desk Based Assessment and Geotechnical Monitoring	EVT	n/a	536872	197832	n/a
61	ELO14286	n/a	Swan and Pike Road [The Rifles Public House], Enfield Lock, Enfield: Evaluation	EVT	n/a	537190	198360	n/a
61	ELO14286	n/a	Swan and Pike Road [The Rifles Public House], Enfield Lock, Enfield: Evaluation	EVT	n/a	537183	198413	n/a
61	ELO14287	n/a	Swan and Pike Road [The Rifles Public House], Enfield Lock, Enfield: Evaluation	EVT	n/a	537199	198297	n/a
62	ELO9265	n/a	Government Row, [Former Royal Ordnance Factory],	EVT	n/a	537450	198541	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
			Enfield Lock: Excavation and Post-excavation					
63	ELO11616	n/a	Percy Road [Whitton School], London, TW2: Desk Based Assessment	EVT	n/a	513875	172788	n/a
64	ELO12887	n/a	Lincoln Avenue/Hanworth Road [Crane Park], Richmond: Conservation Statement	EVT	n/a	514109	172766	n/a
65	ELO2810	n/a	Bankside Close [Land off] Isleworth Greater London: Evaluation	EVT	n/a	515887	174948	n/a
65	ELO9665	n/a	Bankside Close [Land off] Isleworth Greater London: Excavation	EVT	n/a	515887	174948	n/a
66	ELO4565	n/a	Mogden Lane/ Rugby Road [South Middlesex Hospital] Twickenham London Borough of Hounslow: Evaluation	EVT	n/a	515540	174573	n/a
67	ELO4571	n/a	South Middlesex Hospital	EVT	n/a	515455	174555	n/a
68	ELO17422	n/a	Riverside, [Orleans House], Twickenham, Greater London, TW1 3DJ: Evaluation, Excavation, Building Recording	EVT	n/a	516987	173432	n/a
69	ELO5279	n/a	HAM	EVT	n/a	516921	173203	n/a
69	ELO5280	n/a	HAM	EVT	n/a	516904	173204	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
70	ELO20070	n/a	Teddington Weir Eyot [Teddington Weir] Teddington Greater London: Archaeological evaluation	EVT	n/a	516707	171533	n/a
71	ELO2795	n/a	Richmond Road, [British Aerospace Site], Evaluation	EVT	n/a	517628	171297	n/a
72	ELO3956	n/a	Broom Road, [The Lensbury Club], Teddington Lock: Evaluation	EVT	n/a	517055	171255	n/a
73	ELO17440	n/a	Broom Road [Teddington Studios] Teddington London Borough of Richmond upon Thames TW11: Evaluation	EVT	n/a	516797	171343	n/a
73	ELO17444	n/a	Broom Road [Teddington Studios] London Borough of Richmond upon Thames TW11 9NT: Geoarchaeological Investigation	EVT	n/a	516797	171343	n/a
73	ELO18828	n/a	Broom Road [Teddington Studios] Richmond: Oral History Project	EVT	n/a	516798	171344	n/a
73	ELO10603	n/a	Broom Road [The Lensbury Club - Gymnasium] Teddington Lock Greater LondonTW11: Watching brief	EVT	n/a	516874	171322	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
74	ELO7140	n/a	Craig Road [Craig House], Ham, Richmond: an archaeological evaluation	EVT	n/a	517517	171826	n/a
75	ELO18665	n/a	Whitton Road (No. 200) [East Stand Development Twickenham Stadium] Twickenham Richmond upon Thames London: Watching Brief	EVT	n/a	515382	174366	n/a
76	ELO11954	n/a	Percy Road (Proposed Twickenham Academy/ Whitton School), Richmond-upon-Thames. Archaeological Evaluation	EVT	n/a	513843	172946	n/a
77	ELO10515	n/a	Oak Avenue, [Oak Tree Nursery], Hampton: Evaluation	EVT	n/a	512510	170671	n/a
78	22717	n/a	Negative evidence, Kempton Park, Sunbury	EVT	n/a	511883	170070	n/a
78	ESE15584	n/a	Archaeological Monitoring of Geotechnical Trail Pits at Kempton Park, Sunbury	EVT	n/a	511853	169964	n/a
79	19027	n/a	Negative Evidence: Hawke Park, Sunbury	EVT	n/a	510800	169100	n/a
80	ESE2752	n/a	Development of footpath/cycleway at Hawke Park, Sunbury:	EVT	n/a	510310	168940	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
			Archaeological Watching Brief					
81	ESE16001	n/a	Page Works, Sunbury on Thames: Archaeological Evaluation	EVT	n/a	510333	168677	n/a
82	19022	n/a	Negative Evidence: Squires Garden Centre, Halliford Road, Shepperton	EVT	n/a	509400	167800	n/a
82	21736	n/a	Negative Evidence, Squires Garden Centre, Halliford Road, Shepperton	EVT	n/a	509400	167850	n/a
83	ESE1108	n/a	An Archaeological evaluation at the former Turret Works, Fordbridge Road, Sunbury on Thames	EVT	n/a	509729	167758	n/a
83	ESE1109	n/a	An Archaeological Watching Brief at Turret Works, Fordbridge Road, Sunbury-on-Thames	EVT	n/a	509730	167760	n/a
84	ESE2890	n/a	Watersplash Farm, Shepperton, Surrey	EVT	n/a	509404	167631	n/a
85	ESE1888	n/a	An Archaeological Watching Brief on the New Temporary Bridge Works at A244 Walton Bridge, Surrey	EVT	n/a	509300	166600	n/a
86	ESE2880	n/a	Land at Walton Bridge, Walton on Thames, Surrey	EVT	n/a	509311	166522	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
			Archaeological Evaluation					
87	22651	n/a	Negative Evidence, land off Walton Lane, Walton on Thames	EVT	n/a	509281	166392	n/a
87	ESE15582	n/a	Watching Brief of land off Walton Lane, Walton on Thames	EVT	n/a	509282	166393	n/a
88	ESE2881	n/a	Land off Walton Lane, Walton-on-Thames Archaeological Strip, Map and Sample and associated Watching Brief: Post excavation assessment	EVT	n/a	509100	166100	n/a
88	ESE2882	n/a	Land off Walton Lane, Walton-on-Thames Archaeological Strip, Map and Sample and associated Watching Brief: Post-excavation assessment	EVT	n/a	509100	166100	n/a
89	MLO99424	n/a	Jenkins Lane, [Beckton Sewage Treatment Works], Newham, {UK's largest sewage treatment works}	PLA	Post-medieval to modern	544887	182195	n/a
90	061648/00/00	n/a	BARKING CREEK E6	MON	Roman	544575	182945	n/a
91	MLO108038	n/a	Watson Avenue, East Ham, Newham {20th century gas holder}	BLD	Modern	543292	184482	n/a
92	MLO25667	n/a	Avenue Road/Cranmer Road [Hamfrith Farm],	PLA	Medieval to post-medieval	540889	185474	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
			West Ham, Newham {Site of Hamfrith Farm}					
93	MLO106809	n/a	Possible Roman road from London to Chelmsford {Possible Roman Road}	MON	Roman	553070	195132	n/a
94	MLO40733	n/a	Northumberland Avenue [Wanstead Park], Wanstead, Redbridge, E11 {18th century gardens/public park}	PK	Post-medieval to modern	540939	187350	n/a
95	080306/00/00	n/a	FERRY LA	MON	Post-medieval	535050	189650	n/a
96	083648/00/00	n/a	GLOVER DRIVE N18 {Neolithic/Early Bronze Age Lithic}	FS	Later prehistoric	535245	191785	n/a
97	MLO22887	n/a	Government Row, [Former Royal Ordnance Factory], Enfield Lock {19th century small arms factory}	MON	Post-medieval to modern	537460	198566	n/a
98	MLO103111	n/a	Mogden Lane [Mogden Sewage Works], Isleworth, Hounslow {Prehistoric flint}	FS	Prehistoric	515708	174896	n/a
99	100248/00/00	n/a	ORLEANS HOUSE (OPPOSITE)	FS	Prehistoric	516905	173205	n/a
100	100246/00/00	n/a	ORLEANS HOUSE (OPPOSITE)	FS	Later prehistoric	516905	173205	n/a
101	100247/00/00	n/a	ORLEANS HO (OPPOSITE)	FS	Later prehistoric	516905	173205	n/a
102	021041/00/00	n/a	HAM	FS	Roman	516905	173205	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
103	021049/00/00	n/a	Ham, [bank of River Thames] {Early Medieval burials}	MON	Early Medieval	516905	173205	n/a
104	021049/01/00	n/a	HAM	FS	Early Medieval	516905	173205	n/a
105	021049/05/00	n/a	HAM	FS	Early Medieval	516905	173205	n/a
106	022440/00/00	n/a	THAMES FORESHORE	MON	Post-medieval	516975	173215	n/a
107	022446/00/00	n/a	THAMES FORESHORE	MON	Post-medieval	516955	173195	n/a
108	022445/00/00	n/a	THAMES FORESHORE	MON	Undated	516965	173215	n/a
109	MLO14119	n/a	Riverside Drive [Ham Lands], Ham, Richmond, TW10 {Prehistoric artefact scatter}	MON	Prehistoric	516539	172784	n/a
110	021046/00/00	n/a	Thames Gate Close [Ham Fields], Ham, Richmond {Saxon building}	MON	Early Medieval	516925	171605	n/a
111	MLO101207	n/a	Whitton Brook, London, TW1 {Historic parish boundary}	MON	Early Medieval/Dark Age to Modern	515150	174519	n/a
112	MLO102892	n/a	Meadway Twickenham [Kneller Gardens], Richmond TW2 6PH {Public gardens with sports facilities}	PK	Modern	514809	173324	n/a
113	VOID							
114	MLO102839	n/a	Ellerman Avenue/Hanworth Road/Great Chertsey Road [Crane Park], Twickenham,	PK	Modern	513675	172654	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
			Richmond TW2 {20th century Public Park}					
115	n/a	n/a	Staines to Ewell	MON	Roman	514410	169840	n/a
116	2862	n/a	Late Iron Age 'Belgic' urns, near Upper Halliford	MON	Later prehistoric	509000	167000	n/a
117	545	n/a	Later Mesolithic Thames pick and Neolithic greenstone axe, near Walton Bridge, Walton on Thames	FS	Earlier prehistoric	509224	166543	n/a
118	21037	n/a	Walton Bridge House (site of), Shepperton	MON	Post-medieval	509160	166580	n/a
119	19846	n/a	WALTON YACHT WORKS AND WHARF (DEMOLISHED), Staines	MON	Modern	509200	166600	n/a
120	21039	n/a	Callender-Hamilton Bridge, River Thames, Walton-On-Thames	MON	Modern	509260	166550	n/a
121	3585	n/a	Walton Bridge, bridge approach and toll house, River Thames, Walton-on-Thames to Shepperton	MON	Post-medieval	509323	166510	n/a
122	880	n/a	Ring ditch cropmarks, Sunbury	MON	Undated	509620	167660	n/a
123	MLO99080	n/a	Lower Lea Valley {sites of 1970s overhead power transmission line pylons}	MON	Modern	537252	186559	n/a
124	ELO13177	n/a	Angel Road/Meridian Walk/Glover Drive [Former Gothic Works],	EVT	n/a	535240	191924	n/a

OA	HER Ref.	List Entry	Name	Type/Grade	Period	Easting	Northing	Link
			Enfield, N18: Watching Brief					
125	MLO59328	n/a	Ham Street, [Ham House], Ham, Richmond [17th century garden]	PK	Post-medieval to modern	517353	172904	n/a
126	ELO12887	n/a	Lincoln Avenue/Hanworth Road [Crane Park], Richmond: Conservation Statement	EVT	n/a	512941	172879	n/a
127	ELO10979	n/a	Whitton Brook, London, TW1: Historic Survey	EVT	n/a	515148	174519	n/a

APPENDIX 4 AIR QUALITY APPRAISAL SUPPORTING INFORMATION

A4.1 Data sources

A4.1.1 Beckton water recycling scheme

Monitored concentrations

All the local authorities within the boundary of the Beckton water recycling site employ the use of NO_2 diffusion tubes at a range of locations across their authority and some also employ the use of automatic monitoring stations which measure (NO_2, PM_{10} and $PM_{2.5}$).

Details of the closest monitoring sites (within 1km for DT and within 3km for AM) which monitor annual mean NO_2, hourly mean NO_2, annual mean PM_{10}, daily mean PM_{10} and annual mean $PM_{2.5}$ are presented in the tables below.

Table A4.1 indicates that the annual mean NO_2 concentrations at the monitoring sites have reduced with each year. However, the year 2020 is unlikely to be representative of a typical year's concentration due to the Covid lockdown restrictions. Using the pre-covid year of 2019, the annual mean NO_2 concentrations still remain mostly below the National Air Quality Objective (NAQO) of 40 µg/m^3 except at two sites (E17 and A18 within 1km of the SRO) in the London Borough of Waltham Forest.

Table A4.2 indicates that the NO_2 hourly mean NAQO was achieved at all the nearby automatic monitors, and there were no hourly exceedances of 200µg/m^3 from 2018 to 2020. The annual mean NO_2 concentrations at the monitoring sites are less than 60 µg/m^3 at all the DT in Table A4.1, and as such it is expected that the hourly mean objective would also be achieved.

Table A4.3 indicates that the annual mean PM_{10} concentrations at the automatic monitoring sites are within the NAQO of 40 µg/m^3 at all nearby sites with a maximum concentration of 29 µg/m^3 at Crooked Billet Roundabout in 2019.

Table A4.5 indicates that the PM_{10} daily mean NAQO was achieved at all the nearby automatic monitors with a maximum number of daily exceedances of 50µg/m^3 experienced for 19 days at Dawlish Rd and Ruckholt Close in 2019. This is lower than the 35 times a year stipulated in the NAQO.

Table A4.6 indicates that the annual mean $PM_{2.5}$ concentrations at the nearby automatic monitoring sites are within the NAQO of 25 µg/m^3 at all nearby sites with a maximum concentration of 12 µg/m^3 at Dawlish Rd in 2019. However, the annual mean $PM_{2.5}$ exceed the proposed Environment Act 2021 target of 10µg/m^3 at most of the nearby sites.

Table A4.1 Annual-mean NO_2 concentrations (μg/m^3) at nearby monitoring locations – Beckton water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
17	44 Browning Rd E12	542729	185047	Kerbside	38	36	17	Newham	0.1	DT
3	Salisbury Sch. Romford Rd	541954	185430	Urban background	35	35	14	Newham	0.2	DT
E28	Francis Road	538321	186872	Roadside	-	31	21	Waltham	0.4	DT
E17	High Rd E11 junct West St	539227	186335	Kerbside	**57**	**41**	32	Waltham	0.2	DT
E15	High Rd E10	538072	186479	Roadside	41	37	28	Waltham	0.0	DT
E04	Argalway Foot Bridge	535891	187365	Roadside	-	-	23	Waltham	0.2	DT
A16	Lea Bridge Rd and Perth Rd	536457	187238	Roadside	32	32	24	Waltham	0.1	DT
A18	Oliver Rd and Ruckholt Rd	538022	186126	Roadside	**45**	**43**	33	Waltham	0.4	DT
A22	Ruckholt Close	537937	186109	Roadside	35	36	26	Waltham	0.4	DT
A15	Lea Bridge Rd (entrance of Lea Valley	535928	186914	Roadside	27	27	20	Waltham	0.5	DT
WL1	Dawlish Rd	538380	186717	Urban	23	24	19	Waltham	0.2	AM
WL5	Ruckholt Close	537804	186025	Roadside	30	31	25	Waltham	0.5	AM
ENF 4	Derby Road	535056	192470	Roadside	35	37	28	Enfield	0.3	AM
ENF7	Prince of Wales School	536886	198497	Urban	23	23	18	Enfield	0.5	AM
NHM-S 14	Shrewsbury Nursery	541562	185194	School	-	26.2	24.5	Newham	0.6	DT
NHM-S 1	Salisbury Primary School	542089	185416	School	-	26.8	22.2	Newham	0.1	DT
NHM-S 25	Oliver Thomas Children's Centre	543279	183097	School	-	23.3	20.8	Newham	0.6	DT
NHM-S 23	Nelson Primary School	543143	183468	School	-	23.9	20.1	Newham	0.6	DT
NHM-S 10	Kensington Primary School	542701	184632	School	-	24.8	20.4	Newham	0.2	DT
NHM-S 22	Langdon Academy	543501	183538	School	-	25.8	21.9	Newham	0.3	DT

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
NHM-S 8	Little Ilford School	542734	185179	School	-	30.5	19.7	Newham	0.2	DT
NHM-S 42	Godwin Junior School	540838	185646	School	-	19.9	24.4	Newham	0.4	DT
NHM-S 9	Essex Primary School	542549	185070	School	-	24.6	22.6	Newham	0.0	DT
NHM-S 2	Avenue Primary School	542319	185428	School	-	22.4	20.8	Newham	0.1	DT
NHM-S 21	Altmore Infant School	542831	183954	School	-	29.2	19.8	Newham	0.6	DT

Notes: Data capture for all sites >75%

Table A4.2 Number of hours NO_2 concentrations exceeds 200 µg/m^3 at nearby monitoring locations – Beckton water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
ENF7	Prince of Wales School	536886	198497	Urban	0	0	0	Enfield	0.5	AM
ENF 4	Derby Road	535056	192470	Roadside	0	0	0	Enfield	0.3	AM
WL1	Dawlish Rd	538380	186717	Urban	0	0	0	Waltham	0.2	AM
WL5	Ruckholt Close	537804	186025	Roadside	0	0	0	Waltham	0.5	AM

Notes: Data capture for all sites >75%

Table A4.3 Annual-mean PM_{10} concentrations (µg/m^3) at nearby monitoring locations – Beckton water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
NM2	Cam Rd	538661	183969	Roadside	17.5	18	18	Newham	2.5	AM
WL1	Dawlish Rd	538380	186717	Urban	17	19	17	Waltham Forest	0.2	AM
WL5	Ruckholt Close	537804	186025	Roadside	18	19	17	Waltham Forest	0.5	AM
WL4	Crooked Billet Roundabout	537468	191071	Kerbside	28	29	25	Waltham Forest	2.3	AM
KGV	King George V	542950	180215	Urban Background	-	16.6	15.1	Newham	2.8	AM

Notes: Data capture for all sites >75%

Table A4.4 Number of days daily mean PM_{10} concentrations exceeds 50 µg/m^3 at nearby monitoring locations – Beckton water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
WL4	Crooked Billet Roundabout	537468	191071	Kerbside	28	15	10	Waltham Forest	2.3	AM
WL5	Ruckholt Close	537804	186025	Roadside	18	19	4	Waltham Forest	0.5	AM
WL1	Dawlish Rd	538380	186717	Urban	17	19	1	Waltham Forest	0.2	AM
KGV	King George V	542950	180215	Urban Background	-	9	6	Newham	2.8	AM
NM2	Cam Rd	538661	183969	Roadside	1	3	6	Newham	2.5	AM

Notes: Data capture for all sites >75%

Table A4.5 Annual-mean $PM_{2.5}$ concentrations (µg/m^3) at nearby monitoring locations – Beckton water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
WL1	Dawlish Rd	538380	186717	Urban	-	12	10	Waltham Forest	0.2	AM
NM2	Cam Rd	538661	183969	Roadside	-	-	11	Newham	2.5	AM
KGV	King George V	542950	180215	Urban Background	-	10.6	8.9	Newham	2.8	AM

Defra background concentrations

Defra provides modelled background concentrations for each 1x1 km grid across all local authority areas from a base year of 2018. **Table A4.6** presents the estimated background concentrations within 1km of the Beckton water recycling area for 2018.

Table A4.6 Annual-mean Defra Background Mapped Concentrations (µg/m^3) – Beckton water recycling

Grid Square Coordinates (X)	Grid Square Coordinate (Y)	NO_X	NO_2	PM_{10}	$PM_{2.5}$
544500	183500	48.4	30.4	21.4	14.0
543500	183500	53.9	33.3	21.1	13.8
544500	182500	45.3	28.9	21.5	15.1
543500	184500	51.8	32.2	21.6	14.1
542500	184500	39.6	26.0	20.6	13.6
541500	185500	38.6	25.4	19.7	13.1
542500	185500	40.2	26.3	20.5	13.5
534500	189500	40.9	26.6	19.3	12.6
534500	190500	36.2	24.2	19.2	12.8
534500	191500	35.4	23.7	18.7	12.5
536500	186500	36.2	24.1	17.9	11.9
541500	186500	36.3	24.1	18.5	12.3
540500	186500	36.9	24.4	18.7	12.4
537500	186500	41.0	26.5	19.4	12.8
538500	186500	48.6	30.4	21.7	14.2
539500	186500	41.5	26.7	20.4	13.5
534500	188500	35.5	23.7	18.2	12.0
535500	188500	34.8	23.1	18.4	12.1
535500	187500	39.4	25.5	18.3	12.0
536500	187500	42.7	27.2	19.5	12.9
535500	189500	37.2	24.5	18.5	12.3
535500	190500	36.2	24.0	18.6	12.4
535500	191500	38.9	25.4	18.4	12.2
535500	192500	51.3	31.8	20.0	13.2
535500	193500	36.2	24.1	19.4	12.8
536500	194500	28.0	19.5	17.1	11.4
535500	194500	32.8	22.2	19.4	12.9
535500	195500	30.6	21.0	18.3	12.3
536500	195500	31.0	21.2	18.2	11.9
536500	196500	33.7	22.5	17.5	11.7
537500	197500	26.6	18.5	16.1	10.8
536500	197500	34.9	23.2	17.6	11.8
537500	198500	25.9	18.3	16.8	11.3
536500	198500	27.3	19.1	17.5	11.8
	Maximum	53.9	33.3	21.7	15.1

Grid Square Coordinates (X)	Grid Square Coordinate (Y)	NO_x	NO_2	PM_{10}	$PM_{2.5}$
	Minimum	25.9	18.3	16.1	10.8
	NAQO	30	40	40	25 (10)

Background concentrations for the grid squares within which the Beckton water recycling scheme resides are all well within the annual mean NAQOs for all pollutants in 2018 except for the vegetation protection guideline for NOx. $PM_{2.5}$ is within the NAQO of 25µg/m^3 but above the proposed Environment Act 2021 target of 10µg/m^3.

A4.1.2 Mogden water recycling scheme

Monitored concentrations

All the local authorities within the boundary of the Mogden water recycling scheme employ the use of NO_2 diffusion tubes (DT) at a range of locations across their authority and some also employ the use of automatic monitoring (AM) stations which measure (NO_2, PM_{10} and $PM_{2.5}$).

Details of the closest monitoring sites (within 1km for DT and within 3km for AM) which monitor annual mean NO_2, hourly mean NO_2, annual mean PM_{10}, daily mean PM_{10} and annual mean $PM_{2.5}$ are presented in the tables below.

Table A4.7 indicates that the annual mean NO_2 concentrations at the monitoring sites have reduced with each year. However, the year 2020 is unlikely to be representative of a typical yearly concentration due to the Covid lockdown restrictions. Using the pre-covid year of 2019, the annual mean NO_2 concentrations still remain mostly below the National Air Quality Objective (NAQO) of 40 µg/m^3 except at six sites in Richmond.

Table A4.8 indicates that the NO_2 hourly mean NAQO was achieved at all the nearby automatic monitors, with a maximum number of hourly exceedances of 200µg/m^3 for two hours at Haslet Road in 2019. This is much lower than the 18 times a year stipulated in the NAQO. The annual mean NO_2 concentrations at the monitoring sites are less than 60 µg/m^3 at all the DT in **Table A3.7**, and in accordance with Defra guidance for local air quality management, it is expected that the hourly mean objective would also be achieved.

Table A4.9 indicates that the annual mean PM_{10} concentrations at the automatic monitoring sites are within the NAQO of 40 µg/m^3 at all nearby sites with a maximum concentration of 21 µg/m^3.

Table A4.10 indicates that the PM_{10} daily mean NAQO was achieved at all the nearby automatic monitors with a maximum number of daily exceedances of 50µg/m^3 experienced for 9 days at Haslet Road in 2019. This is much lower than the 35 times a year stipulated in the NAQO.

Table A4.11 indicates that the annual mean $PM_{2.5}$ concentrations at the nearby automatic monitoring sites are within the NAQO of 25 µg/m^3 at all nearby sites with a maximum concentration of 12.9 µg/m^3 at Haslet Road in 2019. However, the annual mean $PM_{2.5}$ exceed the proposed Environment Act 2021 target of 10µg/m^3 at most of the nearby sites.

Table A4.7 Annual-mean NO_2 concentrations (μg/m^3) at nearby monitoring locations – Mogden water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
SCC_ECO	Haslett Road	509155	169228	Urban Background	21.6	17.1	17.6	Spelthorne	0.7	AM
SP4	Benwell Centre, Sunbury	510052	169843	Roadside	24.9	26.3	19.5	Spelthorne	0.9	DT
SP10	Walton Bridge Road	509125	166862	Roadside	35.1	37.4	24.5	Spelthorne	0.0	DT
SP11	Halliford Bypass	509033	168146	Kerbside	29.8	34	23.6	Spelthorne	0.4	DT
2	Percy Rd,	513217	169746	roadside	32	29	21	Richmond	0.8	DT
9	Hampton Rd,	514846	172348	kerbside	40	35	31	Richmond	0.9	DT
31	A316 (nr.	515434	174045	roadside	49	45	35	Richmond	0.3	DT
40	Staines Rd,	514068	172435	roadside	41	35	29	Richmond	0.4	DT
11	Percy Rd,	514136	173389	kerbside	46	34	27	Richmond	0.4	DT
10	Twickenham Rd, Twickenham (opp. Fulwell	513390	172233	kerbside	41	40	33	Richmond	0.0	DT
13	Whitton Rd,	515228	174082	kerbside	39	36	30	Richmond	0.1	DT
71	A316, St	516574	174456	roadside	Not open	52	43	Richmond	1.0	DT
73	Hospital Bridge Rd, nr Homelink	513722	172873	roadside	Not open	43	36	Richmond	0.1	DT
58	London Road,	516039	173766	kerbside	43	40	33	Richmond	1.0	DT
57	A316 (Lincoln Avenue)	513915	172899	roadside	43	37	29	Richmond	0.1	DT
59	Whitton Rd,	515980	173758	kerbside	40	34	27	Richmond	0.9	DT
63	High Street,	514188	173801	kerbside	38	33	27	Richmond	0.7	DT
69	Uxbridge Rd nr Longford Cl,	513494	171729	roadside	38	31	22	Richmond	0.3	DT
HS41	Hanworth Library	512103	172506	Roadside	41.8	40.2	33.9	Hounslow	1.0	DT
HS61	Twickenham Road	516208	175793	Roadside	32.1	31.4	21.4	Hounslow	1.0	DT
HS89	Mogden Sewage Works Gate	515424	174719	Roadside	28.9	27.4	22.5	Hounslow	0.0	DT

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
HS74	Swift Road, Hanworth	511989	171797	Roadside	31	29.2	21.7	Hounslow	0.6	DT
HS84	Apex Corner (York Way)	512709	172155	Roadside	31.6	33.4	24.6	Hounslow	0.3	DT
SP41	Green Street, Sunbury	510404	168675	Kerbside	28.2	29.6	20.7	Spelthorne	0.3	DT
SP52	Staines Road East, Sunbury	510542	169997	Roadside	32.7	37.3	24.1	Spelthorne	0.8	DT
SP55	Green Lane, Shepperton	508954	167585	Kerbside	34.2	38.8	25.2	Spelthorne	0.4	DT
SP54	Russell Road, Shepperton	508493	166841	Kerbside	32.1	31	20	Spelthorne	0.5	DT
SP36	St Ignatius School, Sunbury	510104	169508	Roadside	34.7	34.6	24.4	Spelthorne	0.6	DT
SP59	High Street,	507987.6	167083.7 2	Roadside	-	27.9	20.4	Spelthorne	1.0	DT
WALTON 3A	Outside Walton	510140	166328	Kerbside	-	34.4	18.6	Elmbridge	0.9	DT
WALTON 8	Leaders, 46 High St	510154	166281	Roadside	33.2	36.2	25.4	Elmbridge	1.0	DT
WALTON 10	Outside 34 Church Street, Walton	510140	166522	Roadside	34.9	37	28.3	Elmbridge	0.9	DT
WALTON 9	Traffic Sign, Cafe Nero, 18 High St	510082	166379	Roadside	32.4	33.6	23.1	Elmbridge	0.9	DT
WALTON 11	Lampost opposite	510000	166401	Roadside	35.9	39.4	24.2	Eastleigh	0.8	DT

Notes: Data capture for all sites >75%

Table A4.8 Number of hours NO_2 concentrations exceeds 200 µg/m^3 at nearby monitoring locations – Mogden water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
SCC_ECO	Haslett Road	509155	169228	Urban Background	0	2	1	Spelthorne	0.7	AM

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
SUN_01	Sunbury Cross	510064	170199	Urban Background	0	0	0	Spelthorne	1.3	AM
Weybridge	Weybridge High Street 2	507459	164909	Kerbside	-	0	0	Elmbridge	2.4	AM
FELT	Feltham High St / Hanworth Rd Jct	510691	173247	Roadside	0	0	0	Hounslow	2.5	AM
HEST	Heston Road	513655	176842	Roadside	0	0	0	Hounslow	2.8	AM

Notes: Data capture for all sites >75%

Table A4.9 Annual-mean PM_{10} concentrations (µg/m^3) at nearby monitoring locations – Mogden water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
TD0	NPL - Teddington	515542	170420	Suburban	N/A	N/A	13	Richmond	2.7	AM
FELT	Feltham High St / Hanworth Rd Jct	510691	173247	Roadside	20	20	21	Hounslow	2.5	AM
SCC_ECO	Haslett Road	509155	169228	Urban Background	19.5	24.6	20.7	Spelthorne	0.7	AM
SUN_01	Sunbury Cross	510064	170199	Urban Background	14.5	15.7	14.2	Spelthorne	1.3	AM
HEST	Heston Road	513655	176842	Roadside	22	24	23	Hounslow	2.8	AM

Notes: Data capture for all sites >75%, N/A – Not available

Table A4.10 Number of days daily mean PM_{10} concentrations exceeds 50 µg/m^3 at nearby monitoring locations – Mogden water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
TD0	NPL - Teddington	515542	170420	Suburban	N/A	N/A	2	Richmond	2.7	AM
FELT	Feltham High St / Hanworth Rd Jct	510691	173247	Roadside	4	7	2	Hounslow	2.5	AM
SCC_ECO	Haslett Road	509155	169228	Urban Background	4	9	7	Spelthorne	0.7	AM
SUN_01	Sunbury Cross	510064	170199	Urban Background	1	4	1	Spelthorne	1.3	AM
HEST	Heston Road	513655	176842	Roadside	2	5	4	Hounslow	2.8	AM

Notes: Data capture for all sites >75%, N/A – Not available

Table A4.11 Annual-mean $PM_{2.5}$ concentrations (µg/m^3) at nearby monitoring locations – Mogden water recycling

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
TD0	NPL - Teddington	515542	170420	Suburban	11	12	8	Richmond	2.7	AM
SCC_ECO	Haslett Road	509155	169228	Urban Background	11.4	12.9	12.2	Spelthorne	0.4	AM
SUN_01	Sunbury Cross	510064	170199	Urban Background	9.2	9.9	8.3	Spelthorne	1.3	AM

Defra Background concentrations

Defra provides modelled background concentrations for each 1x1 km grid across all local authority areas from a base year of 2018. **Table A3.12** presents the estimated background concentrations within 1km of the Mogden water recycling area for 2018 for locations within the Defra map of Greater London.

Table A4.12 Annual-mean Defra Background Mapped Concentrations (µg/m^3) – Mogden water recycling

Grid Square Coordinates (X)	Grid Square Coordinate (Y)	NO_x	NO_2	PM_{10}	$PM_{2.5}$
515500	173500	33.0	11.8	17.3	11.8
514500	173500	32.6	11.9	17.4	11.9
514500	172500	30.4	11.8	17.1	11.8
513500	172500	31.9	11.7	17.1	11.7
513500	171500	28.1	11.3	16.4	11.3
512500	171500	29.7	11.7	17.0	11.7
512500	170500	25.2	11.3	16.2	11.3
512500	169500	25.6	11.1	16.1	11.1
515500	175500	32.7	11.6	16.9	11.6
515500	174500	32.9	11.6	17.1	11.6
514500	174500	31.0	11.8	17.1	11.8
	Maximum	33.0	11.9	17.4	11.9
	Minimum	25.2	11.1	16.1	11.1
	NAQO	30	40	40	25 (10)

Background concentrations for the grid squares within which the Mogden water recycling scheme resides are all well within the annual mean NAQOs for all pollutants in 2018 except for the vegetation protection guideline for NOx. $PM_{2.5}$ complies with the NAQO of 25µg/m^3 but is above the proposed Environment Act 2021 target of 10µg/m^3.

A4.1.3 Teddington DRA scheme

Monitored concentrations

All the local authorities within the boundary of the Teddington DRA site employ the use of NO_2 diffusion tubes at a range of locations across their authority and some also employ the use of automatic monitoring stations which measure (NO_2, PM_{10} and $PM_{2.5}$).

Details of the closest monitoring sites (within 1km for DT and within 4km for AM) which monitor annual mean NO_2, hourly mean NO_2, annual mean PM_{10}, daily mean PM_{10} and annual mean $PM_{2.5}$ are presented in the tables below.

Table A4.13 indicates that the annual mean NO_2 concentrations at the monitoring sites have reduced with each year. However, the year 2020 is unlikely to be representative of a typical year's concentration due to the Covid lockdown restrictions. Using the pre-covid year of 2019, the annual mean NO_2 concentrations still remain mostly below the National Air Quality Objective (NAQO) of 40 µg/m^3 except at seven sites (within distance 1km of the SRO) in the London Borough of Richmond.

Table A4.14 indicates that the NO_2 hourly mean NAQO was achieved at all the nearby automatic monitors, with a maximum number of hourly exceedances of 200µg/m^3 for five hours at Cromwell Road in 2019. This is much lower than the 18 times a year stipulated in the NAQO. The annual mean NO_2

concentrations at the monitoring sites are less than 60 μg/m^3 at all the DT in **Table A4.13**, and as such it is expected that the hourly mean objective would also be achieved.

Table A4.15 indicates that the annual mean PM_{10} concentrations at the automatic monitoring sites are within the NAQO of 40 μg/m^3 at all nearby sites with a maximum concentration of 26 μg/m^3 at Cromwell Road in 2019.

Table A4.16 indicates that the PM_{10} daily mean NAQO was achieved at all the nearby automatic monitors with a maximum number of daily exceedances of 50μg/m^3 experienced for 15 days at Cromwell Road in 2019. This is much lower than the 35 times a year stipulated in the NAQO.

Table A4.17 indicates that the annual mean $PM_{2.5}$ concentrations at the nearby automatic monitoring sites are within the NAQO of 25 μg/m^3 at all nearby sites with a maximum concentration of 13 μg/m^3 at Brentford, Great West Road in 2019. However, annual mean $PM_{2.5}$ levels exceed the proposed Environment Act 2021 target of 10μg/m^3 at most of the nearby sites.

Table A4.113 Annual-mean NO_2 concentrations (µg/m^3) at nearby monitoring locations – Teddington DRA

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
HS89	Mogden Sewage Works Gate	515424	174719	Roadside	28.9	27.4	22.5	Hounslow	0.4	DT
HS61	Twickenham Road	516208	175793	Roadside	32.1	31.4	21.4	Hounslow	0.6	DT
Rut 01	Civic Centre,	516415	173419	roadside	38	36	29	Richmond	0.3	DT
71	A316, St	516574	174456	roadside	Not open	**52**	**43**	Richmond	0.2	DT
72	St Margarets Rd, nr St Margaret's station, TW1	516839	174238	roadside	Not open	**42**	33	Richmond	0.4	DT
76	Manor Rd, nr	516588	171357	kerbside	Not open	Not open	35	Richmond	0.5	DT
65	York Street, Twickenham	516339	173366	kerbside	**55**	**50**	**40**	Richmond	0.4	DT
56	A316 (nr St	516788	174519	roadside	**43**	39	31	Richmond	0.4	DT
58	London Road,	516039	173766	kerbside	**43**	**40**	33	Richmond	0.5	DT
61	London Road,	516224	173444	roadside	**43**	38	32	Richmond	0.5	DT
59	Whitton Rd,	515980	173758	kerbside	**40**	34	27	Richmond	0.5	DT
45	154 High St,	516383	171154	kerbside	33	32	26	Richmond	0.8	DT
32	Kings St,	516226	173195	roadside	**56**	**47**	**40**	Richmond	0.6	DT
31	A316 (nr.	515434	174045	roadside	**49**	**45**	35	Richmond	0.9	DT
33	Heath Rd,	516098	173153	roadside	**52**	**40**	34	Richmond	0.7	DT
15	Richmond Rd, Twickenham	517196	173933	kerbside	34	32	26	Richmond	0.6	DT
27	Fire Station,	517800	171423	Roadside	34.84	32.4	26.24	Kingston	0.3	DT

Notes: Data capture for all sites >75%

Table A4.114 Number of hours NO_2 concentrations exceeds 200 µg/m^3 at nearby monitoring locations – Teddington DRA

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
Hampton	Hampton Court Parade	515338	168292	Roadside	0	0	0	Eastleigh	3.6	AM
HEST	Heston Road	513655	176842	Roadside	0	0	0	Hounslow	2.4	AM
KT5	Cromwell Road	518562	169519	Roadside	1	5	0	Kingston	2.1	AM
BREN	Brentford, Great West Road	517425	178071	Roadside	0	0	0	Hounslow	3.2	AM

Notes: Data capture for all sites >75%

Table A4.115 Annual-mean PM_{10} concentrations (µg/m^3) at nearby monitoring locations – Teddington DRA

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
TD0	NPL -	515542	170420	Suburban	N/A	N/A	13	Richmond	1.9	AM
HEST	Heston Road	513655	176842	Roadside	22	24	23	Hounslow	2.4	AM
KT5	Cromwell Road	518562	169519	Roadside	30	26	23.9	Kingston	2.1	AM
BREN	Brentford, Great West Road	517425	178071	Roadside	26	22	25	Hounslow	3.2	AM

Notes: Data capture for all sites >75%, N/A – Not available

Table A4.116 Number of days daily mean PM_{10} concentrations exceeds 50 µg/m^3 at nearby monitoring locations – Teddington DRA

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
TD0	NPL -	515542	170420	Suburban	N/A	N/A	2	Richmond	1.9	AM
HEST	Heston Road	513655	176842	Roadside	2	5	4	Hounslow	2.4	AM
KT5	Cromwell Road	518562	169519	Roadside	15	15	9	Kingston	2.1	AM
BREN	Brentford, Great West Road	517425	178071	Roadside	4	8	9	Hounslow	3.2	AM

Notes: Data capture for all sites >75%, N/A – Not available

Table A4.117 Annual-mean $PM_{2.5}$ concentrations (µg/m^3) at nearby monitoring locations – Teddington DRA

Site ID	Site name	x	y	Site type	2018	2019	2020	LA	Distance (km)	Diffusion tube (DT) or Automatic monitor (AM)
BREN	Brentford, Great West Road	517425	178071	Roadside	15	13	12	Hounslow	3.2	AM
TD0	NPL -	515542	170420	Suburban	11	12	8	Richmond	1.9	AM

Defra Background concentrations

Defra provides modelled background concentrations for each 1x1 km grid across all local authority areas from a base year of 2018. **Table A3.18** presents the estimated background concentrations within 1km of the Teddington DRA area for 2018 for locations within the Defra map for Greater London.

Table A4.118 Annual-mean Defra Background Mapped Concentrations (µg/m^3) – Teddington DRA

Grid Square Coordinates (X)	Grid Square Coordinate (Y)	NO_x	NO_2	PM_{10}	$PM_{2.5}$
516500	175500	32.9	22.2	17.2	11.7
515500	175500	32.7	22.0	16.9	11.6
515500	174500	32.9	22.2	17.1	11.6
516500	174500	35.3	23.6	17.7	12.0
516500	172500	28.1	19.5	16.2	11.1
517500	173500	28.0	19.5	16.0	10.9
516500	173500	33.2	22.4	17.2	11.7
517500	171500	29.0	20.0	16.4	11.2
516500	171500	30.7	20.9	16.5	11.3
517500	172500	27.7	19.2	16.2	11.1
	Maximum	35.3	23.6	17.7	12.0
	Minimum	27.7	19.2	16.0	10.9
	NAQO	30	40	40	25 (10)

Background concentrations for the grid squares within which the Teddington DRA Scheme resides are all well within the annual mean NAQOs for all pollutants in 2018 except for the vegetation protection guideline for NOx. $PM_{2.5}$ complies with the NAQO of 25µg/m^3 but is slightly above the proposed Environment Act 2021 target of 10µg/m^3.

A4.2 Methodology for Initial Risk Assessment of dust and air quality Impacts

A4.2.1 Introduction

The methodology for the initial risk assessment of the air quality impacts associated with the SRO is based on relevant guidance documents such as:

- Local Air Quality Management Technical Guidance (LAQM.TG(16))[122] ,
- Environmental Protection UK (EPUK) /Institute of Air Quality Management (IAQM) Land-Use Planning & Development Control: Planning for Air Quality[123]
- IAQM Guidance on the Assessment of Dust from Demolition and Construction[124]
- Highways England (LA105 Air Quality)

Criteria from the aforementioned guidance have been used to ascertain the significance of air quality impacts. The main issue to consider from an air quality perspective will be construction related issues, assuming no emissions from local energy generation during operation. Therefore, the proposed sites and pipeline routes, have been reviewed, in the context of screening distances for potentially significant air quality impacts (e.g. from IAQM guidance relating to control of dust from construction, and guidance on assessment of the effects of air pollution on habitat sites). This will consider proximity to sensitive human populations and potential impacts on nationally and internationally designated habitat sites. The nature of the construction activities

[122] Defra (2021) Local Air Quality Management Technical Guidance (TG16)
[123] EPUK / IAQM (2017) Land-Use Planning & Development Control: Planning for Air Quality v1.2
[124] Institute of Air Quality Management IAQM (2017) Guidance on the Assessment of Dust from Demolition and Construction v1.1

likely to be carried out (e.g. excavation; demolition; construction; tunnelling; road vehicle movements) has also been considered.

Based on this evaluation, areas and aspects of greater or lesser concern with regard to air quality have been identified, and recommendations for preferred components have been made, where possible, from the perspective of minimising air quality impacts. An indication of the measures required to minimise/mitigate air quality impacts have been provided, where impacts could be significant.

A4.2.2 Sensitive Receptor - Location

Key receptors of interest considered by this screening assessment are human receptors and ecological receptors. The assessment also considers proximity of AQMAs as an indication of areas of poor air quality. The datasets used to identify sensitive receptors are as follows[125]:

- Air quality management areas.
- Ordnance Survey Mastermap with Buildings.
- Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites.
- Sites of Special Scientific Interest (SSSI) and National Nature Reserves (NNR).
- Ancient woodlands.

Local nature reserves have not been considered as they are considered to be of low sensitivity to dust in IAQM dust guidance. The European and international sites (SPAs, SACs, potential SACs and Ramsars) are considered high sensitivity to dust while SSSI are medium sensitivity to dust.

A4.2.3 Fugitive Dust Impact risk Assessment

A review of each option has been undertaken in the context of screening distances for potentially significant dust impacts on human and ecological receptors using the IAQM guidance for the control of dust from construction.

The methodology under the IAQM guidance considers the potential for fugitive dust emissions to be generated from the following sources:

- Demolition (however this assessment does not consider demolition as no demolition is proposed as part of the SRO option);
- Earthworks;
- Construction; and
- Trackout - the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by HDVs using the network. At this stage, there is insufficient information on construction routes to assess potential air quality risks of trackout up to 500 m away from entrance, as required by the IAQM guidance, as such the risk of trackout has not been considered in this assessment.

The risk of dust effects is determined by the scale and nature of the works and the proximity of sensitive human and ecological receptors. The IAQM guidance recommends that an assessment be undertaken where there are sensitive human receptors:

- Within 350m of the site boundary; or
- Within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

An assessment should also be carried out where there are dust-sensitive ecological receptors:

- Within 50m of the site boundary; or
- Within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

As such, the assessment of options is based on an initial screening risk assessment which mapped all receptors within these boundary distances from the proposed route options and assuming the sensitivity of individual receptors (ecological and human) is **high**.

---

[125] Local ecological designations and other priority habitats have not been considered at this stage but should be included for assessment once the SRO is selected.

The risk assessment is also based on the existing baseline PM_{10} concentrations at monitoring locations and Defra background maps across the all the SRO options are typically below 24 µg/m^3 in 2019 (pre-covid year), with the exception of one site near Teddington (KT5 - Cromwell Road, with a value of 26 µg/m^3) and another site near Beckton (WL4- Crooked Billet Roundabout, with a value of 29 µg/m^3). However, given these sites are over 2km from the SRO as such they are not considered further in establishing the baseline PM_{10} for the dust risk assessment. It is assumed that the earthworks and construction of shafts and tunnels would result in a **large** dust emission magnitude. The 350m and 50m buffers provide a qualitative overview of all sensitive receptors located in the area potentially affected by the construction activities.

Each of the options have been reviewed to determine whether there are sensitive human and ecological receptors within the distances specified above to the SRO works where earthworks and construction of shafts and tunnels are being undertaken. A further analysis of the number of receptors within this distance will then be undertaken. Finally, an evaluation of the risk of dust impacts for each scenario has been undertaken using the risk criteria below adapted from the IAQM dust guidance. The final risk assigned to the SRO will then be based on the maximum risk attained for the site.

Table A4.19 Dust impact risk rating

Criteria	Description	Human receptors (a)	Ecological receptors
Red	Issue or constraint is likely to be challenging to overcome /**major** environmental constraints, significant additional mitigation required.	NA	Within 20 m
Amber	Issue or constraint can be overcome / **moderate** environmental constraints, potentially extensive and/or challenging additional mitigation requirements.	>100 receptors within 20 m	Within 50 m
Green	**Neutral or minor** issue or constraint, easily mitigatable with best practice measures or minor additional mitigation requirements.	>100 receptors within 50 m to 350 m	Within 350 m

Note: (a) Based on IAQM criteria, this criterion is applicable only to PM_{10} background concentration of less than 24 µg/m^3

This risk rating for human receptors is applicable to health impact and dust soiling impacts.

Based on this evaluation of different options, recommendations for preferred options from the perspective of minimising dust impacts would be proposed.

A4.2.4 Traffic emissions risk assessment

A screening assessment of the potential air quality impacts on nearby sensitive human and ecological receptors due to traffic emissions during construction and operation due to each of the SRO is based on the following criteria:

- Whether there are human and ecological receptors within 200m of the SRO. This is based on guidance developed by Highways England (LA105 Air Quality) highlights that human health and ecological receptors should be considered within 200m of the affected road network (roads which experience a significant change in traffic). The use of 200 metres is therefore informed by this guidance and professional judgement on distances that significant impacts could occur. The Natural England advice to competent authorities considering air impacts in Habitats Regulations Assessment also uses this distance[126].

[126] Natural England (2018) Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations.

- The existing baseline air quality concentrations for each SRO and whether it is located within or near an air quality management area (AQMA) which has been declared due to exceedances of relevant health objectives set for the protection of human health.

- A review of the additional traffic that will be associated with each of the option and whether this is likely to trigger the need for detailed modelling of air quality impacts on human health receptors in accordance with the IAQM Planning Guidance[123]. The IAQM guidance provides indicative criteria for when an air quality assessment is required, recommending that one is undertaken where there is:

    - A change in Light Duty Vehicle flows of:
        - More than 100 Annual Average Daily Traffic (AADT) within or adjacent to an AQMA; or
        - More than 500 AADT elsewhere;
    - A change in Heavy Duty Vehicle flows of:
        - More than 25 AADT within or adjacent to an AQMA; or
        - More than 100 AADT elsewhere.

Each of the SRO schemes has been evaluated to determine the risk of air quality impacts for each scenario using the risk criteria provided in **Table A4.20**.

Table A4.20 Air quality impact risk rating – traffic emissions

Criteria	Description	Receptor Distance	Change in HDV (AQMA)	Change in LDV (AQMA)	Change in HDV (No AQMA)	Change in LDV (No AQMA)
Red	Issue or constraint is likely to be challenging to overcome /**major** environmental constraints, significant additional mitigation required.	<20m	>50 AADT	> 200 AADT	> 200 AADT	> 1000 AADT
Amber	Issue or constraint can be overcome / **moderate** environmental constraints, potentially extensive and/or challenging additional mitigation requirements.	20 - 100m	25 – 50 AADT	100 - 200 AADT	100 – 200 AADT	500 – 1000 AADT
Green	**Neutral or minor** issue or constraint, easily mitigatable with best practice measures or minor additional mitigation requirements.	100 - 200m	< 25 AADT	<100 AADT	<100 AADT	<500 AADT

Based on this evaluation of different options, recommendations for preferred options from the perspective of minimising air quality would be proposed.

A4.4.5 Non-road mobile machinery (NRMMs), generator, and combustion plant emissions risk assessment

A screening assessment of the potential air quality impacts on nearby sensitive human and ecological receptors due to emissions associated with the NRMM, generators and combustion plants used in each of the SRO options has been undertaken. This is based on information on the energy rating, emissions standards, operational mode, and the number of NRMM, generators and combustion plants for each SRO which will be used to estimate the emission rates of NRMM, generators and combustion plants.

The IAQM Planning guidance recommends that "*Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates. Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable*"

Where the emissions rates are greater than 5mg/sec then their risk would be evaluated using the risk criteria in **Table A3.21**.

Table A4.21 Air quality impact risk rating – (NRMM, generator, and combustion plant emissions)

Criteria	Description	Emission rate
Red	Issue or constraint is likely to be challenging to overcome /**major** environmental constraints, significant additional mitigation required.	>50 mg/s and receptors within 500m
Amber	Issue or constraint can be overcome / **moderate** environmental constraints, potentially extensive and/or challenging additional mitigation requirements.	5 – 50 mg/s and receptors within 500m
Green	**Neutral or minor** issue or constraint, easily mitigatable with best practice measures or minor additional mitigation requirements.	<5 mg/s and no receptors within 500m

Based on this evaluation of different options, recommendations for preferred options from the perspective of minimising air quality would be proposed.

A4.2.6 Risk assessment uncertainties

Construction dust

The risk of dust effects (low, medium or high) is determined by the scale and nature of the works and the proximity of sensitive human and ecological receptors. Although this assessment refers to risks, it is not expected that the dust impact can be fully mitigated. The risk descriptors provide indication of the extent of mitigation that would be required for each component.

As this is a screening assessment, seeking to provide a comparative ranking of components, a number of conservative assumptions were made:

- The assessment is based on an unmitigated scheme and does not consider any embedded construction mitigation measures.
- The magnitude of unmitigated dust effects of the relevant sources (earthworks and construction of shafts and tunnels) has been assessed as "large" according to IAQM classifications.
- It is assumed that construction activity occurs everywhere, along each pipeline route, at all times for the duration of approximately one year.
- The sensitivity of individual receptors has been considered as high.

Additional criteria not considered in the assessment at this stage:

- History of dust generating activities in the area.
- Likely cumulative dust effects from nearby construction sites.
- Pre-existing physical screening such as trees or buildings.
- Impact of road network used by the construction vehicles.
- The influence of the prevailing wind direction.
- Local topography.

Construction and operational traffic

The traffic route has not been provided, as such the tunnel route for each of the SRO which would be used to install the pipeline (trenchless or trenched) has been used as a surrogate traffic route to provide an indication as to whether there are receptors within 200m of the traffic route.

APPENDIX 5 FLOOD RISK APPRAISAL METHODOLOGY

A5.1.1 Overview

The flood impact assessment has been based on a Red-Amber-Green (RAG) assessment to assess the severity of the potential flood risks presented as a result of the proposed developments. **Table A5.1** defines the RAG criteria which has been used for each topic assessment. The RAG assessment has been further defined to provide additional detail on how the flood risk impacts have been assessed during the construction and operational phases.

Table A5.1 RAG Criteria

Assessment	Description
Red	Issue or constraint is likely to be challenging to overcome /major environmental constraints, significant additional mitigation required.
Amber	Issue or constraint can be overcome / moderate environmental constraints, potentially extensive and/or challenging additional mitigation requirements.
Green	Neutral or minor issue or constraint, easily mitigatable with best practice measures or minor additional mitigation requirements.

A5.1.2 Construction Phase

The potential flood risk impacts during the construction phase has been assessed for all sources of flood risk. The RAG approach is summarised in **Table A5.2**.

Table A5.2 Construction Phase RAG Criteria

Assessment	Description	Classification
Red	Issue or constraint is likely to be challenging to overcome /major environmental constraints, significant additional mitigation required.	The Construction Phase is likely to cause a significant increase in flood risk on-site or elsewhere with no mitigation
Amber	Issue or constraint can be overcome / moderate environmental constraints, potentially extensive and/or challenging additional mitigation requirements.	The Construction Phase is likely to cause a medium increase in flood risk on-site or elsewhere with no mitigation
Green	Neutral or minor issue or constraint, easily mitigatable with best practice measures or minor additional mitigation requirements.	The Construction Phase is likely to cause a minor or negligible increase in flood risk on-site or elsewhere with no mitigation

A5.1.3 Operation Phase - Flood Zones

The flood zones refer to the probability of river and sea flooding, excluding the presence of defences. Fluvial flooding occurs due to the volume of water flowing along the river and exceeding the capacity of the river channel, causing the water to inundate the floodplain and surrounding area. Along with the amount of rainfall occurring in the catchment, this can be affected by the structures along the river, including bridges, culverts, embankments and flood defences, as well as channel blockages and breaches of the fluvial flood defences. Sea flooding can be caused by extreme tidal levels, storm surges, wave action, as well as a combination of each of these aspects. The flood risks presented in each flood zone is classified in **Table A5.3**.

Table A5.3 EA Flood Zone Definitions

Flood Zones	Risk	Definition
Zone 1	Low	Land having a less than 0.1% Annual Exceedance Probability (AEP) of river or sea flooding.
Zone 2	Medium	Land having between 1% and 0.1% AEP of river flooding; or land having between a 0.5% and 0.1% AEP of sea flooding.
Zone 3a	High	Land having a 1% or greater AEP of river flooding; or land having a 0.5% or greater AEP of sea flooding.
Zone 3b	The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood.

A Flood Risk Assessment will be required for any developments located in Flood Zones 2 and 3.The Flood Zones are used to define the RAG approach as summarised in **Table A5.4**.

Table A5.4 Flood Zone RAG Criteria

Assessment	Description	Classification	Potential Gate 3 Assessments
Red	Issue or constraint is likely to be challenging to overcome /major environmental constraints, significant additional mitigation required.	Flood Zone 3a and/or Flood Zone 3b	FRA with potentially significant mitigation
Amber	Issue or constraint can be overcome / moderate environmental constraints, potentially extensive and/or challenging additional mitigation requirements.	Flood Zone 2	FRA with potential mitigation
Green	Neutral or minor issue or constraint, easily mitigatable with best practice measures or minor additional mitigation requirements.	Flood Zone 1	FRA not required on the basis of the flood zone assessment

A5.1.4 Operation Phase - Surface Water

Surface water flooding is caused by rainfall exceeding the infiltration capacity of the ground and the drainage systems, causing water to accumulate on the surface. This causes surface water to flow across the ground surface and pond in low-lying depressions, according to the area's topography. New developments have the potential to increase the impermeable area of the ground, which could increase the risk of surface water flooding elsewhere from runoff if there is not an adequate drainage system installed.

The RAG approach is based on both the surface water flood risk presented to the sites and the proposed developments, as well as the flood risks that the proposed developments may cause downstream. The flood risks presented to the site have been assessed by using the EA surface water flood maps. The flood risks presented downstream of the site have been assessed from a combination of estimating the potential increase in impermeable area from the development, as well as identifying if the site is located in a Critical Drainage Area. The RAG approach is summarised in **Table A5.5**.

Table A5.5 Surface Water RAG Criteria

Assessment	Description	Classification	Potential Gate 3 Assessments
Red	Issue or constraint is likely to be challenging to overcome /major environmental constraints, significant additional mitigation required.	• Site containing areas classified as having a high surface water flood risk in the EA surface water maps; • Or proposed development introducing significant impermeable areas to the site (increase of more than 0.2ha); • Or site located in a critical drainage area.	Expected FRA and/or Drainage Strategy and/or further assessment of surface water flood risk
Amber	Issue or constraint can be overcome / moderate environmental constraints, potentially extensive and/or challenging additional mitigation requirements.	• Site containing areas classified as having a medium surface water flood risk in the EA surface water maps; • Or proposed development introducing some impermeable areas to the site (increase of 0.005ha to 0.2ha); • And site **not** located in or upstream of a critical drainage area;	Potential Drainage Strategy and/or further assessment of surface water flood risk (depending on Lead Local Flood Authority requirements)
Green	Neutral or minor issue or constraint, easily mitigatable with best practice measures or minor additional mitigation requirements.	• Site containing areas classified as having a low or very low surface water flood risk in the EA surface water maps; • Or proposed development introducing some impermeable areas to the site (increase of less than 0.005ha); • And site **not** located in or upstream of a critical drainage area;	Unlikely to require a Drainage Strategy or further assessment of surface water flood risk (depending on Lead Local Flood Authority requirements)

A5.1.5 Operation - Other Flood Sources

The other sources which have the potential to affect a site's flood risk are groundwater, sewers, and artificial sources including reservoirs and canals. Groundwater flooding is caused by the water table rising and the water emerging at the surface. It can also be caused from water flowing out of a spring due to a change in the underlying strata, or due to the water table being linked to tidal waters.

Sewer flooding can occur to both surface water, foul and combined sewers. It can be caused by a rainfall event and/or foul discharge exceeding the capacity of the sewer, as well as from sediment or debris causing a blockage in the sewer. If a sewer is discharging into a watercourse, a high water level in the watercourse can also prevent sewers from discharging and cause them to back up and flood.

Reservoir flooding can be caused if there is a breach in the dam wall. However, large reservoirs require panel engineers to inspect the reservoirs and implement any essential safety work to be undertaken to manage this risk. Therefore, the probability of a reservoir breach is considered to be extremely unlikely. Canal water levels are managed by the Canal and Rivers Trust. Both these artificial flood sources present a residual flood risk to the developments so they are considered to have a **Green** RAG rating and are not considered further.

The RAG approach for the groundwater and sewer flood risk presented to the sites and the proposed developments are based on the SFRA and associated maps at the location of the site. The RAG approach is summarised in **Table A5.6**.

Table A5.6 Other Flood Sources RAG Criteria

Assessment	Description	Classification	Potential Gate 3 Assessments
Red	Issue or constraint is likely to be challenging to overcome /major environmental constraints, significant additional mitigation required.	Site containing areas classified as having a high groundwater or sewer flood risk in the SFRA.	Expected Phase II Ground Investigation for groundwater flood risk
Amber	Issue or constraint can be overcome / moderate environmental constraints, potentially extensive and/or challenging additional mitigation requirements.	Site containing areas classified as having a moderate groundwater or sewer flood risk in the SFRA.	Potential Phase II Ground Investigation for groundwater flood risk
Green	Neutral or minor issue or constraint, easily mitigatable with best practice measures or minor additional mitigation requirements.	Site containing areas classified as having a low groundwater or sewer flood risk in the SFRA.	No Phase II Ground Investigation for groundwater flood risk

A5.1.6 Operation Phase – Scheme River Flows

Each of the London Effluent Reuse options are expected to increase river flows where effluent is discharged. An increase in river flows could potentially cause a fluvial flood risk if the additional flows result in the river exceeding the capacity of the river channel.

The two aspects that could cause this increase in flood risk depends on the amount of additional water discharged into the river, as well as the existing flows in the river when the additional water is discharged. The RAG approach is based on a combination of these two aspects and is summarised in **Table A5.7**.

Table A5.7 River Flow RAG Criteria

Assessment	Description	Classification
Red	Issue or constraint is likely to be challenging to overcome /major environmental constraints, significant additional mitigation required.	• River flows are high when the effluent is discharged; • And/or the amount of effluent discharged into the river is high compared with the usual river flow range.
Amber	Issue or constraint can be overcome / moderate environmental constraints, potentially extensive and/or challenging additional mitigation requirements.	• River flows are medium when the effluent is discharged; • And/or the amount of effluent discharged into the river is medium compared with the usual river flow range.
Green	Neutral or minor issue or constraint, easily mitigatable with best practice measures or minor additional mitigation requirements.	• River flows are low or very low when the effluent is discharged; • And/or the amount of effluent discharged into the river is low or very low compared with the usual river flow range.

APPENDIX 6 NOISE APPRAISAL SUPPORTING INFORMATION

A6.1 General approach to construction noise calculations

A list of plant for each section of the proposed construction was supplied by the construction engineers. The list was used to identify relevant items of plant from BS5228-1 Tables C1-C12. For each item of plant, sound level data was derived in the form of a sound pressure level at 10m. The list referred to 'Modular Welfare Units', it was assumed that the plant specified for that particular construction stage, would be used to construct the Welfare Units. A number of units and estimated percentage on-time was assigned to each item of plant.

These data were used to determine construction noise emission levels at 10m for each stage of construction, for each London Effluent Reuse SRO scheme.

The nearest receptor positions for each construction site were assigned a daytime baseline noise level, based on the type of location, spot noise measurements and professional judgement. The distance to the nearest receptors was used to determine an initial construction noise level at the receptors, for each construction site. A comparison of the construction noise levels with baseline levels was then used to assess the likelihood of significant noise impacts.

The assessment used the methodology of BS5228-1:2009. Under this approach, the adverse impact threshold is determined at a dwelling using the existing ambient noise level, rounded to the nearest 5dB for the appropriate period (day, evening or night). This result is used to determine the assessment category: A, B or C, which then defines the adverse noise impact threshold,

The predicted construction noise level is then compared to the appropriate noise impact threshold level to determine whether or not the threshold is exceeded. If the threshold is exceeded, a significant effect is likely to occur. However, other factors should be taken into account in assessing the overall significance. These include the duration of the works, the quality of the sound insulation of the receptor building façade, ambient noise levels at particularly noisy or quiet locations and the number of residents likely to be affected.

Such information is not currently available thus the initial assessment of significant effects has concentrated on two factors. Firstly, whether the BS5228 threshold level is likely to be exceeded and secondly, identifying receptors where the baseline noise levels are likely to be exceeded by more than 10dB. This last stage of the assessment is provided in the main report for each London Effluent Reuse SRO scheme.

A6.1.1 Beckton water recycling scheme

Table A6.1 Proposed construction plant Beckton water recycling 300 Ml/day Option

Stage	Activity	Plant	Noise Emission at 10m - dB(A)	BS5228 Ref.	No. of Units	% On-time
AWRP	Establishment	Excavator	77	C2.2	1	50%
		Dumper	76	C4.3	1	50%
		Roller	73	C2.38	1	30%
		HGV (Concrete, Muck Away, Material Delivery)	78	C8.21	1	20%
		Crane	70	C4.43	1	50%
		Small Generators	61	C4.76	2	100%
		Modular Welfare and Offices				
	Earthworks	Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Muck Away, Material Delivery)	78	C8.21	1	20%
	Foundations	Excavator	77	C2.2	1	50%
		Mobile Crane	70	C4.43	1	50%
		Concrete Pump	79	C4.30	1	30%
		Small Tools	73	C4.95	2	30%

	Superstructure and Fit Out	Mobile Crane	70	C4.43	1	50%
		HGV (Material Delivery)	78	C8.21	1	20%
		MEWP	79	C4.59	1	20%
		Telehandler	79	C4.54	1	30%
		Forklift	67	C4.57	1	30%
		Small Tools	73	C4.95	2	30%
Shaft sites	Establishment	Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Concrete, Muck Away, Material Delivery)	78	C8.21	1	20%
		Crane	70	C4.43	1	50%
		Small Generators	61	C4.76	2	100%
		Modular Welfare and Offices				
	Shaft Construction (assume segmental shaft construction)	Crawler Crane	71	C4.50	1	50%
		Hydraulic Power Packs	79	C12.2	1	80%
		HGV (PCC Segment Delivery, Muck Away)	78	C8.21	1	20%
		Dewatering Pumps	68	C4.88	2	100%
		Excavator	77	C2.2	1	50%
		Lighting sets	65	C4.86	4	20%
	TBM Launch	Crawler Crane	71	C4.50	1	50%
		HGV (TBM Section Delivery)	78	C8.21	1	20%
		Dewatering Pumps	68	C4.88	2	100%
	TBM Operation	HGV (Tunnel Segment Delivery, Muck Away)	78	C8.21	1	20%
		Crawler Crane	78	C4.38	1	50%
		Hydraulic Power Packs	79	C12.2	1	90%
		Large Generators to Power TBM (if mains power not available)	66	C4,78	2	90%
		Slurry tanks and filtration system (if slurry TBM)	70	C3.7	1	90%
		Lighting Sets	65	C4.86	4	20%
	Secondary Lining (if required)	Crawler Crane	71	C4.50	1	50%
		HGV (Shuttering and rebar)	78	C8.21	1	20%
		Concrete Wagons	77	C4.21	1	30%
		Static Concrete Pump	71	C4.36	1	50%
River Lee outfall	Establishment	Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Concrete, Muck Away, Material Delivery)	78	C8.21	1	20%
		Crane	70	C4.43	1	50%
		Small Generators	61	C4.76	2	100%
		Modular Welfare and Offices				
	Temporary Cofferdam	Crawler Crane	71	C4.50	1	50%
		Piling Hammer (Vibro)	88	C3.8	1	30%

	(Install and removal)	Piling Hammer (Impact)	89	C3.1	1	30%
		HGV (Sheet pile and temporary steelwork delivery)	78	C8.21	1	20%
		Dewatering Pumps	68	C4.88	2	100%
		Lighting Sets	65	C4.86	4	20%
	Permanent Works Construction	Crawler Crane	71	C4.50	1	50%
		Excavators	77	C2.2	2	50%
		HGV (muck away, rebar, shuttering, Pre-cast, valving, equipment delivery)	78	C8.21	1	20%
		Concrete Wagon	77	C4.21	1	30%

Table A6.2 Construction noise emission levels for each stage of construction: Beckton water recycling scheme

Beckton water recycling	Stage	Noise Emission at 10m
		dB(A)
ARWP	Establishment	78.5
	Earthworks	76.4
	Foundations	79.3
	Superstructure construction and fit out	80.4
Shaft Sites	Establishment	78.4
	Shaft Construction	80.9
	TBM Launch	75.0
	TBM Operation	81.3
	Secondary Lining （if required）	78.9
River Lee Outfall	Establishment	78.5
	Temporary Cofferdam	86.6
	Permanent Works Construction	80.8

A6.1.2 Mogden water recycling scheme

Table A6.3 Proposed construction plant for Mogden water recycling 200 Ml/day Option

Stage	Activity	Plant	Noise Emission at 10m - dB(A)	BS5228 Ref.	No. of Units	% On-time
AWRP	Establishment	Excavator	77	C2.2	1	50%
		Dumper	76	C4.3	1	50%
		Roller	73	C2.38	1	30%
		HGV (Concrete, Muck Away, Material Delivery)	78	C8.21	1	20%
		Crane	70	C4.43	1	50%
		Small Generators	61	C4.76	2	100%
		Modular Welfare and Offices				
	Earthworks	Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Muck Away, Material Delivery)	78	C8.21	1	20%
	Foundations	Excavator	77	C2.2	1	50%
		Mobile Crane	70	C4.43	1	50%
		Concrete Pump	79	C4.30	1	30%
		Small Tools	73	C4.95	2	30%
	Superstructure and Fit Out	Mobile Crane	70	C4.43	1	50%
		HGV (Material Delivery)	78	C8.21	1	20%
		MEWP	79	C4.59	1	20%
		Telehandler	79	C4.54	1	30%
		Forklift	67	C4.57	1	30%
		Small Tools	73	C4.95	2	30%
Final Effluent Transfer Tunnel	Site Establishment	Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Concrete, Muck Away, Material Delivery)	78	C8.21	1	20%
		Crane	70	C4.43	1	50%
		Small Generators	61	C4.76	2	100%
		Modular Welfare and Offices				
	Shaft Construction (assume segmental shaft construction)	Crawler Crane	71	C4.50	1	50%
		Hydraulic Power Packs	79	C12.2	1	80%
		HGV (PCC Segment Delivery, Muck Away)	78	C8.21	1	20%
		Dewatering Pumps	68	C4.88	2	100%
		Excavator	77	C2.2	1	50%
		Lighting sets	65	C4.86	4	20%
	Pipe Jack	Crawler Crane	71	C4.50	1	50%
		HGV (Cutter head and PCC section delivery)	78	C8.21	1	20%
		Dewatering Pumps	68	C4.88	2	100%
		Hydraulic Power Packs	79	C12.2	1	80%
		Large Generators to Power pipe jack (if mains power not available)	66	C4,78	2	90%

Stage	Activity	Plant	Noise Emission at 10m - dB(A)	BS5228 Ref.	No. of Units	% On-time
		Lighting Sets	65	C4.86	4	20%
Recycled Water Transfer Pipeline	Mobile Site Establishment	Mobile Welfare units				
	Open Cut Pipe Laying	Excavator	77	C4.63	1	50%
		Roller	73	C2.38	1	30%
		HGV (Muck away, bedding, pipe and reinstatement delivery)	78	C8.21	1	50%
		Traffic Management				
Outfall	Establishment	Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Concrete, Muck Away, Material Delivery)	78	C8.21	1	20%
		Crane	70	C4.43	1	50%
		Small Generators	61	C4.76	2	100%
		Modular Welfare and Offices				
	Temporary Cofferdam (Install and removal)	Crawler Crane	71	C4.50	1	50%
		Piling Hammer (Vibro)	88	C3.8	1	30%
		Piling Hammer (Impact)	89	C3.1	1	30%
		HGV (Sheet pile and temporary steelwork delivery)	78	C8.21	1	20%
		Dewatering Pumps	68	C4.88	2	100%
		Lighting Sets	65	C4.86	4	20%
	Permanent Works Construction	Crawler Crane	71	C4.50	1	50%
		Excavators	77	C2.2	2	50%
		HGV (muck away, rebar, shuttering, Pre-cast, valving, equipment delivery)	78	C8.21	1	20%
		Concrete Wagon	77	C4.21	1	30%

Table A6.4 Construction noise emission levels for each stage of construction

Mogden water recycling	Stage	Noise Emission SPL at 10m
		dB(A)
ARWP	Establishment	78.5
	Earthworks	76.4
	Foundations	79.3
	Superstructure construction and fit out	80.4
Final Effluent Transfer Tunnel	Establishment	78.4
	Shaft Construction	80.9
	Pipe Jack	80.2
Recycled Water Transfer Pipeline	Open Cut Pipe Laying	78.0
Outfall	Establishment	77.1
	Temporary Cofferdam	86.6
	Permanent Works Construction	80.8

A6.1.3 Teddington DRA scheme

Table A6.5 Proposed construction plant for Teddington 75 Ml/day Option

Stage	Activity	Plant	Noise Emission at 10m - dB(A)	BS5228 Ref.	No. of Units	% On-time
Tertiary treatment plant	Establishment	Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Concrete, Muck Away, Material Delivery)	78	C8.21	1	20%
		Crane	70	C4.43	1	50%
		Small Generators	61	C4.76	2	100%
		Modular Welfare and Offices				
	Deepening of Tank 1 & 2	Core Drilling Rig / Diamond Wire Saw	85	C4.69	1	50%
		Bored Piling Rig	83	C3.14	1	50%
		Ground Anchor Rig	77	C12.43	1	50%
		Concrete Wagon	77	C4.21	1	30%
		Grout Pan				
		HGV (reinforcement delivery, muck away)	78	C8.21	1	20%
		Excavator with Concrete Breaker	88	C5.1	1	10%
		Excavator	77	C2.2	1	50%
		Dust Suppression Systems				
		Dewatering Pumps	68	C4.88	2	100%
		Lighting Sets	65	C4.86	4	20%
		Conveyor for removing demolition and excavation arisings	77	C10.20	1	90%
		Concrete Pump	79	C4.30	1	30%
		Crane	70	C4.43	1	50%
	Filling of Tank 7 & 8	Conveyor systems for placing fill material	77	C10.20	1	90%
		Core Drill Rig	85	C4.69	1	50%
		Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Import of fill material, reinforcement)	78	C8.21	1	20%
		Concrete Pump	79	C4.30	1	30%
		Concrete Wagon	77	C4.21	1	30%
		Crane	70	C4.43	1	50%
	Superstructure construction and fit out	Crane	70	C4.43	1	50%
		HGV (Delivery of modules and equipment)	78	C8.21	1	20%
		MEWP	79	C4.59	1	20%
		Telehandler	79	C4.54	1	30%
Shaft sites	Establishment	Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Concrete, Muck Away, Material Delivery)	78	C8.21	1	20%
		Crane	70	C4.43	1	50%
		Small Generators	61	C4.76	2	100%
		Modular Welfare and Offices				

Stage	Activity	Plant	Noise Emission at 10m - dB(A)	BS5228 Ref.	No. of Units	% On-time
	Shaft Construction (assume segmental shaft construction)	Crawler Crane	71	C4.50	1	50%
		Hydraulic Power Packs	79	C12.2	1	80%
		HGV (PCC Segment Delivery, Muck Away)	78	C8.21	1	20%
		Dewatering Pumps	68	C4.88	2	100%
		Excavator	77	C2.2	1	50%
		Lighting sets	65	C4.86	4	20%
	TBM Launch	Crawler Crane	71	C4.50	1	50%
		HGV (TBM Section Delivery)	78	C8.21	1	20%
		Dewatering Pumps	68	C4.88	2	100%
	TBM Operation	HGV (Tunnel Segment Delivery, Muck Away)	78	C8.21	1	20%
		Crawler Crane	78	C4.38	1	50%
		Hydraulic Power Packs	79	C12.2	1	90%
		Large Generators to Power TBM (if mains power not available)	66	C4,78	2	90%
		Lighting Sets	65	C4.86	4	20%
	Secondary Lining (if required)	Crawler Crane	71	C4.50	1	50%
		HGV (Shuttering and rebar)	78	C8.21	1	20%
		Concrete Wagons	77	C4.21	1	30%
		Static Concrete Pump	71	C4.36	1	50%
Outfall	Establishment	Excavator	77	C2.2	1	50%
		Roller	73	C2.38	1	30%
		HGV (Concrete, Muck Away, Material Delivery)	78	C8.21	1	20%
		Crane	70	C4.43	1	50%
		Small Generators	61	C4.76	2	100%
		Modular Welfare and Offices				
	Temporary Cofferdam (Install and removal)	Crawler Crane	71	C4.50	1	50%
		Piling Hammer (Vibro)	88	C3.8	1	30%
		Piling Hammer (Impact)	89	C3.1	1	30%
		HGV (Sheet pile and temporary steelwork delivery)	78	C8.21	1	20%
		Dewatering Pumps	68	C4.88	2	100%
		Lighting Sets	65	C4.86	4	20%
	Permanent Works Construction	Crawler Crane	71	C4.50	1	50%
		Excavators	77	C2.2	2	50%
		HGV (muck away, rebar, shuttering, Pre-cast, valving, equipment delivery)	78	C8.21	1	20%
		Concrete Wagon	77	C4.21	1	30%

Table A6.6 Construction noise emission levels for each stage of construction

Teddington DRA	Stage	Emission at 10m
Tertiary Treatment Plant	Establishment	78.5
	Deepening Tanks 1 & 2	86.9

	Filling Tanks 7 & 8	84.6
	Superstructure construction/fit out	77.6
Shaft Sites	Establishment	77.1
	Shaft Construction	80.9
	TBM Launch	75.0
	TBM Operation	81.0
	Secondary Lining (if required)	76.0
Outfall	Establishment	77.1
	Temporary Cofferdam	86.6
	Permanent Works Construction	79.2

T: +44 (0) 1235 75 3000
E: enquiry@ricardo.com
W: ee.ricardo.com