



# Annex B4: Water Framework Directive Compliance Assessment 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.

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### **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.*

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# LONDON EFFLUENT REUSE SRO

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## Annex B.2.4. Gate 2 Water Framework Directive (WFD) Regulations Assessment Report

Report for: Thames Water Utilities Ltd

Ref. 4700399659

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Version 1.1 – 22/09/2022	Updates from Physical Environment Assessment Report Updates from Water Quality Assessment Report Incorporation of L2 Assurance Comments Incorporation of NAU Comments.
Version 1.2 – 12/10/2022	Second round of L2 Assurance Comments Incorporation of L3 Assurance Comments Incorporation of Legal Comments

**Customer:**

Thames Water Utilities Ltd

**Customer reference:**

4700399659

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# 1. INTRODUCTION

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## 1.1 BACKGROUND AND PURPOSE OF REPORT

Ofwat, through the PR19 Final Determination, has identified the potential for companies to jointly deliver strategic regional water resources solutions to secure long-term resilience on behalf of customers while protecting the environment and benefiting wider society. As part of the assessment of companies' PR19 business plans, Ofwat introduced proposals to support the delivery of Strategic Regional Water Resource Options (SROs) over the next 5 to 15 years with solutions required to be 'construction ready' for the 2025-2030 period. Ofwat's Final Determination<sup>1</sup> in December 2019 set out a gated process for development of Strategic Resource Options (SROs) for the co-ordination and development of a consistent set of SROs.

This gated process provides a mechanism for the industry, regulators, stakeholders and customers to input into the development and scheduling of these strategic solutions, through a combined set of statutory and regulatory processes. These include the National Framework, Drinking Water Safety Plans, Business Plans and Water Resource Management Plans (WRMPs). The strategic regional working group (consisting of Affinity Water, Anglian Water, Severn Trent Water, Southern Water, South West Water, Thames Water, United Utilities and Wessex Water) published a joint company statement reiterating a commitment to continue working with the Regulators' Alliance for Progressing Infrastructure Development (RAPID), the Environment Agency (EA), Natural Resources Wales (NRW), Ofwat and the Drinking Water Inspectorate (DWI) to make all of the planning processes and statutory timetables a success.

Government and regulators have identified the need for a more integrated planning approach – with the National Framework setting out requirements for five regional plans across England. The aim is to identify best value plans at a regional level that include ambitious demand management, take advantage of local surpluses that may be available and identify the best value SROs for implementation. Ofwat's PR19 Final Determination identified that to achieve this objective it will be important that key inputs to the regional planning processes are consistent. It therefore set out requirements in the submission for conceptual design reports "*using comparable methodologies and consistent assumptions*" including in relation to costs, deployable outputs, environmental and water quality assessments.

In October 2020, the group of Water Companies involved in developing SROs (known as the All Company Working Group - ACWG), published guidance<sup>2</sup> for environmental assessment methods for SROs which is aligned to the Water Resources Planning Guideline (WRPG)<sup>3</sup> to increase the consistency of environmental assessment and the evaluation of impacts on environmental water quality in particular.

The ACWG guidelines indicate that the process requires Water Companies to provide the following information related to each SRO at the stage outlined (see Figure 1-1).

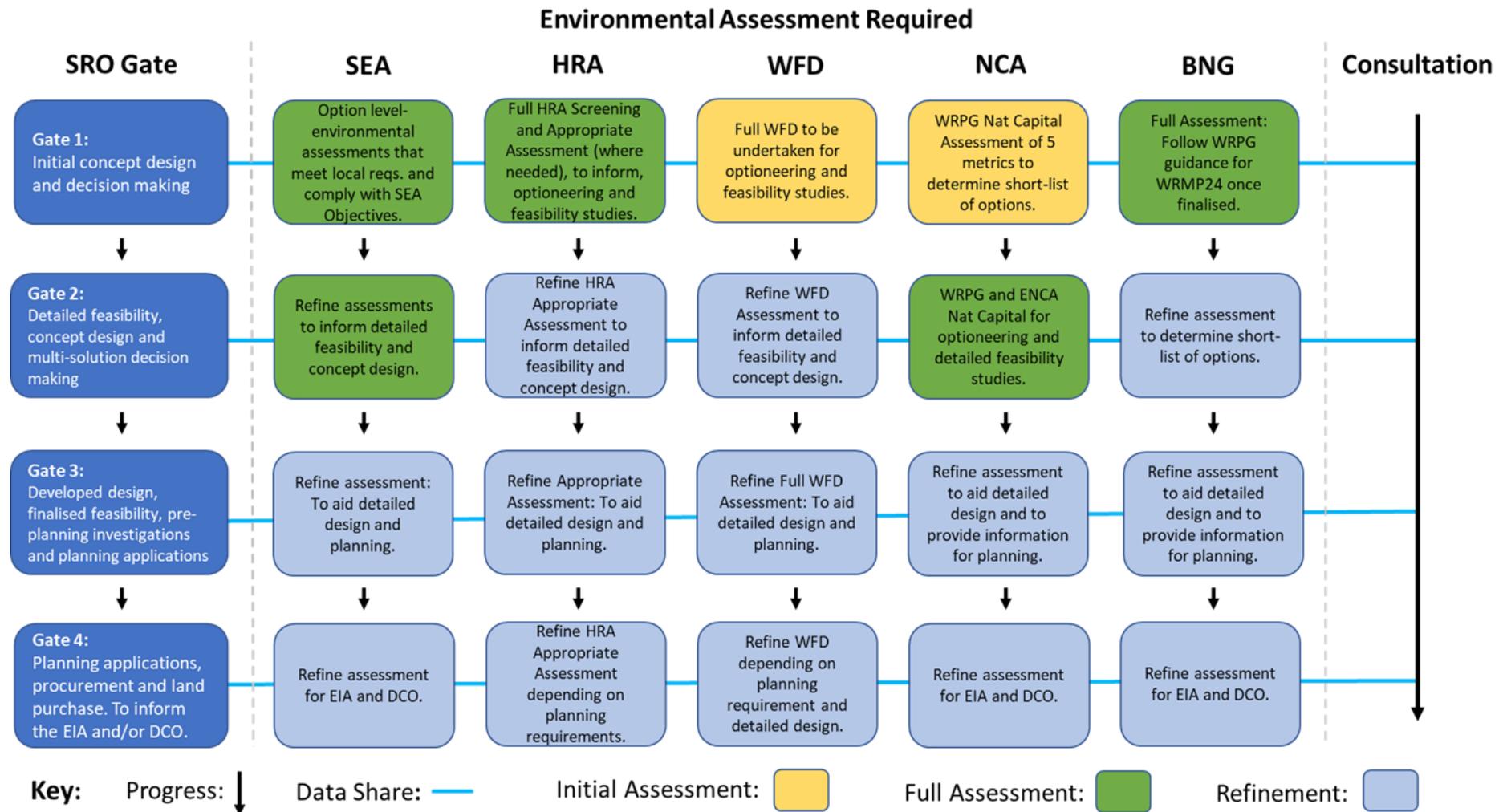
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<sup>1</sup> Ofwat (2019). PR19 Final Determinations, Strategic regional water resource solutions appendix

<sup>2</sup> Mott MacDonald Limited (2020). All Companies Working Group WRMP environmental assessment guidance and applicability with SROs. Published October 2020

<sup>3</sup> Ofwat, NRW & EA (2021). Water Resources Planning Guideline – v9 for Publishing February 2021  
[Water resources planning guideline - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/101444/water-resources-planning-guideline-v9-for-publishing-february-2021.pdf)

Figure 1-1 Environmental Assessment Integration with SRO Gates



This document has been written in line with the requirements of the RAPID Gate 2 Guidance. This report sets out the Water Framework Directive Regulations<sup>4</sup> (WFD) Assessment for the London Effluent Reuse SRO covering Beckton water recycling scheme, Mogden water recycling scheme and Teddington DRA at Gate 2. The RAPID Gate 2 Guidance states for the WFD Assessment, as part of the suite of environmental assessments:

*You must assess all your options to ensure they comply with and support the achievement of Water Framework Directive Regulation requirements and objectives set out in the River Basin Management Plans.*

Gate 2 builds on 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. The SRO schemes are to be developed to a standard suitable for submitting into final regional plans and / or final water resources management plans (WRMPs). A full WFD assessment will be done at a plan level for the WRMP24 and at a project level in the consenting process. Pursuant to the RAPID gated process, this B.4. WFD Regulations Assessment reports the assessment as at the current point in time and will continue to be refined and supplemented in line with the gated process. Therefore, statements of WFD compliance are for the purposes of Gate 2 only.

This Gate 2 assessment is an assessment of the WFD compliance of the London Effluent Reuse SRO individually. It is based upon the assessments undertaken during Gate 1 and Gate 2 cover the physical environment (Annex B.2.1) water quality (Annex B.2.2) and ecology (annexes B.2.3 – B.2.5.). A cumulative WFD compliance assessment with other water resources schemes under consideration regionally is included in the Regional Plan of the Water Resources South East (WRSE) group. Those cumulative effects with the London Effluent Reuse schemes, assessed elsewhere, include, but are not exclusively, other SROs. Cumulative assessments for the London Effluent Reuse schemes are not addressed at Gate 2 but will be considered further on in the Gated process and in the Water Resources South East group (WRSE) Regional Plan. This WFD assessment of the London Effluent Reuse schemes is informed by other assessments, including evidence reporting and assessments.

The Water Framework Directive<sup>5</sup> is an EU Directive which was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (“the WFD Regulation”). As of 31/12/2020 the WFD Regulations became retained EU law, and the references in the WFD Regulations to the Water Framework Directive refer to the version of the Directive that was in force at the time when the WFD Regulations came into force (10 April 2017). Therefore, the principal legal basis is the WFD Regulations which currently mirror the EU Directive. In this report “WFD” refers to WFD Regulations applicable to England and Wales, not the EU Directive.

The WFD assessment of the London Effluent Reuse SRO has been undertaken in the context of the ACWG guidance. This approach has been adopted to assess the various components of the London Effluent Reuse SRO, thus determining the environmental risk of the SRO in a manner consistent with the assessments that will be undertaken for the regional and individual water company WRMPs.

It is noted that there are differences in the review of water quality for environmental permitting and WFD compliance. WFD compliance is assessed in this report strictly according to the WFD assessment objectives set out in Section 3.1. Discharge permitting requirements are as set out through Environment Agency LIT 13134 *Permitting of Hazardous Chemicals and Elements in Discharges to Surface Waters* and Environment Agency Guidance H1 Annex D2 for the *Assessment of Sanitary and Other Pollutants within Surface Waters* and are different to the tests for WFD Regulations compliance. Furthermore it is noted that environmental permitting for discharges is not a RAPID requirement for Gate 2 SRO assessments and that this will commence in RAPID Gate 3 and incorporate *Frequently Asked Questions* advice provided by Environment Agency in Gate 2<sup>6</sup>.

To support the Gate 2 assessment, technical meetings and workshops were held through Gate 2 to facilitate collaborative working with regulators and stakeholders, these focused on developing consistent approaches and sharing technical information. Technical Working Groups (TWGs) were set up with the NAU, EA, NE and

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<sup>4</sup> Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. SI 2017 No. 407

<sup>5</sup> European Union (2000) Directive 2000/60/EC of the European Parliament and of the Council

<sup>6</sup> Environment Agency. National Appraisal Unit Water Quality Permitting for Strategic Resource Options: Transferring Recycled Effluent via Water Bodies for Water Supply. July 2022

Port of London Authority (PLA) where we developed scopes of work, agreed methods and shared outputs on critical topics. Over 35 technical workshops were held through Gate 2 covering the following topics:

- Engineering design
- Terrestrial ecology and Biodiversity net gain
- Fisheries
- Water quality
- Aquatic modelling
- Aquatic ecology
- Regulatory assessments
- Temperature
- Navigation

Feedback from the TWGs was taken into account in the on-going programme of works and the outputs are reflected in the reports prepared as part of Gate 2.

## 1.2 LONDON EFFLUENT REUSE SRO OPERATING PATTERN

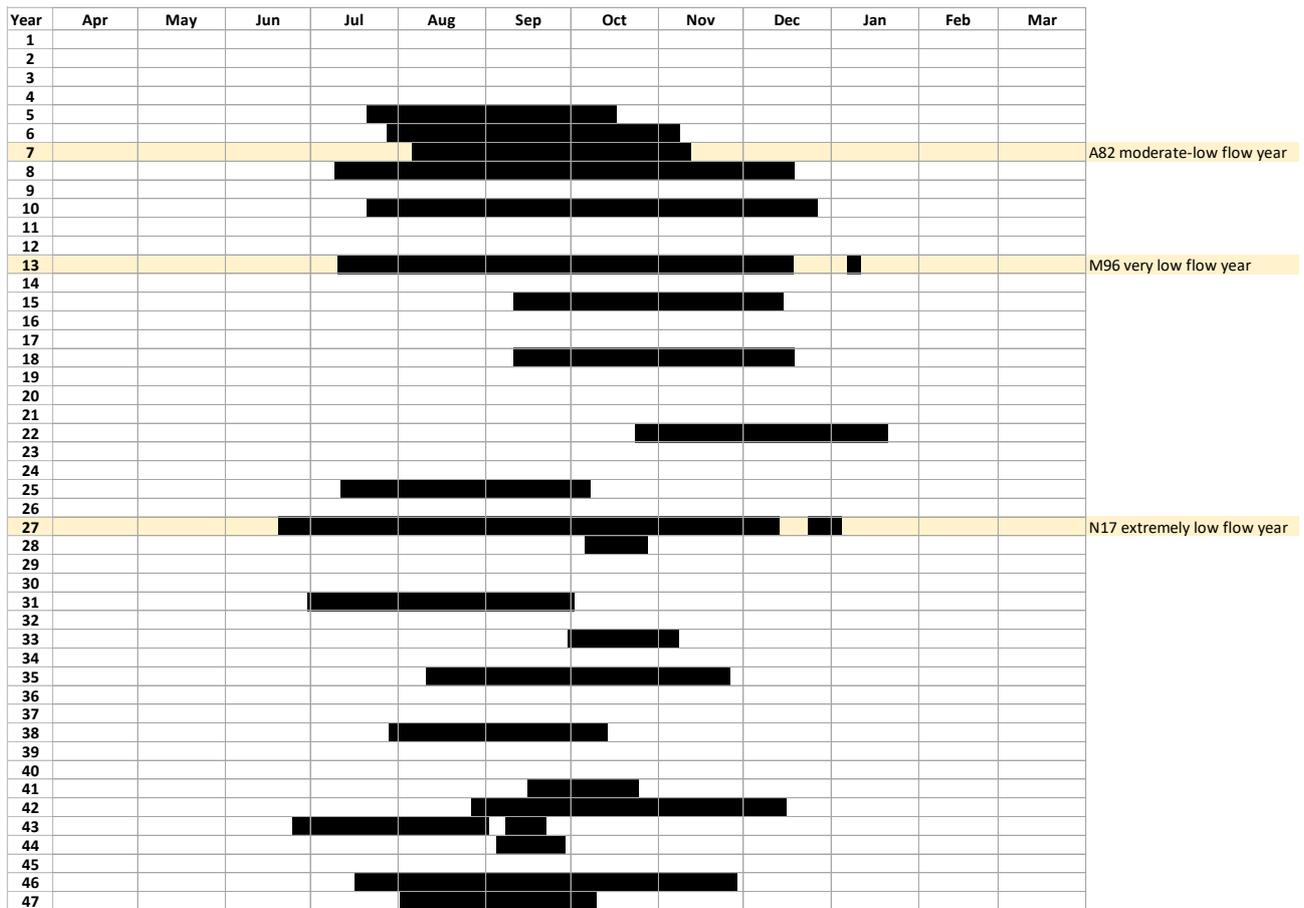
To support the environmental assessments at Gate 2, an indicative operating pattern has been developed. The approach uses the 19,200-year stochastic flow series developed for the River Thames catchment for the WRSE. This is documented in the B.2.1. London Effluent Reuse SRO Gate 2 Physical Environment Assessment Report. 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 Reuse SRO operation<sup>7</sup>. The stochastic years have been made available as 48-year continuous periods, and one of those has been selected as having representative flow characteristics to inform the environmental assessments. The selected 48-year series<sup>8</sup> 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 solution used on its own for Thames Water, without conjunctive use with other Thames Water SROs (such as SESRO). It also uses the controlling triggers developed by Thames Water for current strategic resource options (such as Thames Gateway Water Treatment Plant) based on lower River Thames and Thames Water's total London reservoir storage. The indicative pattern is shown in Figure 1-2, 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 scheme.

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<sup>7</sup> Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Physical Environment Assessment Report.

<sup>8</sup> Note these are 48 calendar years. The environmental assessment period has been selected as a water resource year (1 April to 31 March) and as such the selected period includes 47 resource years from the 48 calendar years.

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



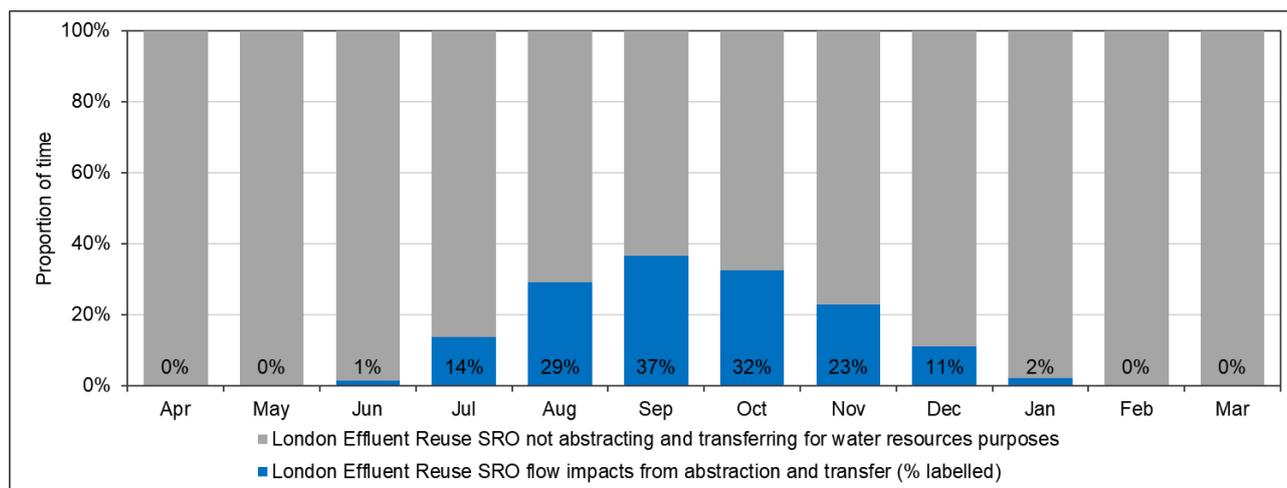
Within these patterns, selected return frequencies have been selected for the detailed assessment including modelling used extensively in the assessments presented for Gate 2. These are a 1 in 5 return frequency year with moderate-low flows in the River Thames at Teddington with a 1 in 5 return frequency operating pattern in terms of duration and season (model reference A82). Also a 1 in 20 return frequency year with very low flow years in the River Thames at Teddington with a 1 in 20 return frequency operating pattern in terms of duration and season (model reference M96). Noting the scheme would only be used on a 1 in 2 return frequency, these capture a suitable range of circumstances and have been discussed and reviewed with the regulators during Gate 2<sup>9</sup>. In addition, a 1 in 50 return frequency year of extremely low flows in the River Thames at Teddington and with a 1 in 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. For further information see the EA’s position statement LIT 14339 01/2021<sup>10</sup>.

As shown on Figure 1-3 expected London Effluent Reuse SRO usage would typically be in the months August to November, peaking at 37% 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.

<sup>9</sup> Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Physical Environment Assessment Report.

<sup>10</sup> EA (2021) Supporting implementation of river basin management plans position. LIT 14339. 01/2021.

Figure 1-3 Representation of the per calendar month operational pattern of London Effluent Reuse schemes from the 47 year period (shown in Figure 1-2) as used in the Gate 2 environmental assessments



Specifically for the assessments in this report, the modelled A82 1 in 5 year return frequency moderate-low flow year includes a period of operation of 99 consecutive days between 6 August and 12 November. The modelled M96 1 in 20 year return frequency very low flow year includes a period of operation of 161 consecutive days between 11 July and 18 December and following a brief period of higher river flows increasing total London reservoir storage, an additional period of 5 days between 7 January and 11 January.

### 1.3 STRUCTURE OF THIS REPORT

The report is divided into the following sections:

- Section 2: Provides a background to the London Effluent Reuse schemes
- Section 3: Provides the methodology adopted for the WFD Regulations assessment;
- Section 4: Provides the results of the WFD assessment Level 1 screening of the Beckton water recycling scheme, Mogden Beckton water recycling scheme and Teddington DRA scheme;
- Section 5: Provides the results of the WFD assessment Level 2 assessment of the Beckton water recycling scheme, Mogden Beckton water recycling scheme and Teddington DRA scheme;
- Section 6: Conclusions and Recommendations.

## 2. LONDON EFFLUENT REUSE STRATEGIC RESOURCE OPTIONS

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For Gate 2, the London Effluent Reuse SRO is set out as three source options and a range of sizes. Two of the options are in west London, utilising crude sewage or final effluent from Mogden STW to a maximum total reduction of 200 MI/d, with differing SRO discharge locations. One option is in east London, utilising final effluent from Beckton STW. The three schemes being assessed at Gate 2 are the Beckton water recycling scheme, the Mogden water recycling scheme and the Teddington DRA scheme.

During 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. The Gate 1 concept design is therefore used in Gate 2, with the exception where scheme elements are shared with the Mogden Beckton water recycling scheme (certain conveyance routes, AWRP and discharge location) which have been further developed through Gate 2.

The 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 MI/d Mogden Beckton water recycling scheme (AWRP, discharge location and volume), the outcomes of that assessment can be considered representative of an assessment of a 50 MI/d Mogden South Sewer scheme.

For assessment purposes mitigation is embedded within the assessment and not assessed separately. That mitigation is best practice mitigation and any additional specific mitigation included as part of option design as set out in conceptual design reports. Furthermore, it is assumed that reuse recycled water discharged will comply with both required environmental permit conditions<sup>11</sup> and Drinking Water Safety Plan (DWSP) raw water requirements. For a direct river abstraction (DRA) outfall, it is assumed that diverted effluent will comply with required environmental permit conditions. A DRA intake would include appropriate fish screening and all new outfalls would include appropriate eel management measures. The source-pathway part of the conceptual model has been set out for each of the three options in Figure 2.1 to 2.3.

### 2.1 BECKTON WATER RECYCLING SCHEME

A portion of final effluent from Beckton STW would be treated at a new advanced water recycling plant (AWRP) within Beckton STW boundary, to the north of the operational area for advanced treatment (Figure 2-1). As set out in the Gate 2 Conceptual Design Report<sup>12</sup> for a Beckton water recycling scheme, the AWRP would include the following water treatment processes: reverse osmosis, UV advanced oxidation process (includes peroxide dosing) and remineralisation. Waste streams from the AWRP would be returned to Beckton STW via pipeline, for treatment prior to being discharged into the Thames Tideway. The discharge quality associated with the recycled water at Gate 2 is as set out in the Conceptual Design and in the B.2.2. Water Quality Assessment Report.

Recycled water would be pumped in a new tunnel to a proposed discharge location on the Enfield Island Loop of the freshwater Lee Diversion, upstream of the existing 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.

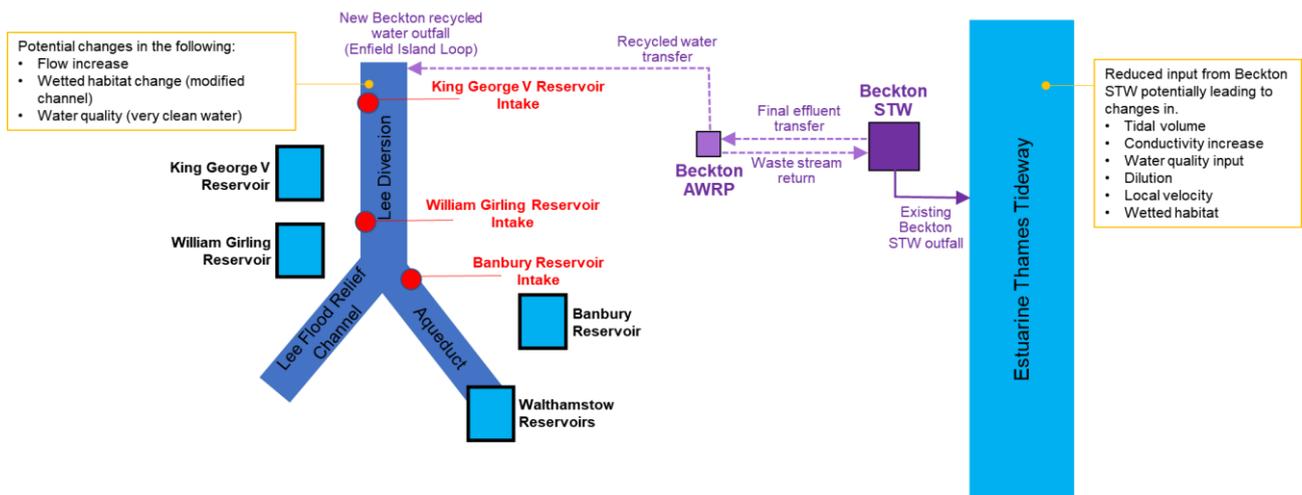
The Beckton water recycling scheme tunnel route is to be assessed for Gate 2 at 100 MI/d, 200 MI/d and 300 MI/d. It is noted that a tunnel could enable the conveyance of water abstracted from the River Thames at Hampton and conveyed in the Thames Lee Tunnel (TLT) to be discharged into the freshwater Lee Diversion at the Enfield Island Loop, where currently this discharges into Lockwood Reservoir and does not enter channels of the Lee. However, for Gate 2 neither the Teddington DRA nor Beckton water recycling scheme operate to transfer River Thames water in to the Enfield Island Loop, so discharge of River Thames water into the Enfield Island Loop has not been assessed.

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<sup>11</sup> With in-river environmental quality standards as set out in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

<sup>12</sup> Jacobs (2022) Beckton water recycling SRO: Conceptual Design Report.

Figure 2-1 Conceptual diagram: Beckton water recycling scheme



The Beckton water recycling scheme is to be assessed for Gate 2 at 100 MI/d, 200 MI/d and 300 MI/d flow transfer when operational for water resources purposes, with a tunnel maintenance flow of 15 MI/d at all other times. Details of the operating pattern, including ramp-up and ramp-down periods and temporary cessation of transfer to mitigate flood risk are not available at Gate 2.

The components of the Beckton water recycling scheme including tunnel shaft locations can be seen in Figure 2-2 below.

The water bodies included in this assessment are:

- Thames Middle (GB530603911402)
- Enfield Lock to Tottenham Locks (GB106038027950)

The area and water bodies under consideration for the Beckton water recycling scheme WFD assessment can be seen in Figure 2-3 below.

Figure 2-2 Beckton Water Recycling Scheme

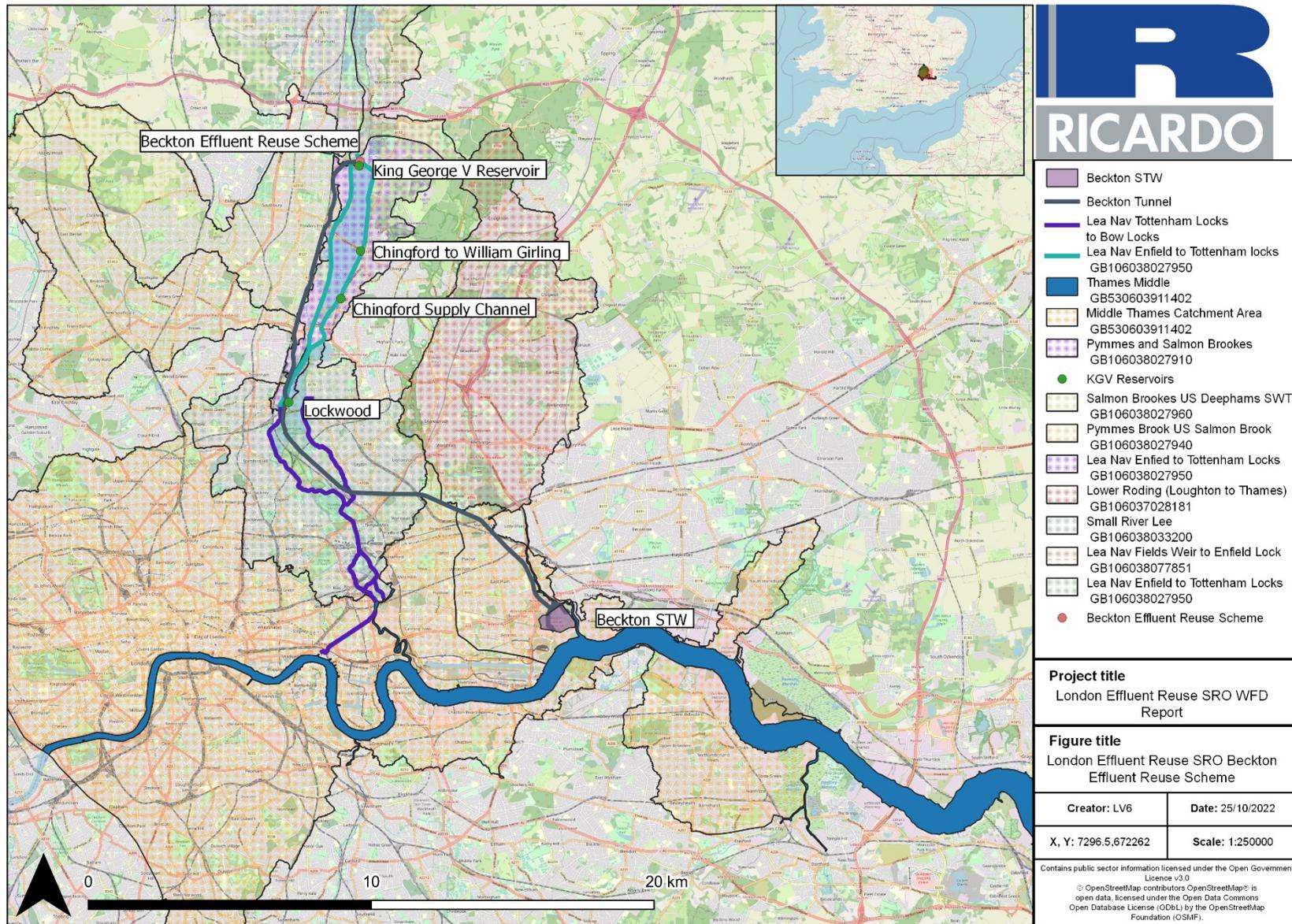
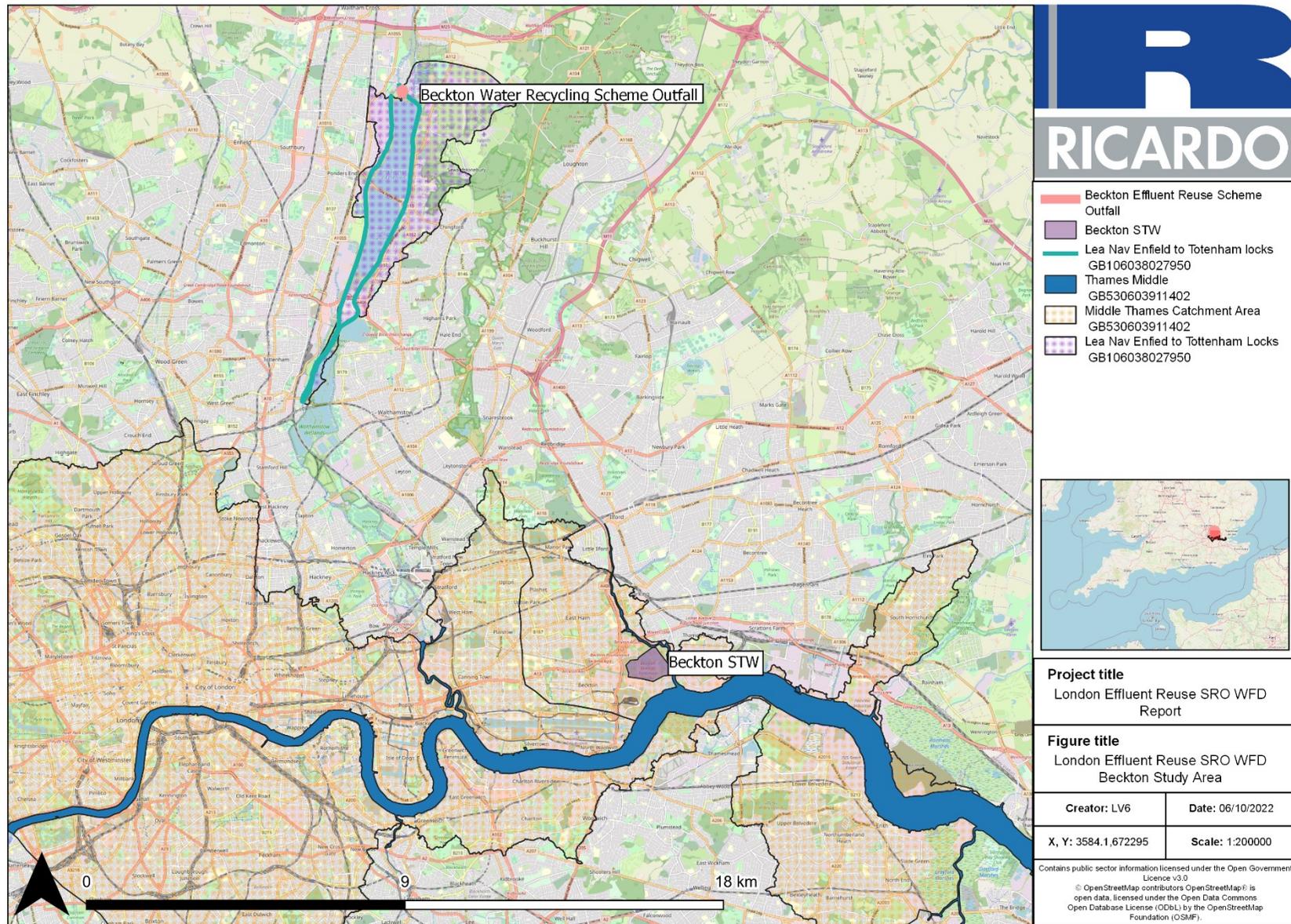


Figure 2-3 Beckton Water Recycling Scheme WFD Study Area



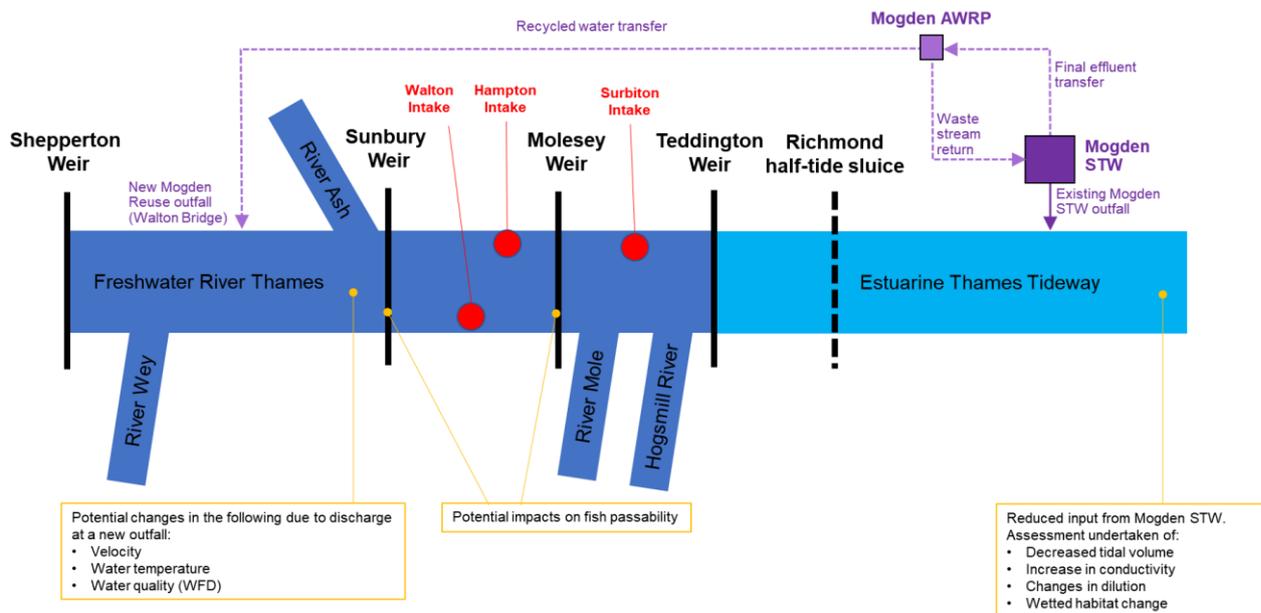
## 2.2 MOGDEN WATER RECYCLING SCHEME

Final effluent from Mogden STW would be pumped in a new pipeline to a new AWRP, located near Kempton Water Treatment Works (WTW) for advanced treatment (Figure 2-4). As set out in the Gate 2 Conceptual Design Report<sup>13</sup> for a Mogden water recycling scheme, the AWRP would include the following water treatment processes: reverse osmosis, UV advanced oxidation process (includes peroxide dosing) and remineralisation. The discharge quality associated with the recycled water at Gate 2 is as set out in the Conceptual Design and in the B.2.2. Water Quality Assessment Report.

Recycled water would be transferred in a new pipeline for discharge into the freshwater River Thames at an outfall upstream of the existing Thames Water Walton WTW intake. Additional abstraction for public water supply on a put/take would be through existing intakes on the freshwater River Thames. Waste streams from the AWRP would be returned to Mogden STW via pipeline, for treatment prior to being discharged into the Thames Tideway.

The Mogden water recycling scheme is to be assessed for Gate 2 at 50 MI/d, 100 MI/d, 150 MI/d and 200 MI/d flow transfer when operational for water resources purposes, with a plant maintenance flow of 25% of the applicable rate at all other times. Details of the operating pattern, including ramp-up and ramp-down periods and temporary cessation of transfer to mitigate flood risk are not available at Gate 2.

Figure 2-4 Conceptual Diagram: Mogden water recycling scheme



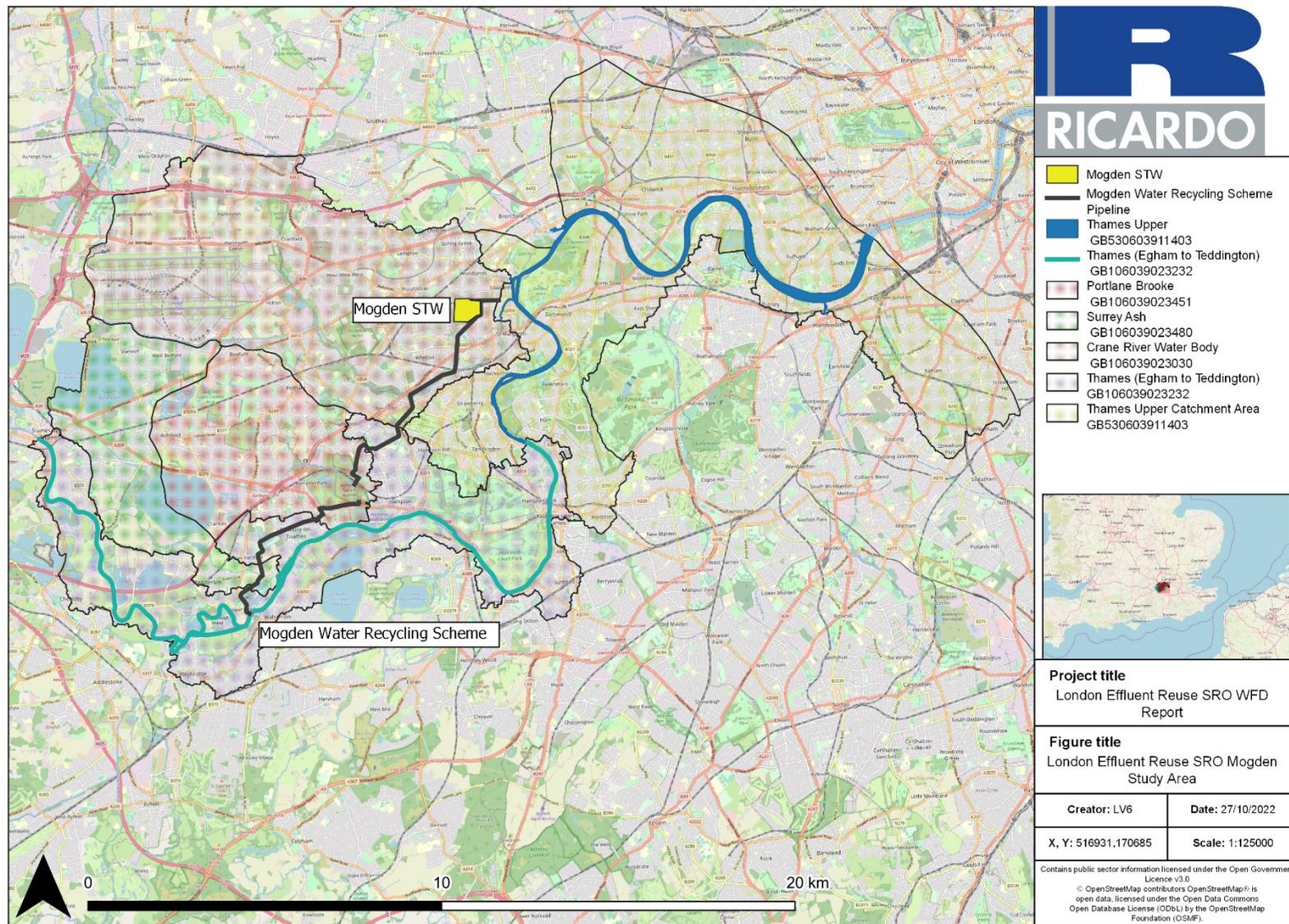
The scheme components of the Mogden water recycling scheme including pipelines and shaft locations can be seen in Figure 2-5 below.

The water bodies included in this assessment are:

- Thames (Egham to Teddington) (GB106039023232)
- Thames Upper (GB530603911403)

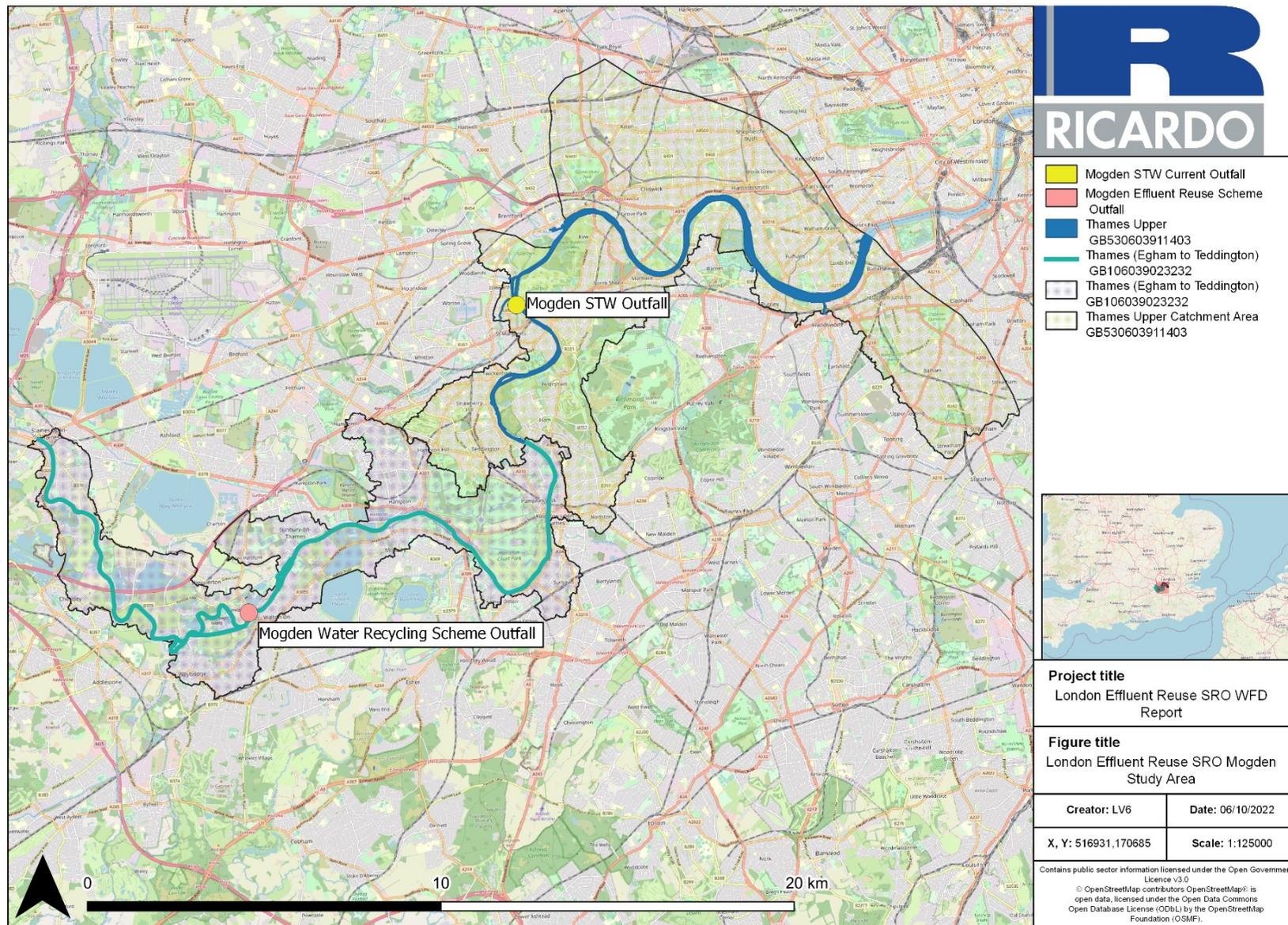
<sup>13</sup> Jacobs (2022) Beckton water recycling SRO: Conceptual Design Report.

Figure 2-5 Mogden Water Recycling Scheme



The area and water bodies under consideration for the Mogden water recycling scheme WFD assessment can be seen in Figure 2-6 below.

Figure 2-6 Mogden Water Recycling Scheme WFD study area



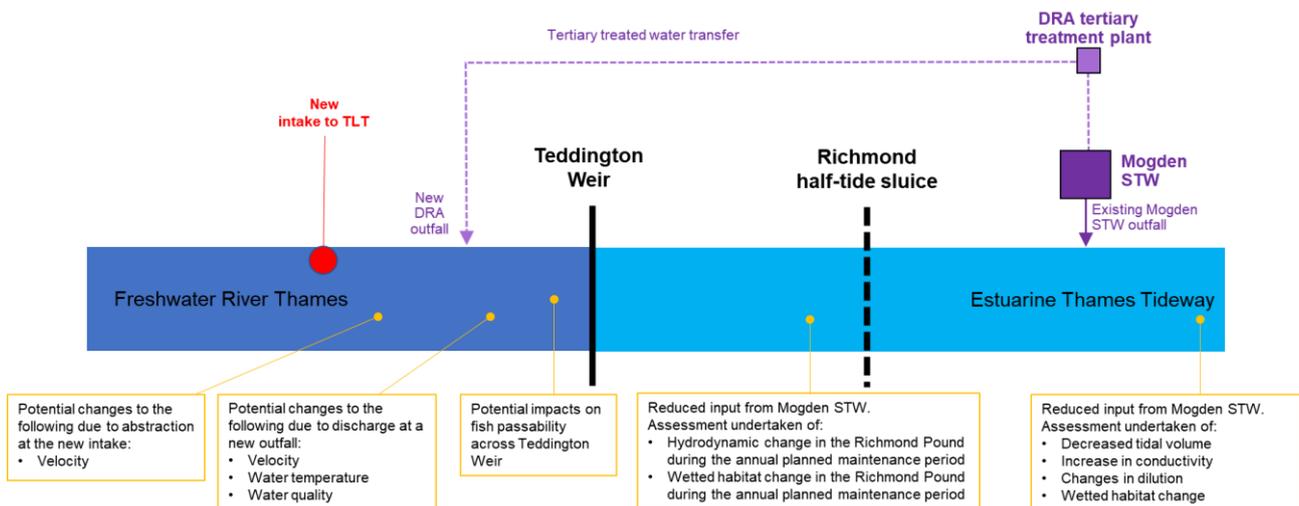
## 2.3 TEDDINGTON DRA SCHEME

A portion of final effluent from Mogden STW would be subject to tertiary treatment at a new tertiary treatment plant at Mogden STW (Figure 2-7). As set out in the Gate 2 Conceptual Design Report<sup>14</sup> for a Teddington DRA scheme, the DRA treatment plant would include the following water treatment processes: ferric sulphate dosing, Nitrifying Sand Filters, Mechanical Cloth Filters and associated backwash and desludging equipment for filter units. The discharge quality associated with the recycled water at Gate 2 is as set out in the Conceptual Design and in the B.2.2 Water Quality Assessment Report.

The treated water would be transferred in a tunnel for discharge into the freshwater River Thames, at an outfall upstream of the tidal limit at Teddington Weir. Additional abstraction for public water supply on a take-and-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 Thames-Lee Tunnel for transfer to Lockwood Reservoir, part of the Lee Valley reservoirs in East London.

The Teddington DRA scheme is to be assessed for Gate 2 at 50 MI/d, 75 MI/d, 100 MI/d and 150 MI/d flow transfer when operational for water resources purposes, with a tunnel maintenance flow of 25% of the applicable rate at all other times. Details of the operating pattern, including ramp-up and ramp-down periods and temporary cessation of transfer to mitigate flood risk are not available at Gate 2.

Figure 2-7 Conceptual Diagram: Teddington DRA Scheme



The scheme components of the Teddington DRA WFD assessment including pipelines and shaft locations can be seen in Figure 2-8 below.

The WFD study area and water bodies under consideration for the Teddington DRA WFD assessment can be seen in Figure 2-9 below.

The water bodies included in this assessment are:

- Thames (Egham to Teddington) (GB106039023232)
- Thames Upper (GB530603911403)

<sup>14</sup> Jacobs (2022) Beckton water recycling SRO: Conceptual Design Report.

Figure 2-8 Teddington DRA Scheme

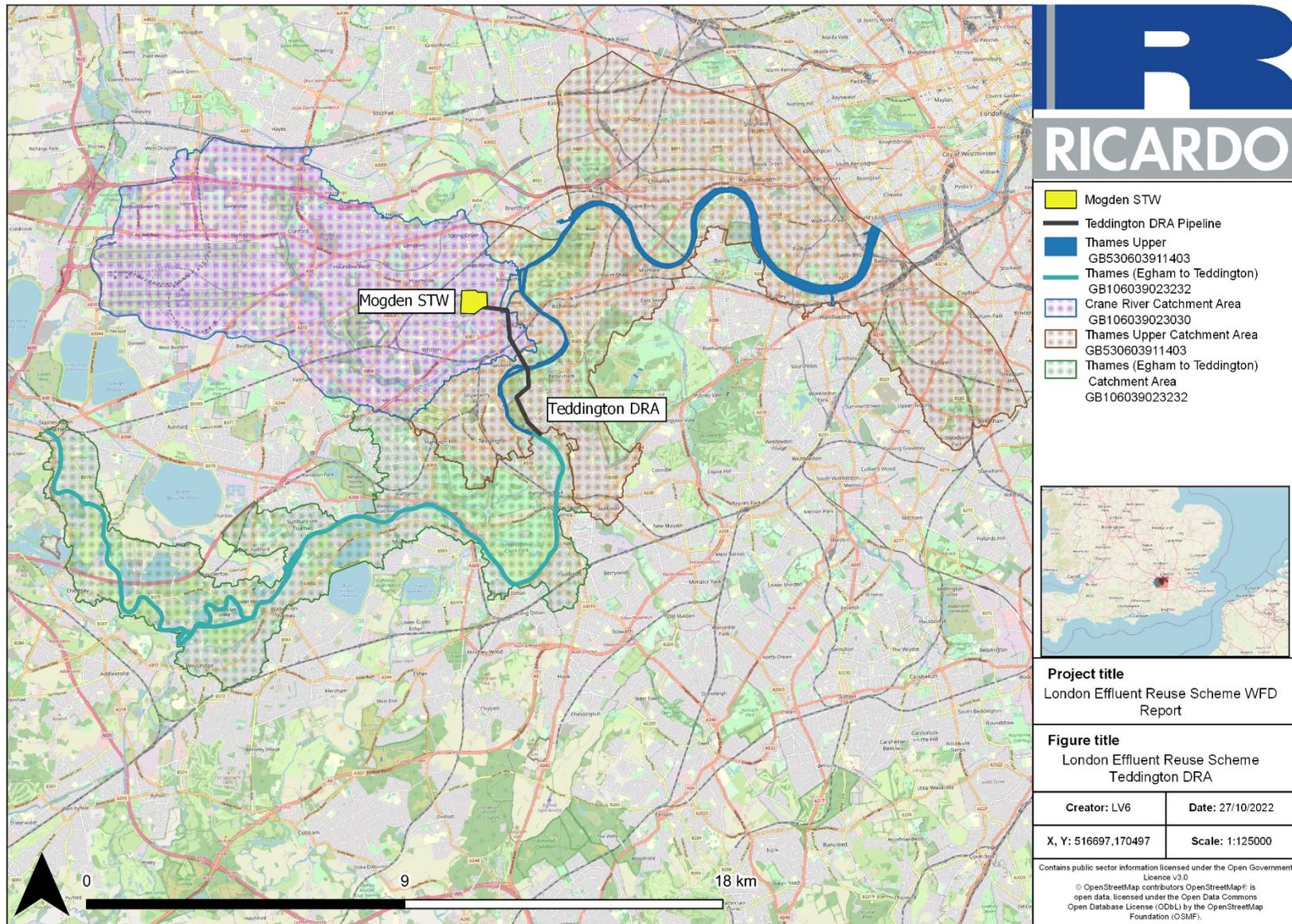
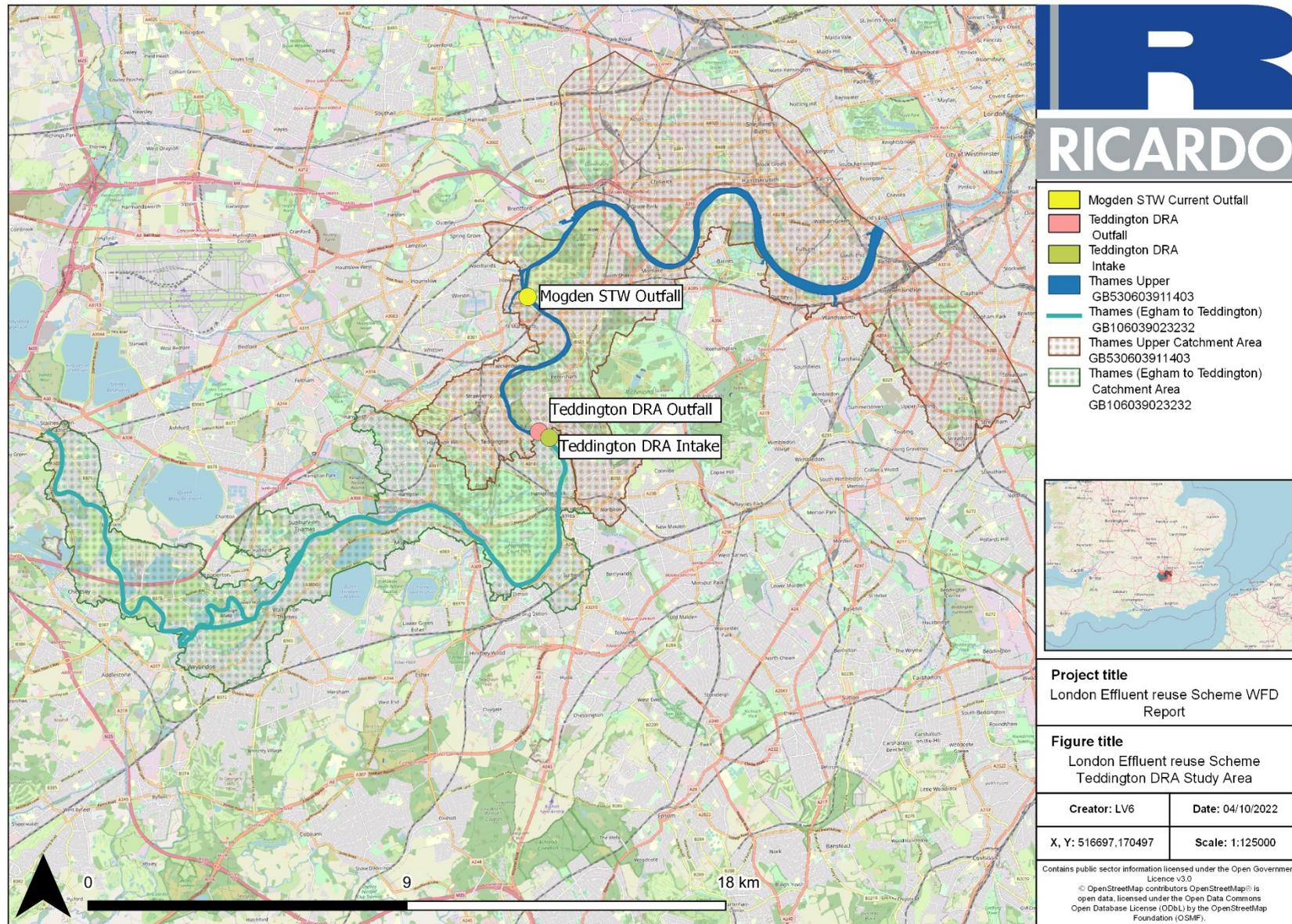


Figure 2-9 Teddington DRA WFD Study Area



## 3. METHODOLOGY

### 3.1 OVERALL APPROACH

The ACWG guidelines set out an assessment approach and accompanying reporting spreadsheet for undertaking tests of WFD Regulations compliance that is required for SROs. Following discussion with the EA during preparation of the WFD Regulations assessment methodology for the Water Resources West group of companies' 2022 Regional Plan, the WFD assessment objectives have been revised. In Gate 2, the London Effluent Reuse schemes will be tested against the principle WFD Assessment Objectives as follows:

The ACWG guidelines identify three WFD objectives for assessing WFD compliance. These are established from Regulation 13 of the WFD Regulation as follows:

1. To prevent deterioration<sup>15</sup> of any WFD element of surface water and groundwater bodies - in line with Regulation 13(2)(a) and 13(5)(a);
2. To prevent the introduction of impediments to the attainment of 'Good' WFD status or potential for any water body in line with Regulation 13(2)(b) and 13(5)(c)<sup>16</sup>; and
3. To ensure that the planned programme of water body measures in River Basin Management Plan (RBMP) 2, to protect and enhance the status of water bodies, are not compromised.

The WFD Assessment Objectives detailed above are the fundamental WFD Assessment Objectives that will be used for testing. All assessments will be undertaken for the reporting unit of a WFD water body. The appropriate baseline information for water bodies status and targets is as set out using 2021 WFD status as published in the third cycle of RBMPs (RBMP3). It is worth noting that the 3rd cycle of RBMP3 is expected to be published later in 2022, however, it is our current understanding<sup>17</sup> that the RBMP3 status, when published, will match the 2019 interim status as currently published. As such, assessments have been undertaken against the 2019 interim status as an indicator of draft RBMP3 status.

There are a number of further WFD Assessment Objectives, set out in the WRPG, which have been reviewed against in the Gate 2 assessment. These are considered as progressive WFD Assessment Objectives to identify opportunities rather than tests of compliance and do not lead to WFD non-compliance of the London Reuse SRO if not achieved. These are as follows:

4. To assist the attainment of the WFD Objectives for the water body – in line with Regulation 13(2)(b) and 13(2)(c);
5. To assist the attainment of the objectives for associated WFD protected areas – in line with Regulation 13(6); and
6. To reduce the treatment needed to produce drinking water and look to work in partnership with others; promoting the requirements of Article 7 of the WFD<sup>18</sup>.

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<sup>15</sup> European Court of Justice (ECJ) ruling

ECJ Case C-461/13: Bund für Umwelt und Naturschutz Deutschland v Bundesrepublik

Deutschland <http://curia.europa.eu/juris/document/document.jsf?docid=178918&mode=req&pageIndex=1&dir=&occ=first&part=1&text=&doclang=EN&cid=175124> [accessed 30.6.16]

clarified that 'no deterioration' means a deterioration **between** a whole 'status class' (e.g. 'good', 'moderate', etc.) of one or more of the relevant 'quality elements' (e.g. biological, physico-chemical, etc.). This definition applies equally to Artificial Water Bodies and Heavily Modified Water Bodies in respect of the relevant quality elements that relate to the defined uses of these water bodies. The ECJ ruling further states that if the quality element concerned is already in the lowest class, any deterioration of that element constitutes a deterioration of the status. References to 'no deterioration' in this WFD methodology align to this ECJ ruling.

<sup>16</sup> WRPG (2021) states that this is a test to identify any options that 'prevent the achievement of the water body status objectives in the river basin management plan'. At present this is RBMP3. Discussion with EA review of EA internal guidance<sup>#1</sup> has identified that the EA consider 'less stringent objectives are not permanent and the assessment of any new activity or project must take into account the need to continue to aim for good status. The new activity or project must not jeopardise the achievement of good status in the future, irrespective of whether a less stringent objective was set in RBMP2'.

<sup>#1</sup> EA (2021) Supporting implementation of river basin management plans position. LIT 14339. 01/2021

<sup>17</sup> As identified to Ricardo by Environment Agency NAU lead for Severn to Thames Transfer SRO (Alison Williams) at WFD assessment approach meeting, 13 December 2021

<sup>18</sup> Specifically set out in WRPG 2021 (updated 17 March 2021) at Section 9.4.5

A negative answer to WFD Assessment Objectives 4-6 above does not determine that the London Effluent Reuse schemes may have WFD compliance risks; however, they can be used in decision making through the Annex B.5. IEA.

Following the ACWG guidelines, activities have been assessed using the Level 1 basic screening to identify potentially affected WFD water bodies and possible impacts based on activities. Using relevant EA guidance<sup>19</sup> most construction activities have been screened out at Level 1 as these would not lead to WFD non-compliance. For each of the WFD water bodies screened into the Level 2 assessment for each grouping the ACWG reporting spreadsheet has been completed and is available as a separate annex, see Table 3.1.

**Table 3.1 Accompanying ACWG assessment spreadsheets to this report**

Filename	Content
Appendix A - WFD_Annex_1__Beckton_Reuse_100MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Beckton water recycling scheme at 100 MI/d</a>
Appendix A - WFD_Annex_1__Beckton_Reuse_200MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Beckton water recycling scheme at 200 MI/d</a>
Appendix A - WFD_Annex_1__Beckton_Reuse_300MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Beckton water recycling scheme at 300 MI/d</a>
Appendix A - WFD_Annex_1__Mogden_Reuse_50MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Mogden water recycling scheme at 50 MI/d</a>
Appendix A - WFD_Annex_1__Mogden_Reuse_100MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Mogden water recycling scheme at 100 MI/d</a>
Appendix A - WFD_Annex_1__Mogden_Reuse_150MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Mogden water recycling scheme at 150 MI/d</a>
Appendix A - WFD_Annex_1__Mogden_Reuse_200MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Mogden water recycling scheme at 200 MI/d</a>
Appendix A - WFD_Annex_1__Teddington_DRA_50MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Teddington DRA Scheme at 50 MI/d</a>
Appendix A - WFD_Annex_1__Teddington_DRA_75MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Teddington DRA Scheme at 75 MI/d</a>
Appendix A - WFD_Annex_1__Teddington_DRA_100MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Teddington DRA Scheme at 100 MI/d</a>
Appendix A - WFD_Annex_1__Teddington_DRA_150MI/d Conveyance (Full Support)	<a href="#">Completed ACWG WFD compliance worksheet for London Reuse Teddington DRA Scheme at 150 MI/d</a>

The Level 2 assessment is a detailed assessment for potential impact on each WFD status element and RBMP2 programme of measures for each WFD water body passed forward from Level 1. The ACWG reporting spreadsheet sets out the published dRBMP3 status of each WFD status element - for assessing elements included in status classification, not supporting elements. This provides the baseline for no deterioration to be established; therefore, supports the assessment of WFD Objective 1. This information also informs the assessment of WFD Objective 2 – for status elements already achieving Good status or their published dRBMP3 target Objective 2 is not required to be tested. The spreadsheet also identifies the published Reasons for Not Achieving Good status assessments undertaken by the EA. The spreadsheet will be used to record the published RBMP2 programme of measures for the water body for the assessment of WFD Objective 3.

<sup>19</sup> Environment Agency Operational Instruction OI 488\_10\_SD01 WFD compliance assessment for new physical modifications

### 3.1.1 Level 1 WFD screening

The Level 1 screening has been completed for all in-river construction works and the combined operating effects of the SRO grouping. For the purposes of this report this considers the activities relating to the discharge of recycled water from each scheme in addition to abstraction of water for potable supply.

For construction activities this includes any intake and outfall construction. The screening does not include pipeline activities. It is noted that within the Level 2 activities assessment that all pipeline activities are scored as 0 or 1 and therefore no pipeline activities pass-forward to the detailed assessment. The ACWG guidance<sup>20</sup> scoring for construction and operational activities are provided in Table 3.2. Generic assumptions and mitigations assumed to be in place during construction and operation are included in the ‘2. Level 1 activities’ sheet of each workbook. This includes water industry good practice. Additional built-in mitigation for the schemes, such as treatment process efficacy is set out at Gate 2 in the Conceptual Design.

The associated evidence and assessments reports which have informed this report include:

- B.2.1. London Effluent Reuse SRO Gate 2 Physical Environment Assessment Report, October 2022
- B.2.2. London Effluent Reuse SRO Gate 2 Environmental Water Quality Assessment Report, October 2022
- B.2.3. London Effluent Reuse SRO Gate 2 Fish Assessment Report, October 2022
- B.2.4. London Effluent Reuse SRO Gate 2 Aquatic Ecology Assessment Report, October 2022.

Table 3.2 ACWG guidance impact scoring for construction and operational activities

Impact	Score	Description
Very beneficial	-2	Impacts that, taken on their own, have the potential to lead to the improvement in the ecological status or potential of a WFD quality element for the entire waterbody
Beneficial	-1	Impacts that, when taken on their own, have the potential to lead to a minor localised or temporary improvement that does not affect the overall WFD status of the waterbody or any quality elements
No/minimal	0	No measurable change in the quality of the water environment or the ability for target WFD objectives to be achieved.
Low	1	Impacts that, when taken on their own, have the potential to lead to a minor localised, short-term and fully reversible effects on one or more of the quality elements but would not result in the lowering of WFD status. Impacts would be very unlikely to prevent any target WFD objectives from being achieved.
Medium	2	Impacts that, when taken on their own, have the potential to lead to a widespread or prolonged effect on the quality of the water environment that may result in the temporary reduction in WFD status. Impacts have the potential to prevent target WFD objectives from being achieved.
High	3	Impacts when taken on their own have the potential to lead to a significant effect and permanent deterioration of WFD status. Potential for high impact on preventing target WFD objectives from being achieved.

### 3.1.2 Level 2 WFD assessment

Within the ACWG template, we note the following style guide to how we have documented the WFD assessment:

<sup>20</sup>Mott Macdonald, 2020, All Company Working Group - Water Framework Directive: Consistent framework for undertaking no deterioration assessments

Within the ACWG spreadsheet template, the following style guide indicates how the WFD assessment has been documented:

- Assessment has been undertaken against draft RBMP3 status (to be finalised following consultation and review period by September 2022<sup>21</sup>). The embedded data in the ACWG spreadsheet template has been updated by manually inputting the draft RBMP3 targets into the spreadsheet to ensure the assessment is up to date. Status targets from previous years are not applicable and have therefore not been assessed against. To ensure that older targets have not been assessed, these have been removed from the ACWG spreadsheet embedded data.
- Where the associated evidence and assessment reports have identified an impact to a WFD status element with no published targets in the draft RBMP3, this impact has still been considered within the Level 2 assessment. This is to ensure a holistic understanding of the potential impacts of the scheme is maintained throughout the assessment. When this is the case, a note stating ‘No Classification in RBMP3’ within the waterbody-specific tabs has been provided.
- The ACWG spreadsheet template includes the objective “Assists attainment of waterbody objectives”. That objective is outside the ACWG guidelines and has not been used in the assessment of the London Effluent Reuse SRO.
- For WFD status elements, in the upper section of the worksheet, the relevant WFD objectives that have been assessed against are “Deterioration between status classes” (Objective 1) and “Impediments to GES (Good Ecological Status)/GEP (Good Ecological Potential)” (Objective 2).
- Where draft RBMP3 reported status is High or Good, Objective 2 is not applicable and has not been assessed against.
- For water body measures, in the lower section of the worksheet, the relevant WFD objective that has been assessed against is “Compromise WB objectives” (Objective 3).
- The relevant WFD status elements for assessment of Objective 1 and Objective 2 in river water bodies are those in the WFD Directions<sup>22</sup>, as listed in Table 3.3.
- The ACWG template includes data from the EA “Reasons for Not Achieving Good” status database. These are not applicable to Objectives 1, 2, or 3 and have not been assessed against.
- For proportionality of assessment, the ACWG spreadsheet template “potential impacts of asset” have been collated for each “activity” with one consolidated assessment undertaken for each WFD status element.
- All assessments have been undertaken using the design and mitigation measures set out for the Gate 2 London Effluent Reuse schemes, as documented in the Conceptual Design Reports. Furthermore, this includes the assumptions/mitigations as set out in the ACWG template which recognise compliance with regulations and good design practice. As such, there is no difference between the “impact” and “post mitigation impact” in the Level 2 assessment worksheet. Where there is potential for WFD objective non-compliance, additional mitigation actions that may reduce this potential and lead to WFD compliance is indicated in the narrative summary in Section 5 below, but not included in the WFD compliance assessment as it is not currently committed to or costed into LRU design.

The 2015 Directions note the reporting of additional substances from 2018. These substances have been given a formal status in draft RBMP3, and a target status for 2027.

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<sup>13</sup> [Draft river basin management plans: 2021 - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/103443/draft-river-basin-management-plans-2021-2027.pdf)

<sup>22</sup> Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

**Table 3.3 Relevant WFD status elements from which to assess compliance in river and transitional water bodies**

<b>Ecological status</b>			
Biological status elements	<b>In river water bodies</b> Invertebrates Macrophytes & phytobenthos combined Fish		<b>In transitional water bodies</b> Angiosperms Fish Invertebrates Macroalgae Phytoplankton
Physio-chemical	<b>In river water bodies</b> Water temperature pH Dissolved oxygen saturation Ammonia (Phys-Chem) Acid neutralizing capacity Reactive phosphorus (orthophosphate)		<b>In transitional water bodies</b> Dissolved Inorganic Nitrogen Dissolved oxygen concentration
Specific pollutants*	2,4-dichlorophenol 2,4-dichlorophenoxyacetic acid 3,4 dichloroaniline Arsenic Benzyl butyl phthalate <i>Carbendazim</i> <i>Chlorothalonil</i> <i>Chromium (III)</i> Chromium (VI) <i>Chlorine</i>	Copper Cyanide Cypermethrin Diazinon Dimethoate Glyphosate Iron Linuron <i>Manganese</i>	Mecoprop <i>Methiocarb</i> <i>Pendimethalin</i> Permethrin Phenol <i>Tetrachloroethane</i> Toluene Triclosan <u>Un-ionised ammonia</u> Zinc
<b>Chemical status</b>			
Priority Substances, Priority Hazardous Substances and Other pollutants contributing to chemical status*	Aclonifen Alachlor Anthracene Atrazine Benzene Benzo(a)-pyrene (BaP) Benzo(b)-fluor-anthene Benzo(k)-fluor-anthene Benzo(g,h,i)-perylene Bifenox Brominated diphenylether Cadmium and its compounds Carbon tetrachloride Chlorfenvinphos C10-13 chloroalkanes Chlorpyrifos Cyclodiene pesticides isodrin Cypermethrin DDT total Para-para-DDT 1,2-dichloroethane Dichloromethane Dichlorovos Di(2-ethylhexyl)-phthalate (DEHP) Dioxins and dioxin-like compounds Diuron Endosulfan	Fluoranthene Heptachlor and cis-Heptachlor epoxide Hexabromocyclododecane (HBCDD) Hexachlorobenzene Hexachlorobutadiene Hexachlorocyclohexane Indeno(1,2,3-cd)-pyrene Isoproturon Lead and its compounds Mercury and its compounds Naphthalene Nickel and its compounds Nonylphenol Octylphenol Pentachlorobenzene Pentachlorophenol Perfluorooctane sulphonate (PFOS) Polybrominated diphenyl ethers (PBDE) Quinoxifen Simazine Terbutryn Tetrachloroethylene Tributyltin compounds Trichlorobenzenes Trichloroethylene Trichloromethane Trifluralin	

\*Those specific pollutants and chemical status elements applicable to river water bodies only are in italics; those for transitional water bodies only are underlined

## 4. SUMMARY OF BASIC LEVEL 1 WFD SCREENING

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### 4.1 INTRODUCTION

For each of the London Effluent Reuse schemes, the ACWG template Level 1 screening comprises the following worksheets completed by Ricardo:

“1. List relevant water bodies” – these are the water bodies in the study area as set out in the conceptualisation below

“2. Level 1 activities” – completed for construction activities and operational activities as set out below

A third worksheet “3. Level 1 summary” is auto-generated by the template to summarise those water bodies to be carried forward to the level 2 assessment.

As the ACWG template does not have specific sections for documenting the reasoning behind the selection of water bodies or activities, relevant description is set out below.

### 4.2 BECKTON WATER RECYCLING SCHEME

#### 4.2.1 Brief overview of study area and water bodies

Further to the outline conceptualisation in Section 2.1, following advanced wastewater treatment, recycled water would be discharged into the freshwater Lee Diversion Channel in the WFD river water body Lea Navigation Enfield Lock to Tottenham Locks (GB106038027950). Abstraction for potable supply, to the same rate as discharged, would be through existing intakes in the same river water body and there would be no transfer of flow to the downstream river water body Lee (Tottenham Locks to Bow Locks/Three Mills Locks) (GB106038077852) at times when the scheme is in operation for water resources purposes. Within the estuarine Thames Tideway in the transitional water body Thames Middle (GB530603911402) there would be reduction in effluent discharge from Beckton STW, to the same rate as the water recycling scheme. Hydrodynamic, temperature, salinity and water quality modelling of the Thames Tideway undertaken bespoke for the London Effluent Reuse SRO at Gate 2 identified a study area in the estuarine Thames Tideway from Beckton water recycling scheme that can be constrained for WFD assessment to the Thames Middle water body.

#### 4.2.2 In-river hydrological effects from construction

##### 4.2.2.1 *Water bodies and activities deemed WFD compliant and not passed forward from Level 1 screen*

No Beckton water recycling scheme construction activities have been passed forward from the Level 1 screening. The range of WFD compliant in-river construction activities associated with this grouping have been documented in the Level 1 spreadsheet:

- Outfall headworks for recycled water outfall in the Enfield Island Loop of the freshwater Lee Diversion.

No Beckton water recycling scheme tunnel construction activities have been passed forward from the Level 1 screening. For this scheme, WFD compliant tunnel activities would occur in nine water bodies. For completeness, these are identified as:

- Lea Navigation Enfield Lock to Tottenham Locks (GB106038027950)
- Middle Thames Catchment Area (GB530603911402)
- Pymmes and Salmon Brookes (GB106038027910)
- Pymmes Brookes Upstream of Salmon Brook (GB106038027940)
- Salmon Brookes Upstream of Deephams STW (GB10603802960)
- Small River Lee (and tributaries) (GB106038033200)
- Lea Navigation Fields Weir to Enfield Lock (GB106038077851)
- Lee (Tottenham Locks to Bow Locks/Three Mills Locks) (GB106038077852)
- Lower Roding (Loughton to Thames) (GB106037028181).f

### 4.2.3 In-river hydrological effects from operation

The B.2.1. Gate 2 Physical Environment assessment report identified appropriate reference conditions for times when a London Effluent Reuse scheme could be utilised (see Section 1.2). The detailed assessment has focused on more regular effects at a 1 in 5 return frequency in a moderate-low flow rate year (A82); and less regular effects at a 1 in 20 return frequency in a very low flow year (M96).

Indicative flow changes in the study reaches are summarised for the 100 MI/d scheme in Table 4.1, 200 MI/d scheme in Table 4.2 and 300 MI/d scheme in Table 4.3 listing the WFD water body and assessment of the magnitude of flow change. The magnitude of flow change has been used to support the selection of the appropriate Level 1 activity category. There are major flow changes in the heavily modified channel of the Enfield Island Loop associated with 100 MI/d, 200 MI/d and 300 MI/d schemes. These affects are seen in the ~100m reach of heavily modified channel of the Enfield Island Loop between a Beckton water recycling scheme outfall and the existing intake to King George V Reservoir. In the remaining ~500m heavily modified reach of the Enfield Island Loop flow effects cannot be quantified as they are entirely dependent on the abstraction regime operated for the Thames Water intakes. This is in the context that derived reference conditions Q95 very low flow is 126 MI/d. However, 126 MI/d is a non-natural flow in the middle reaches of the Lee and Q95 is considered by the Environment Agency as 280 MI/d for an assessment point in the Lee Diversion prior to the Enfield Island Loop offtake channel. At times a Beckton water recycling scheme would be in operation for water resources purposes, the Thames Water operating protocol for the lower Lee intakes would see Flanders Weir closed and all flow in the Lee Diversion Channel abstracted, and no flow passed forward to the downstream Lee Flood Relief Channel. As this is not a change in the pass-forward flow regime, no downstream river water bodies have been included in the Level 1 screening. The magnitude of change assessment is detailed in the B.2.1. Gate 2 Physical Environment assessment report.

Table 4.1 Relevant reaches and associated indicative flow changes from 100 MI/d Beckton water recycling scheme

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to Flanders Weir on the Lee Flood Relief Channel	Lea Navigation Enfield Lock to Tottenham Locks (GB106038027950)	80% increase in very low flows. (Q95) in ~100m reach of Enfield Island Loop between Beckton water recycling outfall and existing King George V Reservoir intake.  0-80% increase in flows D/S in ~500m reach of Enfield Island Loop and D/S Lee Diversion to Flanders Weir. D/S King George V Reservoir intake flows are managed by Thames Water dependent on operating pattern.  D/S Flanders Weir there would be no change in (zero) pass-forward flow to the Lee Flood Relief Channel at times of Beckton water recycling scheme use for water resources purposes.	Major
Estuarine Thames Tideway from Tower Bridge to 3km seawards of Beckton STW	Thames Middle (GB530603911402)	100 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

**Table 4.2 Relevant reaches and associated indicative flow changes from 200 MI/d Beckton water recycling scheme**

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to Flanders Weir on the Lee Flood Relief Channel	Lea Navigation Enfield Lock to Tottenham Locks (GB106038027950)	160% increase in very low flows (Q95) in ~100m reach of Enfield Island Loop between Beckton water recycling outfall and existing King George V Reservoir intake.  0-160% increase in flows D/S in ~500m reach of Enfield Island Loop and D/S Lee Diversion to Flanders Weir. D/S King George V Reservoir intake flows are managed by Thames Water dependent on operating pattern.  D/S Flanders Weir there would be no change in (zero) pass-forward flow to the Lee Flood Relief Channel at times of Beckton water recycling scheme use for water resources purposes.	Major
Estuarine Thames Tideway from Tower Bridge to 3km seawards of Beckton STW	Thames Middle (GB530603911402)	200 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

**Table 4.3 Relevant reaches and associated indicative flow changes from 300 MI/d Beckton water recycling scheme**

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to Flanders Weir on the Lee Flood Relief Channel	Lea Navigation Enfield Lock to Tottenham Locks (GB106038027950)	240% increase in very low flows (Q95) in ~100m reach of Enfield Island Loop between Beckton water recycling outfall and existing King George V Reservoir intake.  0-240% increase in flows D/S in ~500m reach of Enfield Island Loop and D/S Lee Diversion to Flanders Weir. D/S King George V Reservoir intake flows are managed by Thames Water dependent on operating pattern.  D/S Flanders Weir there would be no change in (zero) pass-forward flow to the Lee Flood Relief Channel at times of Beckton water recycling scheme use for water resources purposes.	Major
Estuarine Thames Tideway from Tower Bridge to 3km seawards of Beckton STW	Thames Middle (GB530603911402)	300 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

**4.2.3.1 Water bodies and activities deemed WFD compliant and not passed forward from Level 1 screen**

In operation the abstracted water would supplement abstraction from the Lee Diversion Channel into the Lee Valley Reservoirs. This would include into King George V Reservoir (GB30641523) via the Enfield Intake, William Girling Reservoir (GB30641659) via the Chingford South intake, or into the Chingford Aqueduct and on to either Banbury Reservoir (GB30647003) or High Maynard Reservoir (GB30641884). Abstraction of the Beckton water recycling scheme augmented flows would reduce the rate of drawdown of reservoirs supplied by those intakes, and assist their refill rates. The AWRP would result in better water quality from the Beckton water recycling scheme than the receiving water quality of the Lee Diversion Channel and as there would be no lowering of water level in the operational reservoirs it is considered at Gate 2 that the water recycling

scheme is WFD compliant in reservoirs and no WFD effects have been passed forward from the Level 1 screen.

#### 4.2.3.2 Water bodies and activities passed forward from Level 1 screen as requiring further consideration

For the Gate 2 Beckton water recycling scheme the hydrological assessment identified one WFD river water body passed forward from Level 1 screen as requiring further consideration based on major hydrological effects. The Thames Middle (GB530603911402) transitional water body was also included on a precautionary basis.

Water bodies and relevant activities from the ACWG list are summarised in Table 4.4.

**Table 4.4 Water bodies and activities passed forward from Level 1 screen as requiring further consideration**

Water body	ACWG Listed Activity
Lea Navigation Enfield Lock to Tottenham Locks (GB106038027950)	High volume discharge of water with a quality element of the same WFD status as the receiving water body <sup>23</sup>
Thames Middle (GB530603911402)	New or increased surface water abstraction Cessation of existing discharge to a watercourse <sup>24</sup>

## 4.3 MOGDEN WATER RECYCLING SCHEME

### 4.3.1 Brief overview of study area and waterbodies

Further to the outline conceptualisation in Section 2.2, following advanced treatment, recycled water would be discharged into the freshwater River Thames in the WFD river water body Thames (Egham to Teddington) (GB106039023232). Abstraction for potable supply, to the same rate as discharged, would be through existing intakes in the same river water body. There would be no change in the rate of pass-forward flow from the freshwater River Thames to the estuarine Thames Tideway in the downstream transitional water body Thames Upper (GB530603911403) ) at times when the scheme is in operation for water resources purposes. Within that transitional water body there would be reduction in effluent discharge from Mogden STW, to the same rate as the reuse scheme. Hydrodynamic, temperature, salinity and water quality modelling of the estuarine Thames Tideway undertaken bespoke for the London Effluent Reuse SRO at Gate 2 identified a study area in the Thames Tideway that can be constrained for WFD assessment to the Thames Upper water body.

### 4.3.2 In-river hydrological effects from construction

#### 4.3.2.1 Water bodies and activities deemed WFD compliant and not passed forward from Level 1 screen

No Mogden water recycling scheme construction activities have been passed forward from the Level 1 screen. The range of WFD compliant in-river construction activities associated with this grouping have been documented in the Level 1 spreadsheet:

- Outfall headworks for recycled water outfall in the freshwater River Thames.

No Mogden water recycling scheme pipeline construction activities have been passed forward from the Level 1 screen. For completeness, for this scheme, WFD compliant pipeline activities would occur in six water bodies, identified as:

- Thames (Egham to Teddington) (GB106039023232)
- Portlane Brook (GB106039023451)
- Crane (GB106039023030)
- Surrey Ash (GB106039023480)
- Lower Duke of Northumberland's River (GB806100095)
- Longford River (GB806100109).

<sup>23</sup> It is noted that the ACWG listed activity "High volume discharge of water with a quality element of a lower WFD status than the receiving water body", which is a truer reflection of the Beckton water recycling scheme discharge, scores -2 and would be screened as WFD compliant at Level 1. The high rates of discharge warrants inclusion in Level 2 and as such the "same WFD status" listed activity has been selected.

<sup>24</sup> Note that this is the most applicable ACWG listed activity. The Beckton STW discharge would not cease, but be reduced by the scheme.

### 4.3.3 In-river hydrological effects from operation

The B.2.1. Gate 2 Physical Environment assessment report identified appropriate reference conditions for times when a London Effluent Reuse scheme could be utilised (see Section 1.2). The detailed assessment has focused on more regular effects at a 1 in 5 return frequency in a moderate-low flow rate year (A82); and less regular effects at a 1 in 20 return frequency in a very low flow year (M96).

Indicative flow changes in the study reaches are summarised in Table 4.5, Table 4.9, Table 4.7 and Table 4.8 listing the WFD water body and assessment of the magnitude of flow change. The magnitude of flow change has been used to support the selection of the appropriate Level 1 activity category. The Mogden water recycling scheme may lead to minor to moderate impact on the river flows compared to baseline conditions. However, these changes are negligible when considering the impacts to the water level depth and average flow velocities. At times a Mogden water recycling scheme would be in operation for water resources purposes, all augmented flow would be abstracted at one of Thames Water’s downstream intakes. The greatest flow changes would be in the reach to the first of these intakes, the Walton intake. A proportion of the augmented flow would likely be retained to the next intake, the Hampton intake. As water abstracted at the Hampton intake is transferred to the Lee Valley Reservoirs via the Thames-Lee Tunnel, the relative split between abstraction at Walton and Hampton would be part dependent on storage locally in the Lee Valley Reservoirs. It is less likely that a proportion of the augmented flow would be retained to the last intake, the Surbiton intake. The licensed abstraction rate at the Surbiton intake is low and at those low flows in the River Thames which would associate with operation of a Mogden water recycling scheme, it is likely to already be at capacity in order to maximise abstraction of flows added by the River Mole, within the conditions of the Lower Thames Operating Agreement.

Table 4.5 Relevant reaches and associated indicative flow changes from a 50 MI/d Mogden water recycling scheme

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to normal tidal limit at Teddington Weir (freshwater)	Thames (Egham to Teddington) (GB106039023232)	5% increase in very low flows (Q95) with main flow increase affecting 3.4km reach (Walton Bridge outfall to Walton intake).	Minor
Estuarine Thames Tideway from Teddington Weir to Battersea Park	Thames Upper (GB530603911403)	50 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

Table 4.6 Relevant reaches and associated indicative flow changes from a 100 MI/d Mogden water recycling scheme

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to normal tidal limit at Teddington Weir (freshwater)	Thames (Egham to Teddington) (GB106039023232)	11% increase in very low flows (Q95) with main flow increase affecting 3.4km reach (Walton Bridge outfall to Walton intake).	Minor
Estuarine Thames Tideway from Teddington Weir to Battersea Park	Thames Upper (GB530603911403)	100 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

**Table 4.7 Relevant reaches and associated indicative flow changes from a 150 MI/d Mogden water recycling scheme**

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to normal tidal limit at Teddington Weir (freshwater)	Thames (Egham to Teddington) (GB106039023232)	150 MI/d - 16% increase in very low flows (Q95) with main flow increase affecting 3.4km reach (Walton Bridge outfall to Walton intake).	Moderate
Estuarine Thames Tideway from Teddington Weir to Battersea Park	Thames Upper (GB530603911403)	150 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

**Table 4.8 Relevant reaches and associated indicative flow changes from a 200 MI/d Mogden water recycling scheme**

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to normal tidal limit at Teddington Weir (freshwater)	Thames (Egham to Teddington) (GB106039023232)	200 MI/d - 21% increase in very low flows (Q95) with main flow increase affecting 3.4km reach (Walton Bridge outfall to Walton intake).	Moderate
Estuarine Thames Tideway from Teddington Weir to Battersea Park	Thames Upper (GB530603911403)	200 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

**4.3.3.1 Water bodies and activities deemed WFD compliant and not passed forward from Level 1 screen**

In operation the recycled water would increase water available for abstraction at the existing Thames Water intakes on the River Thames at Walton, Hampton and Surbiton.

Increased rate of abstraction at the Walton and Surbiton intakes would reduce the rate of drawdown of reservoirs supplied by those intakes, and assist their refill rates. However, as the water quality in those reservoirs would remain that of the lower River Thames and there would be no lowering of water level in the operational reservoirs it is considered at Gate 2 that the water recycling scheme is WFD compliant in reservoirs and no WFD effects have been passed forward from the Level 1 screen. For completeness the WFD artificial lake water bodies that are the storage reservoirs are listed as:

- Knight Reservoir (GB30642791)
- Bessborough Reservoir (GB30642779)
- Island Barn Reservoir (GB30642841)
- Queen Elizabeth 2 Storage Reservoir (GB30642813)

The Hampton intake provides water into Lockwood Reservoir (GB30641865), one of the Walthamstow Reservoirs in the lower Lee catchment. Increased rate of transfer into that reservoir would reduce residence times in a reservoir that is typically maintained full. However, as the water quality would remain that of the lower River Thames and there would be no changes in water level in the operational reservoir, it is considered at Gate 2 that any augmented transfer is WFD compliant and no WFD effects have been passed forward from the Level 1 screen.

**4.3.3.2 Water bodies and activities passed forward from Level 1 screen as requiring further consideration**

The Mogden water recycling scheme the hydrological assessment identified one WFD water river body passed forward from Level 1 screen as requiring further consideration based on major or moderate hydrological effects. The Thames Upper (GB530603911403) transitional water body was also included for water quality considerations.

Water bodies and relevant activities from the ACWG list are summarised in Table 4.9.

Table 4.9 Water bodies and activities passed forward from Level 1 screen as requiring further consideration for the Mogden water recycling scheme

Water body	ACWG Listed Activity
Thames (Egham to Teddington) (GB106039023232)	High volume discharge of water with a quality element of the same WFD status as the receiving water body <sup>25</sup>
Thames Upper	New or increased surface water Cessation of existing discharge to a watercourse <sup>26</sup>

## 4.4 TEDDINGTON DRA SCHEME

### 4.4.1 Brief overview of study area and waterbodies

Further to the outline conceptualisation in Section 2.3, abstraction for potable supply, to the same rate as discharged locally downstream, would be through a new intake from the freshwater River Thames in the WFD river water body Thames (Egham to Teddington) (GB106039023232). Following additional tertiary treatment, recycled water would be discharged into the same river water body a short distance (~250m) downstream of the abstraction prior to the end of that water body. There would be no change in the rate of pass-forward flow from the freshwater River Thames to the estuarine Thames Tideway in the downstream transitional water body Thames Upper (GB530603911403) at times when the scheme is in operation for water resources purposes, but there may be changes to the water temperature and water quality passed forward. Within that transitional water body there would be reduction in effluent discharge from Mogden STW, to the same rate as the reuse scheme. Hydrodynamic, temperature, salinity and water quality modelling of the estuarine Thames Tideway undertaken bespoke for London Effluent Reuse SRO at Gate 2 identified a study area in the Thames Tideway that can be constrained for WFD assessment to the Thames Upper water body.

### 4.4.2 In-river hydrological effects from construction

#### 4.4.2.1 Water bodies and activities deemed WFD compliant and not passed forward from Level 1 screen

No Teddington DRA scheme construction activities have been passed forward from the Level 1 screen. The range of WFD compliant in-river construction activities associated with this grouping have been documented in the Level 1 spreadsheet:

- Intake headwork in the freshwater River Thames
- Outfall headworks for recycled water outfall in the freshwater River Thames.

No Teddington DRA scheme pipeline construction activities have been passed forward from the Level 1 screen. For this scheme, WFD compliant pipeline activities would occur in three water bodies. For completeness, these are identified as:

- Thames (Egham to Teddington) (GB106039023232)
- Crane (GB106039023030)
- Lower Duke of Northumberland's River (GB806100095).

### 4.4.3 In-river hydrological effects from operation

The B.2.1. Gate 2 Physical Environment assessment report identified appropriate reference conditions for times when a London Effluent Reuse scheme could be utilised (see Section 1.2). The detailed assessment has focused on more regular effects at a 1 in 5 return frequency in a moderate-low flow rate year (A82); and less regular effects at a 1 in 20 return frequency in a very low flow year (M96).

Indicative flow changes in the study reaches are summarised in Table 4.10, Table 4.11, Table 4.12 and Table

<sup>25</sup> It is noted that the ACWG listed activity "High volume discharge of water with a quality element of a lower WFD status than the receiving water body", which is a truer reflection of the Mogden water recycling scheme discharge, scores -2 and would be screened as WFD compliant at Level 1. The high rates of discharge warrants inclusion in Level 2 and as such the "same WFD status" listed activity has been selected.

<sup>26</sup> Note that this is the most applicable ACWG listed activity. The Mogden STW discharge would not cease, but be reduced by the scheme.

4.13 listing the WFD water body and assessment of the magnitude of flow change. The magnitude of flow change has been used to support the selection of the appropriate Level 1 activity category. Teddington DRA schemes may lead to up to a moderate reduction in flow compared to be baseline conditions in the ~250m of the freshwater River Thames between intake and outfall. However, these changes are negligible when considering impacts to water level, depth and flow velocities at those flows when the scheme would be operational for water resources purposes.

Table 4.10 Relevant reaches and associated indicative flow changes from a 50 MI/d Teddington DRA scheme

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to normal tidal limit at Teddington Weir (freshwater)	Thames (Egham to Teddington) (GB106039023232)	50 MI/d - 17% reduction in exceptionally low flows for 250m between intake and outfall (300 MI/d U/S of intake)	Moderate
Estuarine Thames Tideway from Teddington Weir to Battersea Park	Thames Upper (GB530603911403)	50 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

Table 4.11 Relevant reaches and associated indicative flow changes from a 75 MI/d Teddington DRA scheme

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to normal tidal limit at Teddington Weir (freshwater)	Thames (Egham to Teddington) (GB106039023232)	75 MI/d - 25% reduction in exceptionally low flows for 250m between intake and outfall (300 MI/d U/S of intake).	Moderate
Estuarine Thames Tideway from Teddington Weir to Battersea Park	Thames Upper (GB530603911403)	75 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

Table 4.12 Relevant reaches and associated indicative flow changes from 100 MI/d Teddington DRA scheme

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to normal tidal limit at Teddington Weir (freshwater)	Thames (Egham to Teddington) (GB106039023232)	100 MI/d - 33% reduction in exceptionally low flows for 250m between intake and outfall (300 MI/d U/S of intake)	Major
Estuarine Thames Tideway from Teddington Weir to Battersea Park	Thames Upper (GB530603911403)	100 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

**Table 4.13 Relevant reaches and associated indicative flow changes from 150 MI/d Teddington DRA scheme**

Study reach	WFD water body	Flow change during operation	Assessed magnitude of flow change
Reuse outfall to normal tidal limit at Teddington Weir (freshwater)	Thames (Egham to Teddington) (GB106039023232)	150 MI/d - 50% reduction in exceptionally low flows for 250m between intake and outfall (300 MI/d U/S of intake)	Major
Estuarine Thames Tideway from Teddington Weir to Battersea Park	Thames Upper (GB530603911403)	150 MI/d STW effluent flow reduction into dynamic tidal system when scheme operational for water resources purposes.	Negligible

**4.4.3.1 Water bodies and activities deemed WFD compliant and not passed forward from Level 1 screen**

In operation the abstracted water would supplement water in the Thames-Lee Tunnel abstracted at Thames Water’s Hampton intake on the River Thames and collectively provide water into Lockwood Reservoir (GB30641865), one of the Walthamstow Reservoirs in the lower Lee catchment. Increased rate of transfer into that reservoir would reduce residence times in a reservoir that is typically maintained full. However, as the water quality would remain that of the lower River Thames and there would be no changes in water level in the operational reservoir, it is considered at Gate 2 that the augmented transfer is WFD compliant and no WFD effects have been passed forward from the Level 1 screen.

**4.4.4 Water bodies and activities passed forward from Level 1 screen as requiring further consideration**

For the Gate 2 Teddington DRA scheme the hydrological assessment identified no WFD water bodies passed forward from Level 1 screen as requiring further consideration based on major or moderate hydrological effects. The Thames (Egham to Teddington) (GB106039023232) water body and Thames Upper (GB530603911403) water bodies were included for water quality considerations.

Water bodies and relevant activities from the ACWG list are summarised in Table 4.14.

**Table 4.14 Water bodies and activities passed forward from Level 1 screen as requiring further consideration**

Water body	ACWG Listed Activity
Thames (Egham to Teddington) (GB106039023232)	New or increased surface water abstraction High volume discharge of water with a quality element of the same WFD status as the receiving body
Thames Upper (GB530603911403)	Cessation of existing discharge to a watercourse <sup>27</sup>

<sup>27</sup> Note that this is the most applicable ACWG listed activity. The Mogden STW discharge would not cease, but be reduced by the scheme.

## 5. SUMMARY OF LEVEL 2 WFD ASSESSMENT

### 5.1 INTRODUCTION

For each of the London Effluent Reuse schemes, the ACWG template Level 2 assessment comprises the following worksheets completed by Ricardo:

“4. Assign Level2 WB Impacts” – these are the specific activities to be assessed per water body. For consistency, these have been selected as those reported in worksheet “2. Level 1 activities” and set out in Section 4 above.

“5. Level 2 assessment template” – a copy of this template has been set out for each of the water bodies carried forward to the Level 2 assessment and these are renamed as the water body ID code.

A third worksheet “6. Level 2 summary” is auto-generated by the template to summarise the per water body level 2 assessments.

Using the information presented in the spreadsheets, a narrative description of the WFD assessment for each grouping is provided below. In particular, the narrative provides information on the confidence in the assessment – the data confidence and the design certainty. Where the assessment reports identify potential for WFD objective non-compliance, additional mitigation actions that may reduce this potential and lead to WFD compliance is indicated in the narrative summary.

### 5.2 BECKTON WATER RECYCLING SCHEME

#### 5.2.1 300 MI/d Beckton water recycling scheme

The 300 MI/d Beckton water recycling scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.1, this is in two specific water bodies.

Table 5.1 Gate 2 WFD assessment summary – 300 MI/d Beckton water recycling scheme

Water body	WFD compliant against assessed WFD objectives
Lea Navigation Enfield Lock to Tottenham Lock (GB106038027950)	Yes (medium confidence)
Thames Middle (GB530603911402)	Yes (medium confidence)

##### 5.2.1.1 Discussion of potential non-compliance with WFD objectives in Lea Navigation Enfield Lock to Tottenham Lock (GB106038027950)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body, there is potential for major (240%) increases in very low (Q95) flows in approximately 100m of the Enfield Island Loop. It is important to note that the Environment Agency’s CAMS assessment has a flow increase of 300 MI/d on the measured Q95 as consistent with a moderate low flow of Q65. As the channel is steep sided and the wetted width complete, there would be no change in water width from flow increase. The level control by weirs in the reach is recorded through survey to not result in water level change at this magnitude of flow change. However, there would be a Moderate change (0.23m/s increase) in mean flow velocity in ~100m reach of heavily modified channel of the Enfield Island Loop at very low flow conditions.

Downstream in the 500m of the heavily modified Enfield Island Loop, and beyond that in the artificial Lee Diversion Channel (to Flanders Weir) the magnitude of flow change is not known as it is dependent on Thames Water’s abstraction pattern, determined by operational circumstances. A 0-240% increase in flow is possible. However, it is noted that these flows are constantly changing, without a stable flow regime, and that the channel is heavily modified in the Enfield Island Loop, and artificial in the Lee Diversion Channel.

In line with the B.2.2. Gate 2 Water Quality Assessment Report approach for this water body a Beckton water recycling scheme at 300 MI/d may have negligible changes in the general physico-chemical environment compared to the baseline conditions of the freshwater Enfield Island Loop of the Lee Diversion Channel. Negligible temperature change is expected with this scheme size. 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. The in-river assessment at Gate 2 assumes no addition of chemicals.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, localised impacts on invertebrates may exceed the tolerable range due to increased flows and discharge resulting in favourable conditions for species with greater tolerance. It may also be the case that the increase in marginal wetted area could provide additional habitat for invertebrates during scheme operation. Temperature change (a predicted reduction), oxygen impact and ammonia are not likely to exceed tolerable range therefore negligible impacts for invertebrates. For marginal habitat assessment overall, there is a decrease in preliminary condition score but remains in 'Fairly poor' category. Macrophytes may change to favour populations with a preference for faster flowing water in the ~100m reach of the Enfield Island Loop. Temperature changes are likely to have minor to no significant impact on macrophyte populations and oxygen and phosphorus changes likely to have a minor positive impact. Major increases in very low flows ~100m of the Enfield Island Loop have the potential to increase fitness and available habitat for diatoms of high motility species and potential for adverse impact to species with low motility. No impacts on diatoms from oxygen saturation and phosphorus are expected.

From the B.2.3. Gate 2 Fish Assessment report, it is evident that the localised changes in flow are considered to be of a magnitude to affect only the juvenile fish communities within the Enfield Island Loop, which may result in temporary changes to species distribution and create potential barriers to migratory juvenile European eel within the Enfield Island Loop and the Lee Diversion Channel to the Chingford Abstraction. The results of the water quality modelling indicate that temperature changes (a predicted reduction) 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.

#### 5.2.1.2 Discussion of potential non-compliance with WFD objectives in Thames Middle (GB530603911402)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body there are no anticipated impacts to tidal water level or changes to intertidal exposure from the 300 MI/d reduction in Beckton STW flow.

The B.2.2. Gate 2 Water Quality Assessment report demonstrates that water temperature in the middle Thames Tideway would not change as consequence of reduced discharge from Beckton STW discharge. For Dissolved Inorganic Nitrogen (DIN), the scheme on period only overlaps with WFD status time periods during early November (for the A82 the 1 in 5 year moderate-low flow year) and during this time is indicative of 'good' status. However, the 1 in 20 very low flow year (M96) WFD status improves to 'good' status. There are negligible salinity increases under both scenarios.

In line with the B.2.2. Gate 2 Water Quality Assessment Report approach for this water body, a Beckton water recycling scheme at 300 MI/d is predicted to have negligible changes on WFD chemicals. Fifteen chemicals were recorded by the Gate 2 monitoring programme to have values exceeding the mean EQS for tidal waters in the discharge of Beckton STW, with a further two potentially re-concentrated by the AWRP process water to on occasion have values above the mean EQS. These are identified as potential risks. It must again 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.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, velocity, intertidal exposure and oxygen concentration are not expected to impact the water body. There is a negligible impact on macroalgae as well and no potential impacts identified for designated and protected sites and species.

The B.2.4. Gate 2 Aquatic Ecology Assessment Report findings show that the scheme has a negligible impact on phytoplankton.

From the results of the B.2.3. Gate 2 Fish Assessment report, it is evident that the potential changes in STW effluent flow input are not considered to be of a magnitude to affect the fish communities within the Thames Tideway. There are also no predicted impacts upon temperature within the Thames Tideway and thus no predicted impacts upon the estuarine fish community. One additional WFD chemical (dissolved mercury) are at risk of increasing to exceed the standard, though the extent to which these chemicals will impact the estuarine fish community is not yet understood. However, several olfactory inhibitors have been conservatively highlighted as increasing in concentration (but not load) in the Beckton STW discharge, including dissolved copper, cypermethrin, permethrin, pirimicarb and dissolved zinc which may impact olfaction.

### 5.2.2 200 MI/d Beckton water recycling scheme

The 200 MI/d Beckton water recycling scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.2, this is in two specific water bodies.

**Table 5.2 Gate 2 WFD assessment summary – 200 MI/d Beckton water recycling scheme**

Water body	WFD compliant against assessed WFD objectives
Lea Navigation Enfield Lock to Tottenham Lock (GB106038027950)	Yes (medium confidence)
Thames Middle (GB530603911402)	Yes (medium confidence)

**5.2.2.1 Discussion of potential non-compliance with WFD objectives in Lea Navigation Enfield Lock to Tottenham Lock (GB106038027950)**

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body, there is potential for major (160%) increases in very low (Q95) flows in approximately 100m of the Enfield Island Loop. It is important to note that the Environment Agency’s CAMS assessment has a flow increase of 200 MI/d on the measured Q95 as consistent with a low flow of Q85. As the channel is steep sided and the wetted width complete, there would be no change in water width from flow increase. The level control by weirs in the reach is recorded through survey to not result in water level change at this magnitude of flow change. However, there would be a Moderate change (0.15m/s increase) in mean flow velocity in ~100m reach of heavily modified channel of the Enfield Island Loop at very low flow conditions.

Downstream in the 500m of the heavily modified Enfield Island Loop, and beyond that in the artificial Lee Diversion Channel (to Flanders Weir) the magnitude of flow change is not known as it is dependent on Thames Water’s abstraction pattern, determined by operational circumstances. A 0-160% increase in flow is possible. However, it is noted that these flows are constantly changing, without a stable flow regime, and that the channel is heavily modified in the Enfield Island Loop, and artificial in the Lee Diversion Channel.

In line with the B.2.2. Gate 2 Water Quality Assessment Report approach for this water body a Beckton water recycling scheme at 200 MI/d may have negligible changes in the general physico-chemical environment compared to the baseline conditions of the freshwater Enfield Island Loop of the Lee Diversion Channel. Negligible temperature change is expected with this scheme size. 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. The in-river assessment at Gate 2 assumes no addition of chemicals.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology are inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, negligible impacts on fish from the potential changes in flow, ammonia and temperature, although temperature decreases below the mixing zone could impact community structure. Flows are considered to be of a magnitude to affect only the juvenile fish communities within the Enfield Island Loop, which may result in temporary changes to species distribution and potential barriers to migratory juvenile European eel within the Enfield Island Loop and the Lee Diversion Channel to the Chingford Abstraction.

**5.2.2.2 Discussion of potential non-compliance with WFD objectives in Thames Middle (GB530603911402)**

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body there are no anticipated impacts to tidal water level or changes to intertidal exposure.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report less impacts than the detailed 300 MI/d assessment which concluded negligible impacts.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology are inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, negligible impacts on fish from the potential changes in flow, ammonia and temperature, although several olfactory inhibitors have been highlighted including dissolved copper, cypermethrin, permethrin, pirimicarb and dissolved zinc.

**5.2.3 100 MI/d Beckton water recycling scheme**

The 100 MI/d Beckton water recycling scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.3, this is in two specific water bodies.

Table 5.3 Gate 2 WFD assessment summary – 100 MI/d Beckton water recycling scheme

Water body	WFD compliant against assessed WFD objectives
Lea Navigation Enfield Lock to Tottenham Lock (GB106038027950)	Yes (medium confidence)
Thames Middle (GB530603911402)	Yes (medium confidence)

**5.2.3.1 Discussion of potential non-compliance with WFD objectives in Lea Navigation Enfield Lock to Tottenham Lock (GB106038027950)**

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body, there is potential for major (80%) increases in very low (Q95) flows in approximately 100m of the Enfield Island Loop. It is important to note that the Environment Agency’s CAMS assessment has a flow increase of 100 MI/d on the measured Q95 as consistent with an extremely low flow of Q99. As the channel is steep sided and the wetted width complete, there would be no change in water width from flow increase. The level control by weirs in the reach is recorded through survey to not result in water level change at this magnitude of flow change. However, there would be a Moderate change (0.08m/s increase) in mean flow velocity in ~100m reach of heavily modified channel of the Enfield Island Loop at very low flow conditions.

Downstream in the 500m of the heavily modified Enfield Island Loop, and beyond that in the artificial Lee Diversion Channel (to Flanders Weir) the magnitude of flow change is not known as it is dependent on Thames Water’s abstraction pattern, determined by operational circumstances. A 0-80% increase in flow is possible. However, it is noted that these flows are constantly changing, without a stable flow regime, and that the channel is heavily modified in the Enfield Island Loop, and artificial in the Lee Diversion Channel.

In line with the B.2.2. Gate 2 Water Quality Assessment Report approach for this water body a Beckton water recycling scheme at 100 MI/d may have negligible changes in the general physico-chemical environment compared to the baseline conditions of the freshwater Enfield Island Loop of the Lee Diversion Channel. 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. The in-river assessment at Gate 2 assumes no addition of chemicals.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, negligible impacts on fish from the potential changes in flow, ammonia and temperature, although temperature decreases below the mixing zone could impact community structure. Flows are considered to be of a magnitude to affect only the juvenile fish communities within the Enfield Island Loop, which may result in temporary changes to species distribution and potential barriers to migratory juvenile European eel within the Enfield Island Loop and the Lee Diversion Channel to the Chingford Abstraction.

**5.2.3.2 Discussion of potential non-compliance with WFD objectives in Thames Middle (GB530603911402)**

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body there are no anticipated impacts to tidal water level or changes to intertidal exposure.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report less impacts than the detailed 300 MI/d assessment which concluded negligible impacts.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, negligible impacts on fish from the potential changes in flow, ammonia and temperature, although several olfactory inhibitors have been highlighted including dissolved copper, cypermethrin, permethrin, pirimicarb and dissolved zinc.

## 5.3 MOGDEN WATER RECYCLING SCHEME

### 5.3.1 200 MI/d Mogden water recycling scheme

The 200 MI/d Mogden water recycling scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.4 this is in two specific water bodies.

Table 5.4 Gate 2 WFD assessment summary – 200 Ml/d Mogden water recycling scheme

Water body	WFD compliant against assessed WFD objectives
Thames (Egham to Teddington) (GB106039023232)	Yes (medium confidence)
Thames Upper (GB530603911403)	Yes (medium confidence)

5.3.1.1 Discussion of potential non-compliance with WFD objectives in River Thames (Egham to Teddington) (GB106039023232)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body, there is potential for moderate increases (21%) in very low (Q95) flows affecting a reach of approximately 3.4km from the Walton Bridge outfall to the Thames Water Walton intake. For operational reasons, it is rare or unlikely that there would be change in flow further than 5.4km downstream, after the Thames Water Hampton intake. With respect to wetted habitat there are very minor increase in flow velocity at Sunbury weir pool but no likely change at Molesey Weir.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report approach for this water body a Mogden water recycling scheme at 200 Ml/d may have negligible changes in temperature compared to the baseline conditions. Negligible temperature change is expected with this scheme size.

With respect to the general physico-chemical environment compared to the baseline conditions of the River Thames, the process in the AWRP would treat the recycled water of the Mogden water recycling scheme to a very high standard with only traces of ammonia and BOD and c0.04mg/l phosphorus. As such the Gate 2 time-series 1D modelling of the 1 in 5 year moderate-low flow year (A82) flow scenario shows quality improvements for dissolved oxygen saturation, ammoniacal nitrogen and phosphorus. No change is anticipated in pH although re-mineralisation is noted to require further review in Gate 3. For the 1 in 20 year (M96) very low flow year scenario predicted impacts mirror the 1 in 5 year predictions.

The reverse osmosis process in the AWRP would treat the recycled water of the Mogden water recycling scheme such that the discharge would be without chemicals, except those added by the re-mineralisation process. The in-river assessment at Gate 2 assumes no addition of chemicals.

Consistent with B.2.4. Gate 2 Aquatic Ecology Assessment Report, for aquatic invertebrates the localised increased flows at discharge outfall may exceed the tolerable range of some species, favouring species with general tolerance. However, velocity increases appear to be limited to the surface of the watercourse therefore the impact to the benthic invertebrate community may be limited and impact is expected to be minor. Temperature increases not likely to exceed tolerable range and a possible increase in metabolic rates of species present. Changes in oxygen saturation and ammonia may have minor positive impacts for some invertebrates furthermore, pH changes are not likely to exceed tolerable range. For the marginal habitat assessment, no changes were reported to the assessment site (TR\_01) upstream of Mogden water recycling scheme outfall. Minor positive changes were reported to indicator scores for the assessment site (TR\_02) due to increased hydraulic feature richness, with the river condition assessed to increase in this location. No assessed changes were reported to indicators at the assessment sites (TR\_03, TR\_04, TR\_05, TR\_06, TR\_07 or TR\_08) downstream of the outfall.

For plants/diatoms, velocity and flow has the potential for localised impacts due to increased flow at the outfall, with the potential to increase fitness and habitat availability for diatom species with high motility within the area of the outfall. In areas locally downstream of the outfall with reduced velocity (as indicated in the modelling), there will likely be minor adverse impact on diatom communities with low motility. Any minor temperature increase will favour diatoms with greater tolerance and oxygen saturation changes are likely to have negligible impact.

From the results of the B.2.3. Gate 2 Fish Assessment Report, it is evident that the potential changes in flow or local velocity are not considered to be of a magnitude to affect the resident fish communities within the freshwater River Thames, though they may result in temporary changes to species distribution. However, localised increase in velocity 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.

The results of the water quality modelling indicate that the water quality and temperature changes within the freshwater River Thames are not 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. The

area of flow change falls within the WFD Lower Thames Operational Catchment, which is formed by 17 water bodies and includes the Thames (Egham to Teddington) water bodies<sup>28</sup>. The current WFD status of temperature within these water bodies is moderate which for WFD salmonid waters<sup>29</sup> equates to river temperature as a 98 %tile not exceeding 28°C . For river temperature to achieve good status then river temperature as a 98 %tile should not exceed 23°C. As Mogden STW final effluent temperature does not exceed 23°C the Mogden water recycling scheme effluent is not predicted to exceed that temperature and as such there may be benefits to reducing maximum water temperatures in the River Thames from scheme operation.

Impacts to fish behaviour may also extend to migratory species such as Atlantic salmon and sea trout, where avoidance of warmer waters may prevent upstream migration due to the extent of cross-sectional impacts at the discharge location. These impacts are likely to be dependent upon the ambient temperature in the wider River Thames. 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 tolerant of warmer climates may show increased success compared to species indicative of colder climates, this may lead to localised changes to the community structure downstream of the recycled water outfall.

The results of the HR Wallingford thermal plume modelling indicate that the 200 MI/d scheme at 780 MI/d river flow scenario (25m downstream of the outfall) 47.2% of the River Thames channel is affected by the plume. As the plume under these model scenarios exceeds 25% then these scheme sizes are non-compliant with current Environment Agency thermal plume guidance. As such, it is likely that under these scenarios both Atlantic salmon and sea trout will be impacted by the Mogden water recycling scheme of 200 MI/d for limited periods of time under rare flow conditions. Temperature impacts in relation to migratory *Lampetra sp.* are not considered to be an issue given that they are warm water Lusitanian species.

Modelled increases in dissolved oxygen are not likely to effect fish communities in the freshwater River Thames, similarly modelled improvements in ammonia is not likely to impact the freshwater fish population.

#### 5.3.1.2 Discussion of potential non-compliance with WFD objectives in Thames Upper (GB530603911403)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body there are no anticipated impacts to tidal water level or changes to intertidal exposure from the 200 MI/d reduction in Mogden STW flow.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report approach for this water body a Mogden water recycling scheme at 200 MI/d may have minor changes in temperature compared to the baseline conditions. A minor temperature reduction of approximately 1°C is expected at this scheme size, though it is noted that there is no standard for temperature in transitional and coastal water bodies. Minor increases in dissolved oxygen concentration are predicted for this water body, of up to 0.5mg/l.

The scheme on period only overlaps with WFD status time period during early November for the 1 in 5 year moderate-low flow year (A82) and during this time is indicative of 'good' status (1<sup>st</sup> Nov – 28<sup>th</sup> Feb). While the scheme overlaps with WFD status time period during November to mid-December and for a few days in January for the 1 in 20 very low flow year (M96) during this time is also indicative of 'good' status. Overall, DIN status within the estuarine Thames Tideway from Mogden effluent is of 'good' status under both scenarios.

In line with the B.2.2. Gate 2 Water Quality Assessment Report approach for this water body, a Mogden water recycling scheme at 200 MI/d is predicted to have negligible changes on WFD chemicals. Seven chemicals were recorded by the Gate 2 monitoring programme to have values exceeding the mean EQS for tidal waters in the discharge of Mogden STW, with a further eight potentially re-concentrated by the AWRP process water to on occasion have values above the mean EQS. These are identified as potential risks. For three chemicals: hexachloro-cyclohexane, PFOS and cypermethrin tracer modelling indicates that there may be elevated concentrations over a longer length area of the upper Tideway with a 200MI/d Mogden water recycling scheme than modelled reference conditions. However, it is acknowledged that this remains a small proportion of the water body length and that overall the scheme is set out at Gate 2 to operate for 19% of time overall. Such factors are important to consider when assessing risk of status deterioration or risk of jeopardising achieving targets. It must again 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. Of the

<sup>28</sup> <https://environment.data.gov.uk/catchment-planning/>

<sup>29</sup> The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015

three named chemicals, dRBMP3 status for cypermethrin in this water body is Fail; for hexachloro-cyclohexane and PFOS it is Good.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, no impact is predicted for aquatic invertebrates due to velocity or intertidal exposure. The temperature change is also not likely to impact these populations, though as noted above there is no temperature standard in transitional and coastal water bodies. Oxygen concentration impacts are not expected to decrease to be below ‘Good’ standard and therefore no impacts on ecological communities are predicted. There is predicted to be a negligible macroalgae impact.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, the impact on phytoplankton is negligible.

From the B.2.3. Gate 2 Fish Assessment report, it is evident that the potential changes in velocity are not considered to be of a magnitude to affect the resident fish communities within the Thames Tideway, though they may result in temporary changes to species distribution. However, localised increase in velocity 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. Additionally the potential changes in flows are not likely to result in impacts to migratory species associated with the Thames Estuary. There are no predicted adverse impacts upon temperature within the Upper Tideway and thus no predicted impacts upon the estuarine fish community.

Benefits to dissolved oxygen are not likely to affect fish communities in the estuarine Thames Tideway. A number of WFD chemicals and specific pollutants have been identified as at risk of increasing in concentration and may exceed standards through operation of 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 as increasing in concentration (but not load) in the Mogden STW discharge including dissolved copper, cypermethrin, permethrin, pirimicarb and dissolved zinc which may impact olfaction in the estuarine Thames Tideway.

### 5.3.2 150 MI/d Mogden water recycling scheme

The 150 MI/d Mogden water recycling scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.5 this is in two specific water bodies.

Table 5.5 Gate 2 WFD assessment summary - 150 MI/d Mogden water recycling scheme

Water body	WFD compliant against assessed WFD objectives
Thames (Egham to Teddington) (GB106039023232)	Yes (medium confidence)
Thames Upper (GB530603911403)	Yes (medium confidence)

#### 5.3.2.1 Discussion of potential non-compliance with WFD objectives in River Thames (Egham to Teddington) (GB106039023232)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body, there is potential for moderate increases (16%) in very low (Q95) flows affecting a reach of approximately 3.4km from the Walton Bridge outfall to the Thames Water Walton intake. For operational reasons, it is rare or unlikely that there would be change in flow further than 5.4km downstream at the Thames Water Hampton intake. With respect to wetted habitat there are very minor increase in flow velocity at Sunbury weir pool but no likely change at Molesey weir.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment.

#### 5.3.2.2 Discussion of potential non-compliance with WFD objectives in Thames Upper (GB530603911403)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment.

### 5.3.3 100 MI/d Mogden water recycling scheme

The 100 MI/d Mogden water recycling scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.6 this is in two specific water bodies.

Table 5.6 Gate 2 WFD assessment summary - 100 MI/d Mogden water recycling scheme

Water body	WFD compliant against assessed WFD objectives
Thames (Egham to Teddington) (GB106039023232)	Yes (medium confidence)
Thames Upper (GB530603911403)	Yes (medium confidence)

#### 5.3.3.1 Discussion of potential non-compliance with WFD objectives in River Thames (Egham to Teddington) (GB106039023232)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body, there is potential for minor increases (11%) in very low (Q95) flows affecting a reach of approximately 3.4km from the Walton Bridge outfall to the Thames Water Walton intake. For operational reasons, it is rare or unlikely that there would be change in flow further than 5.4km downstream at the Thames Water Hampton intake. With respect to wetted habitat there are very minor increase in flow velocity at Sunbury weir pool but no change at Molesey weir.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment.

#### 5.3.3.2 Discussion of potential non-compliance with WFD objectives in Thames Upper (GB530603911403)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment.

### 5.3.4 50 MI/d Mogden water recycling scheme

The 50 MI/d Mogden water recycling scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.7 this is in two specific water bodies.

Table 5.7 Gate 2 WFD assessment summary - 50 MI/d Mogden water recycling scheme

Water body	WFD compliant against assessed WFD objectives
Thames (Egham to Teddington) (GB106039023232)	Yes (medium confidence)
Thames Upper (GB530603911403)	Yes (medium confidence)

**5.3.4.1 Discussion of potential non-compliance with WFD objectives in River Thames (Egham to Teddington) (GB106039023232)**

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body, there is potential for minor increases (5%) in very low (Q95) flows affecting a reach of approximately 3.4km from the Walton Bridge outfall to the Thames Water Walton intake. For operational reasons, it is rare or unlikely that there would be change in flow further than 5.4km downstream at the Thames Water Hampton intake. With respect to wetted habitat there are very minor increases in flow velocity at Sunbury weir pool but no change at Molesey weir.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment. Overall the changes to flows predicted are not likely to result in a change to the fish community overall, but may result in minor changes to species distribution in the immediate vicinity of the discharge outfall during operation.

**5.3.4.2 Discussion of potential non-compliance with WFD objectives in Thames Upper (GB530603911403)**

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 200 MI/d assessment.

**5.4 TEDDINGTON DRA SCHEME**

**5.4.1 150 MI/d Teddington DRA scheme**

The Teddington DRA Scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.10 this is in two specific water bodies.

Table 5.8 Gate 2 WFD assessment summary - 150 MI/d Teddington DRA scheme

Water body	WFD compliant against assessed WFD objectives
Thames (Egham to Teddington) (GB106039023232)	Yes (medium confidence)
Thames Upper (GB530603911403)	Yes (medium confidence)

**5.4.1.1 Discussion of potential non-compliance with WFD objectives in River Thames (Egham to Teddington) (GB106039023232)**

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body, there is potential for moderate reductions (50%) in exceptionally low flows of 300 MI/d that could occur on a 1 in 20 return frequency, for 250m between the intake and outfall. At other times of operation, for water resources purposes, river flows would be higher (400-700 MI/d) and the proportion flow change between the DRA intake and outfall would be lower. Negligible change in water level or flow is anticipated at any location in the water body. Negligible change to suspended sediment is expected and no change to fish passage at Teddington Weir are predicted.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, the Teddington DRA scheme may lead to minor changes in the general physico-chemical environment compared to the baseline conditions. The magnitude of change assessed is very low and if assessed locally, rather than at a water body scale, would not be expected to lead to class deterioration for any physico-chemical status elements. Nor would the change

be considered locally as impeding target for the two physico-chemical status elements less than GES in the water body: phosphorus and water temperature.

It again 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. The dRBMP3 identifies failures in this water body for PFOS, Polybrominated diphenyl ethers (PBDE), Tributyltin Compounds and Cypermethrin. Under the 1 in 5 moderate-low flow year (A82) scenario the assessment concludes an increase in pressure for six WFD chemicals, leading to a potential risk of non-compliance. Whilst under the 1 in 20 very low flow year (M96) scenario the assessment concludes an increase in pressure for 10 WFD chemicals, leading to a potential risk of non-compliance. It should be noted that water quality effects have been assessed before any treatment from an advanced treatment plant that would occur prior to discharge to the freshwater Thames via the DRA outfall. Assessment using the Gate 2 measured dataset indicates the potential for an increase in concentration of Cypermethrin from scheme operation. As this is dependent on river flows and concentrations at the time of discharge and influenced by the duration of operation (19% of time overall) this is not necessarily consistent with scheme WFD non-compliance. A further seven WFD chemicals associate at Gate 2 with increased concentration in the River Thames from a 150 MI/d Teddington DRA scheme - noting that this is a modelled risk assessment of increase in values above the long term (average) EQS rather than a statement that the overall mean value would increase above the EQS. It should be noted that chemical water quality effects have been assessed without inclusion of any reduction from the tertiary treatment plant.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, velocity and flow, oxygen saturation and pH are not likely to have an impact on aquatic invertebrates and the temperature increases are not likely to exceed tolerable range. In the marginal habitat assessment, there is an overall decrease in preliminary condition score but remains in the 'Fairly poor' category. For macrophyte populations, there are potential adverse impacts on macrophyte species already close to tolerance threshold for low flows in the 250m between intake and outfall. The local temperature increase will favour species with greater tolerance range and the oxygen saturation and pH changes are not expected to have an impact. Impacts on diatoms as a result of changes in flow and velocity from this scheme are expected to be limited and localised. Temperature changes may favour diatoms with greater tolerance range, but impacts are not expected. Oxygen saturation and pH changes not expected to impact diatom populations.

From the B.2.3. Gate 2 Fish Assessment report, it is evident that the potential changes in velocity and flow, oxygen saturation and pH are not likely to have an impact on fish and the temperature increases are not likely to exceed tolerable range. Temperature increases close to the discharge outfall of up to 10.4°C (maximum temperature difference, at times of 37.5 MI/d maintenance flow and high river flows only) are likely to result in impacts to the behaviour of fish species dependent upon the temperature of the wider River Thames, during colder periods a warmer effluent may act to attract species whereas in warmer periods increase temperatures at the outfall may elicit avoidance behaviours. Maximum temperature changes of 2.2°C below the mixing zone are modelled and would result in minor changes to metabolic rate, embryonic development and hatch rate of most species. In summary the scheme may result in minor changes to the fitness of cold-water species such as minnow, perch, pike and roach but beneficial to species belonging to warm water guilds such as bleak, common bream, chub and tench.

#### *5.4.1.2 Discussion of potential non-compliance with WFD objectives in Thames Upper (GB530603911403)*

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body there are no anticipated impacts to tidal water level or changes to intertidal exposure from the 150 MI/d reduction in Mogden STW flow (or 37.5 MI/d during plant maintenance periods).

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report approach for this water body a Teddington DRA scheme at 15 MI/d may have minor changes in temperature compared to the baseline conditions. A maximum temperature increase of approximately 2.2°C was modelled at this scheme size, noting this is an increase in cooler autumn temperatures and not an increase in maximum temperatures. Temperature increases associate with the DRA discharge and potentially affect the upper Richmond Pound. There are also temperature reductions associated with final effluent flow rate reduction at the Mogden STW outfall at Isleworth Ait. It is noted that there is no standard for temperature in transitional and coastal water bodies. Minor increases in dissolved oxygen concentration are predicted for this water body associated with final effluent flow rate reduction at the Mogden STW outfall at Isleworth Ait.

The scheme on period only overlaps with WFD status time period during early November for the 1 in 5 year moderate-low flow year (A82) and during this time is indicative of 'good' status (1<sup>st</sup> Nov – 28<sup>th</sup> Feb). While the scheme overlaps with WFD status time period during November to mid-December and for a few days in

January for the 1 in 20 very low flow year (M96) during this time is also indicative of ‘good’ status. Overall, DIN status within the estuarine Thames Tideway from Mogden effluent is of ‘good’ status under both scenarios.

The tertiary treatment unit from the Teddington DRA scheme would not return liquid process wastes to Mogden STW for mixing into the final effluent stream. As consequence the concentration of WFD chemicals or olfactory inhibitors in the Mogden STW final effluent would remain as per reference conditions. However, as the discharge flow rate would reduce by 150 MI/d (or 37.5 MI/d during plant maintenance periods) the total load discharged in Mogden STW final effluent would reduce.

Consistent with B.2.4. Gate 2 Aquatic Ecology Assessment Report, velocity and flow changes are not expected to have an impact on aquatic invertebrate species. Oxygen concentrations are not expected to have significant impacts on invertebrates. Assessment of dissolved inorganic nitrogen (DIN) indicates concentrations to decrease. There is no available macrophyte data. A negligible macroalgae impact is predicted. A negligible impact on phytoplankton is also predicted.

From the B.2.3. Gate 2 Fish Assessment report, it is evident that the potential changes in velocity are not considered to be of a magnitude to affect the resident fish communities within the Thames Tideway, though they may result in temporary changes to species distribution. However, localised increase in velocity 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. Additionally the potential changes in flows are not likely to result in impacts to migratory species associated with the Thames Estuary. There are no predicted adverse impacts upon temperature within the Upper Tideway and thus no predicted impacts upon the estuarine fish community

#### 5.4.2 100 MI/d Teddington DRA scheme

The Teddington DRA Scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.9 this is in two specific water bodies.

Table 5.9 Gate 2 WFD assessment summary - 100 MI/d Teddington DRA scheme

Water body	WFD compliant against assessed WFD objectives
Thames (Egham to Teddington) (GB106039023232)	Yes (medium confidence)
Thames Upper (GB530603911403)	Yes (medium confidence)

##### 5.4.2.1 Discussion of potential non-compliance with WFD objectives in River Thames (Egham to Teddington) (GB106039023232)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body, there is potential for moderate reductions (33%) in exceptionally low flows of 300 MI/d that could occur on a 1 in 20 return frequency, for 250m between the intake and outfall. At other times of operation, for water resources purposes, river flows would be higher (400-700 MI/d) and the proportion flow change between the DRA intake and outfall would be lower. Negligible change in water level or flow is anticipated at any location in the water body. Similarly, no change to suspended sediment or impacts to fish passage at Teddington Weir are predicted.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded minor impacts.

Consistent with the B.2.4. Gate 2 Aquatic Ecology Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

##### 5.4.2.2 Discussion of potential non-compliance with WFD objectives in Thames Upper (GB530603911403)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body there are no anticipated impacts to tidal water level or changes to intertidal exposure from the 100 MI/d reduction in Mogden STW flow (or 25 MI/d during plant maintenance periods).

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

Consistent with B.2.4. Gate 2 Aquatic Ecology Assessment Report, velocity and flow changes are not expected to have an impact on aquatic invertebrate species. Oxygen concentrations are not expected to have significant impacts on invertebrates. Assessment of dissolved inorganic nitrogen (DIN) indicates concentrations to decrease. There is no available macrophyte data. A negligible macroalgae impact is predicted. Consistent with the B.2.4 Gate 2 Aquatic Ecology Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

### 5.4.3 75 MI/d Teddington DRA scheme

The Teddington DRA Scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.10 this is in two specific water bodies.

Table 5.10 Gate 2 WFD assessment summary - 75 MI/d Teddington DRA scheme

Water body	WFD compliant against assessed WFD objectives
Thames (Egham to Teddington) (GB106039023232)	Yes (medium confidence)
Thames Upper (GB530603911403)	Yes (medium confidence)

#### 5.4.3.1 Discussion of potential non-compliance with WFD objectives in River Thames (Egham to Teddington) (GB106039023232)

Consistent with the B.2.1 Gate 2 Physical Environment Assessment Report for this water body, there is potential for moderate reductions (16%) in exceptionally low flows of 300 MI/d that could occur on a 1 in 20 return frequency, for 250m between the intake and outfall. At other times of operation, for water resources purposes, river flows would be higher (400-700 MI/d) and the proportion flow change between the DRA intake and outfall would be lower. Negligible change in water level or flow is anticipated at any location in the water body. Similarly, no change to suspended sediment or impacts to fish passage are predicted.

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded minor impacts.

Consistent with the Gate 2 Aquatic Ecology Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

#### 5.4.3.2 Discussion of potential non-compliance with WFD objectives in Thames Upper (GB530603911403)

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body there are no anticipated impacts to tidal water level or changes to intertidal exposure from the 75 MI/d reduction in Mogden STW flow (or 18.75 MI/d during plant maintenance periods).

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

Consistent with the Gate 2 Aquatic Ecology Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

### 5.4.4 50 MI/d Teddington DRA scheme

The Teddington DRA Scheme has been assessed to determine compliance with WFD objectives. As summarised in Table 5.11 this is in two specific water bodies.

Table 5.11 Gate 2 WFD assessment summary - 50 MI/d Teddington DRA scheme

Water body	WFD compliant against assessed WFD objectives
Thames (Egham to Teddington) (GB106039023232)	Yes (medium confidence)
Thames Upper (GB530603911403)	Yes (medium confidence)

#### 5.4.4.1 *Discussion of potential non-compliance with WFD objectives in River Thames (Egham to Teddington) (GB106039023232)*

Consistent with the B.2.1 Gate 2 Physical Environment Assessment Report for this water body, there is potential for moderate reductions (11%) in exceptionally low flows of 300 MI/d that could occur on a 1 in 20 return frequency, for 250m between the intake and outfall. At other times of operation, for water resources purposes, river flows would be higher (400-700 MI/d) and the proportion flow change between the DRA intake and outfall would be lower. Negligible change in water level or flow is anticipated at any location in the water body. Similarly, no change to suspended sediment or impacts to fish passage are predicted.

Consistent with the B.2.2 Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded minor impacts.

Consistent with the B.2.4 Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

#### 5.4.4.2 *Discussion of potential non-compliance with WFD objectives in Thames Upper (GB530603911403)*

Consistent with the B.2.1. Gate 2 Physical Environment Assessment Report for this water body there are no anticipated impacts to tidal water level or changes to intertidal exposure from the 50 MI/d reduction in Mogden STW flow (or 12.5 MI/d during plant maintenance periods)..

Consistent with the B.2.2. Gate 2 Water Quality Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

Consistent with the B.2.4 Gate 2 Aquatic Ecology Assessment Report, negligible impacts on aquatic ecology inferred from larger schemes.

Consistent with the B.2.3. Gate 2 Fish Assessment Report, impacts are expected to be less than those detailed for the 150 MI/d assessment, which concluded negligible impacts.

## 6. CONCLUSIONS AND RECOMMENDATIONS

The specific RAPID requirements of WFD Assessment at Gate 2<sup>30</sup> are set out as five points:

1. Screening
2. Options assessment
3. Consideration of mitigation measures and monitoring to reduce uncertainty of impacts and support identification of potential mitigation
4. Gather evidence to meet a Regulation 19 exemption, if applicable
5. Provide a plan to gather further evidence for gate three.

For each of the Gate 2 London Effluent Reuse SRO schemes individually, the Gate 1 WFD assessments have been updated. The Gate 2 WFD assessment has incorporated additional evidence (including monitoring), and updated design (including mitigation measures) as per Requirement 3 above. The Gate 2 WFD assessment has been undertaken to the appropriate levels using the ACWG methodology which included Level 1 Screening and Level 2 Options assessment, as per Requirements 1 and 2 above. These are documented in this report and its accompanying Excel workbooks. The conclusions of these assessments, documented in this section, do not identify the need for consideration of a Regulation 19 exemption<sup>31</sup>. As such Requirement 4 above is not covered in this Gate 2 report. The Requirement 5 for plans for evidence collection are set out in each of the supporting Gate 2 Assessment Reports and are summarised specific to each scheme in this recommendation section below.

This assessment is of the London Effluent Reuse SRO at Gate 2 using the scheme design information appropriate for Gate 2 and the environmental evidence and assessment undertaken at Gate 2. The assessment will be refined during Gate 3 and statements made here on WFD compliance should be considered as appropriate to assessing feasibility, a requirement of Gate 2, and not as definitive or final statements on WFD compliance.

It is noted at Gate 2 that this report forms part of a progressive assessment whereby the conclusions at Gate 1 have been re-evaluated with the inclusion of extra data and evidence. It is a strategic assessment undertaken in line with the ACWG methodology for WFD assessments of SROs. In Gate 3, as the London Effluent Reuse schemes move away from strategic assessment towards planning, the WFD assessment will move towards that suitable for accompanying an application<sup>32</sup>.

The assessment undertaken is against the three WFD compliance objectives set out in Section 3.1 that are used to test potentially adverse effects of the schemes (objectives 1-3). The assessment at Gate 2 has not identified any specific opportunities to assist with objectives 4-6.

### 6.1 BECKTON WATER RECYCLING SCHEME

An assessment has been undertaken of the WFD compliance of a Beckton water recycling scheme sized at 100 MI/d, 200 MI/d or 300 MI/d.

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 potential for status deterioration or introducing impediments to target status were identified in the Thames Middle (GB530603911402) transitional water body from effluent flow reductions. It must be noted that WFD water body status is assigned by the Environment Agency and that the impact on WFD chemicals informs

<sup>30</sup> As listed in Section 6.1 of RAPID Gate 2 Guidance dated April 2022

<sup>31</sup> It is noted that a Regulation 19 assessment is applicable to schemes that result in modifications to physical characteristics of water bodies that do not comply with WFD requirements, and is not applicable to non-compliance with WFD chemical requirements.

<sup>32</sup> PINS Advice Note Eighteen on Water Framework Directive.

<https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-18/>

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.

This assessment has been supported by bespoke modelled and measured data on pathways of impact and have a medium confidence at Gate 2.

Where a Beckton water recycling scheme is selected for continuation through the RAPID Gated process, the recommendations for further evidence collection set out in the Assessment Reports inform the plan for Gate 3 evidence collection for reducing uncertainties. Noting that further scheme design, additional model development and model scenarios are recommended for Gate 3; the further evidence environmental evidence collection in support of the WFD assessment is set out as:

- The B.2.1 Gate 2 Physical Environment Assessment Report identified that no additional physical evidence collection is considered to be required to further verify these assessments. 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 B.2.2. Gate 2 Environmental Water Quality Assessment Report recommended to continue with the spot water quality monitoring programme for WFD chemicals and continuous physico-chemical water quality monitoring programme at monitoring points in the Beckton STW final effluent (the source water for a Beckton water recycling scheme) and the Enfield Island Loop (the receiving water).
- The B.2.3. Gate 2 Fish Assessment Report recommended the continued use of eDNA in the Lee Diversion Channel to resolve evidence of presence of sea lamprey (recorded as *Petromyzontidae* SP.) and potentially river lamprey (recorded as *Lampetra* sp.) in order to support further assessment. The Gate 2 Fish Assessment Report also recommended the continued use of eDNA in the middle Thames Tideway to resolve the presence of twaite shad (*Alosa fallax*) in order to support further assessment.
- The B.2.4. Gate 2 Aquatic Ecology Assessment Report recommended the continuation of invertebrate and phytoplankton surveys in the Thames Tideway in order to support further assessment.

## 6.2 MOGDEN WATER RECYCLING SCHEME

An assessment has been undertaken of the WFD compliance of a Mogden water recycling scheme sized at 50 MI/d, 100 MI/d, 150 MI/d or 200 MI/d.

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. 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.

This assessment has been supported by bespoke modelled and measured data on pathways of impact and have a medium confidence at Gate 2.

Where a Mogden water recycling scheme is selected for continuation through the RAPID Gated process, the recommendations for further evidence collection set out in the Assessment Reports inform the plan for Gate 3 evidence collection for reducing uncertainties. Noting that further scheme design, additional model development and model scenarios are recommended for Gate 3; the further evidence environmental evidence collection in support of the WFD assessment is set out as:

- The B.2.1 Gate 2 Physical Environment Assessment Report identified that no additional physical evidence collection is considered to be required to further verify these assessments.
- The B.2.2. Gate 2 Environmental Water Quality Assessment Report recommended to continue with the spot water quality monitoring programme for WFD chemicals and continuous physico-chemical water quality monitoring programme at monitoring points in the Mogden STW final effluent (the source

water for a Mogden water recycling scheme) and the River Thames at Walton Bridge (the receiving water).

- The B.2.3. Gate 2 Fish Assessment Report recommended the continued use of eDNA in the lower River Thames to resolve evidence of presence of sea lamprey (recorded as *Petromyzontidae* SP.) and potentially river lamprey (recorded as *Lampetra* sp.) in order to support further assessment.
- The B.2.4. Gate 2 Aquatic Ecology Assessment Report recommended the continuation of invertebrate and phytoplankton surveys in the Thames Tideway in order to support further assessment.

### 6.3 TEDDINGTON DRA SCHEME

An assessment has been undertaken of the WFD compliance of a Teddington DRA scheme sized at 50 MI/d, 75 MI/d, 100 MI/d or 150 MI/d.

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 75 MI/d scheme size. 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 confidence at Gate 2.

Where a Teddington DRA scheme is selected for continuation through the RAPID Gated process, the recommendations for further evidence collection set out in the Assessment Reports inform the plan for Gate 3 evidence collection for reducing uncertainties. Noting that further scheme design, additional model development and model scenarios are recommended for Gate 3; the further evidence environmental evidence collection in support of the WFD assessment is set out as:

- The B.2.1 Gate 2 Physical Environment Assessment Report identified that no additional physical evidence collection is considered to be required to further verify these assessments.
- The B.2.2. Gate 2 Environmental Water Quality Assessment Report recommended to continue with the spot water quality monitoring programme for WFD chemicals and continuous physico-chemical water quality monitoring programme at monitoring points in the Mogden STW final effluent (the source water for a Teddington DRA scheme) and the River Thames at Teddington (the receiving water).
- The B.2.3. Gate 2 Fish Assessment Report recommended the continued use of eDNA in the lower River Thames to resolve evidence of presence of sea lamprey (recorded as *Petromyzontidae* SP.) and potentially river lamprey (recorded as *Lampetra* sp.) in order to support further assessment.
- The B.2.4. Gate 2 Aquatic Ecology Assessment Report recommended the continuation of invertebrate and phytoplankton surveys in the Thames Tideway in order to support further assessment.



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