Draft Water Resources Management Plan 2024

Technical Appendix BB – Invasive Non-Native Species Risk Assessment

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1 Introduction

1.1 Background and context

Thames Water is the UK's largest water and wastewater services company, it supplies 2.6 billion litres of drinking water per day and treats 4.7 billion litres of wastewater per day. It is responsible for the public water supply and wastewater treatment for most of Greater London, Luton, the Thames Valley, Surrey, Gloucestershire, north Wiltshire, and far west Kent. The area covered by Thames Water has a population of 15 million, that comprise 27% of the UK population.

Water companies have a statutory obligation to produce a Water Resources Management Plan (WRMP). The WRMP sets out how a company intends to achieve a secure supply of water for customers while protecting and enhancing the environment over a minimum 25-year period. The plans must be prepared every 5 years and reviewed annually. Thames Water's WRMP 2024 (WRMP24) renews the previous WRMP published in 2019.

1.2 Scope of this report

The scope of this report is to identify and evaluate the potential for the 34 options within the WRMP24 Best Value Plan (BVP) or Least Cost (LC) and Best Environment and Society (BES) plans to spread invasive non-native species (INNS) – plants and animals which can spread, and cause harm to the environment and cost to the economy[1] .

The aims of this assessment are to:

- Undertake a high-level ‘Level 1 screening’ of options in the WRMP24 BVP/LC/BES
- Use the results of the Level 1 screening to identify options requiring a more detailed assessment
- For those options initially assessed as having a Low, Medium, or High risk - undertake a more detailed ‘Level 2 assessment’
- Present the results of the Strategic Resource Option (SRO) assessments in order to document the INNS risk of all options

A Level 1 screening was undertaken in order to highlight INNS transfer risk during operation, and to identify options requiring a more detailed assessment. Options with a Level 1 screening result presenting a Low, Medium or High INNS risk were put forward for further assessment in the form of a more detailed Level 2 assessment. The Level 1 screening was applied to all 23 non-SRO options. This followed the same methodology as the high-level INNS screening undertaken at Water Resources South East (WRSE), and screening results for individual options were reviewed for the purpose of this assessment.

The remaining 11 options are SROs, which were subject to Level 2 assessments as part of Gate 2 of the Regulators’ Alliance for Progressing Infrastructure Development (RAPID) gated assessment scheme. Level 2 INNS assessments for SROs have thus been assessed in separate studies, and the results are included in this report.

[1] GB Non-Native Species Secretariat, 2022. *Non-native species.* [online] Available at: <https://www.nonnativespecies.org/non-native-species/> [Accessed 29 September 2022].

1.3 WRMP24 Option Descriptions

Assessments have been carried out for options selected under Situation 4 of the planning process. The 34 option descriptions are shown in Table 1.1: WRMP24 options. below.

Table 1.1: WRMP24 options.

Option ID	Option name	Option Description
TWU_SWX_HI-IMP_SWX_ALL_wessextoswoxflax	Wessex Water to SWOX (Flaxlands)	Transfer 2.9Ml/d from Wessex Water to Flaxlands - one new main from Minety service reservoir (SR) (Wessex) to Flaxlands SR (TW), also included is the transfer main from Charlton water treatment works (WTW) to Minety SR
TWU_SWX_HI-TFR_HEN_ALL_henley-swox5	Henley to SWOX – 5 Ml/d	The option is for one new main from New Farm SR (Henley) to Nettlebed SR (SWOX) - this will require a new 5.9km, 350mm diameter main from New Farm to Nettlebed and a new pumping station at New Farm. 5Ml/d capacity
TWU_SWX_HI-TFR_SWA_ALL_tw(swa)to(swx)con	Thames Water (SWA) to Thames Water (SWOX) Conveyance	Potable water transfer -Thames Water (SWA) to Thames Water (SWOX)
TWU_GUI_HI-TFR_RZ5_ALL_sewtogui	South East Water to Guildford	10Ml/d transfer from South East Water (Hogsback) to Mount SR Guildford
TWU_HEN_HI-TFR_KVZ_ALL_tw(kv)to(hen)con	Thames Water (Kennet Valley) to Thames Water (Henley) Conveyance	Potable water transfer - Thames Water (Kennet Valley) to Thames Water (Henley) Conveyance
TWU_LON_HI-TFR_LON_ALL_lockwood ps-kgv res	TLT extension from Lockwood PS to King George V Reservoir intake	TLT (Thames Lee Tunnel) extension from Lockwood PS to King George V Reservoir intake
TWU_LON_HI-TFR_LON_ALL_teddingtondrated/tlt	Direct River Abstraction - Teddington to Thames Lee Tunnel Shaft 75 MLD London Reuse SRO	Direct river abstraction - Teddington to Thames Lee Tunnel Shaft 75 MLD – London Reuse SRO
TWU_KVZ_HI-TFR_T2S_ALL_t2st cul to speen	T2ST SRO Culham to Speen transfer option	Thames to Southern Transfer SRO (T2ST) - this option is part of the T2ST pipeline transferring water from River Thames to the south
TWU_KVZ_HI-TFR_UTC_ALL_thamestofobney	River Thames to Fobney Transfer Option	Transfer from River Thames to Fobney, to supply 40Ml/d to Kennet Valley - existing treatment facilities available at Fobney
TWU_KVZ_RE-DRP_ALL_ALL_dp-playhatch-kv	Playhatch Drought Permit	Drought intervention - drought permit
TWU_LON_HI-GRW_ALL_ALL_addington gw	Groundwater Addington	New abstraction borehole and upgrade to WTW; DO benefit 1Ml/d average; 1.5Ml/d peak
TWU_LON_HI-GRW_ALL_ALL_s'fleet lic disagg	Southfleet/Greenhithe	Southfleet-Greenhithe licence disaggregation and new headworks and pumping station at borehole sites and new 3km main from Greenhithe to new WTW, DO benefit is 8Ml/d average, 9Ml/d peak
TWU_LON_HI-GRW_RE1_ALL_asrhortonkirby	ASR Horton Kirby	Construction of pipelines between two existing ASR boreholes in the Lower Greensand aquifer to an existing WTW at Horton Kirby in Kent - water abstracted from existing Chalk aquifer boreholes (via the mains supply) will be recharged into the two ASR boreholes during periods of water surplus and abstracted when needed and treated at the WTW
WFD TWU_LON_HI-TFR_LON_ALL_hampton-battersea	New ring main tunnel from Hampton to Battersea	TWRM extension - Hampton to Battersea – construction-distribution capacity expansion
TWU_LON_HI-ROC_WT1_CNO_kemptonwtw150	Kempton 150 Construction Option	Treatment to drinking water standards of 150Ml/d of raw water from the West London reservoirs

Option ID	Option name	Option Description
TWU_STR_HI-RSR_RE1_CNO_abingdon100(lon)	Reservoir Abingdon 100 (Lon) – Construction SESRO SRO	South East Strategic reservoir option (SESRO) - these three options form part of the SESRO project for a new reservoir in the south east – SESRO SRO
TWU_STT_HI-IMP_STT_CNO_sttpipe500(lon)	Severn to Thames transfer SRO (STT)	Raw water transfer Deerhurst to Culham 500 Ml/d (Lon only) – Construction - these four options all form parts of the proposed transfer from the River Severn to the River Thames
TWU_STT_HI-RAB_RE1_ALL_p9-500-vyrnwy_100_b	Severn to Thames transfer SRO (STT)	Vyrnwy Reservoir river release (75 Mld) and 25 Mld of bypass (105Mld) - Severn to Thames transfer SRO (STT) - these four options all form parts of the proposed transfer from the River Severn to the River Thames
TWU_STT_HI-REU_RE1_ALL_p5-500-neth_p35	Severn to Thames transfer SRO (STT)	Netheridge STW effluent diversion (35Mld) - Deerhurst Pipeline Severn to Thames transfer SRO (STT) - these four options all form parts of the proposed transfer from the River Severn to the River Thames
TWU_U7T_HI-RAB_RE1_ALL_p1-500-unsupported	Severn to Thames transfer SRO (STT)	Part-time, unsupported abstraction up to 500Ml/d from the River Severn at Deerhurst and transferred to the River Thames at Culham - these four options all form parts of the proposed transfer from the River Severn to the River Thames
TWU_SWA_HI-GRW_ALL_ALL_datchet do	Datchet Increase DO Option	Increase capacity of Datchet site
TWU_SWA_HI-TFR_SWX_ALL_swoxswa48	SWOX to SWA Option	Abingdon WTW to Long Crendon to supply SWA
TWU_SWX_HI-GRW_ALL_ALL_moulsford gw	Moulsford Option	Construction of an abstraction borehole in the unconfined Chalk north of Streatley on the west bank of the River Thames - water abstracted from the borehole will be treated at the existing Cleeve WTW located on the eastern side of the River Thames; DO benefit is 3.5Ml/d peak and 2Ml/d average
TWU_SWX_HI-GRW_ALL_ALL_woods farm do	Woods Farm Increase DO	New borehole to be constructed on site to bring DO up to licence (this is an additional 2.4Ml/d to average licence of 4.99Ml/d or an additional 2.91Ml/d to peak licence of 5.5Ml/d) - the option includes a new borehole and a 1.4km raw water pipeline from the new satellite borehole to Woods Farm WTW
TWU_SWX_HI-ROC_WT1_CNO_abingdon wtw ph1	SESRO SRO	SESRO - forms part of the SESRO project for a new reservoir in the south east
TWU_SWX_HI-ROC_WT2_ALL_abingdon wtw ph2	SESRO SRO	SESRO - forms part of the SESRO project for a new reservoir in the south east
TWU_SWX_HI-TFR_STR_ALL_abing-farmoor pipe	Abingdon to Farmoor Reservoir Pipeline	Transfer of raw water from proposed Abingdon reservoir to Farmoor reservoir via enclosed pipeline - treatment would be provided at existing waterworks
TWU_SWX_RE-DRP_ALL_ALL_dp-gatehampton-swox	Gatehampton Drought Permit	DP-Gatehampton-SWOX Drought intervention-Drought permit
TWU_TED_HI-TFR_TED_ALL_teddingtondramog/ted	Mogden to Teddington outfall 75 Ml/d London Reuse SRO	Mogden to Teddington outfall 75 Ml/d – London Reuse SRO
TWU_GUI_HI-GRW_ALL_ALL_dapdune lic disagg	Dapdune Licence Disaggregation	Licence disaggregation, DO benefit 0Ml/d average, 2.2Ml/d peak
TWU_KVZ_HI-GRW_ALL_ALL_mortimer recomm	Mortimer Disused Source	Refurbishment of two disused abstraction boreholes located on-site at the existing, but disused Mortimer WTW - water abstracted from the boreholes will be treated at the disused WTW which will be upgraded for ammonia and iron removal and recommissioned; DO benefit; 4.5 Ml/d average and peak

Option ID	**Option name**	**Option Description**
TWU_SWX_HI-GRW_RE1_ALL_britwell roc	Britwell Removal of Constraints	Construction of a new run to waste facility to allow operation of existing borehole
TWU_TED_HI-RAB_RE1_CNO_teddington dra 75	Teddington DRA 75 MLD – Construction London Reuse SRO	Teddington DRA 75 MLD option - direct river abstraction – London Reuse SRO
TWU_SWX_HI-TFR_SVE_ALL_dukescut-farmoor	Dukes Cut to Farmoor	15 Ml/d conveyance option from the Oxford Canal to Farmoor Reservoir, with abstraction from a point approximately 800m north of Dukes Cut on the Oxford Canal, discharging into the River Thames for subsequent re-abstraction at the existing Farmoor Reservoir intake

2 Methodology

2.1 Level 1 screening

2.1.1 Overview

The Level 1 screening is based on the concept of risk as the product of the frequency and severity of INNS being transferred as the result of a water resource management option during its operation. Therefore, the methodology involves an assessor determining a Frequency of Impact and Severity of Impact which are combined to give an overall Magnitude of Risk.

The Level 1 screening methodology is informed by the Environment Agency's Position Statement on managing the risk of INNS through raw water transfers[2] The approach to reducing the risk of INNS transfer outlined within this document is focused upon the pathways that transfers create, rather than current INNS distribution. Therefore, the Magnitude of Risk generated by the Level 1 screening relates to the nature of any pathways created by water resource options and the impacts these pathways are likely to have. Thus, the severity of risk is greater if an option links previously unconnected waterbodies, or if it involves the transfer of raw fresh or saline water (rather than treated water or groundwater).

2.1.2 Frequency of Impact rating

Table 2.1 below shows the criteria for determining the Frequency of Impact rating.

Table 2.1: Frequency of Impact risk criteria used to assess INNS risk.

Frequency of Impact	Criteria
None	Does not occur/no impact for which to determine a frequency
Infrequent	Only occurs in emergency or during situations not considered part of the normal running of the scheme
Periodical	Will happen during start up or shut down, or periodically during routine maintenance or operation of the option
Regular	Will occur throughout the regular operation of the option

2.1.3 Severity of Impact rating

Table 2.2 below shows the criteria for determining the Severity of Impact rating.

Table 2.2: Severity of Impact risk criteria used to assess INNS risk.

Severity	Criteria
None	No additional severity of impact risk beyond risk associated with existing operations

[2] Environment Agency, 2022. *Position Statement. Managing the Risk of Spread of Invasive Non-Native Species Through Raw Water Transfers*. [pdf]

Severity	Criteria
Very Low	Treated water, effluent or groundwater – assumed no aquatic or riparian INNS present
Low	Existing pathway between waterbodies or treated water/groundwater/effluent with no INNS risk being transferred
Medium	Change in volume of transfer between waterbodies which are already connected
High	New pathway between waterbodies not current connected or potential to introduce new INNS not currently observed in the UK

2.1.4 Magnitude of Risk rating

Once Frequency of Impact and Severity of Impact have been determined for a WRMP option, the results are combined to give an overall Magnitude of Risk rating as shown in Table 2.3 below. If 'None' is selected for Frequency of Impact and/or Severity of Impact, 'No additional risk' is assigned as the Magnitude of Risk level.

Table 2.3: Magnitude of Risk calculation matrix used to determine INNS risk.

Frequency/Severity	None	Infrequent	Periodical	Regular
None	0 = No additional risk	0 = No additional risk	0 = No additional risk	0 = No additional risk
Very Low	0 = No additional risk	1 = Very Low	1 = Very Low	1 = Very Low
Low	0 = No additional risk	2 = Low	2 = Low	3 = Low
Medium	0 = No additional risk	3 = Low	4 = Moderate	4 = Moderate
High	0 = No additional risk	4 = Moderate	5 = High	6 = High

2.1.5 Progression to Level 2

All non-SRO options initially screened as having a Low, Moderate or High INNS transfer risk were progressed to Level 2 assessment. Level 2 assessments have been undertaken for all SRO options as part of RAPID Gate 2 submission, unless impacts are from construction-phase risks only.

2.2 Level 2 Assessment

2.2.1 Assessment methodology

The Level 2 assessment methodology utilised the SRO Aquatic INNS Risk Assessment Tool (SAI-RAT)[3] developed by APEM on behalf of the Environment Agency (EA) to quantify the INNS

[3] APEM, 2021. *SRO Aquatic INNS Risk Assessment Tool (SAI-RAT) – User Guide*. Produced on behalf of the Environment Agency [pdf].

risk associated with all options (both SRO and non-SRO), based on the conceptual design information currently available.

Risk assessments are processes by which the level of risk presented by certain hazards can be assessed, where hazards are anything that can cause harm. The level of risk is typically the combination of the chance and extent of the harm which could be caused. In the case of this tool, the hazard is the potential movement of INNS along key pathways, and the risk is the chance of that movement occurring combined with the extent of the harm this could cause.

The tool takes a pragmatic pathway and source-pathway-receptor model approach to the assessment of INNS risk relating to assets and raw water transfers. A desk-based search for INNS within 1km of the source and pathway is undertaken. The list of High Impact INNS that were cross-referenced for these assessments is detailed within the *UK Technical Advisory Group on the Water Framework Directive Revised classification of aquatic alien species according to their level of impact*[4] revised classification of aquatic alien species - this includes aquatic and riparian species.

The SAI-RAT takes the form of a Microsoft Excel spreadsheet, into which data and information about water transfer options are entered by the assessor to automatically generate an overall risk score. Risk scores are presented as a percentage of the highest potential score, with a higher score signifying an increased risk of introducing and transferring INNS.

For the SRO INNS assessments, the latest environmental assessment results available at the time of writing have been used to inform the INNS assessment. These results are subject to change following any further refinement of the Gate 2 SRO assessment but are unlikely to, given the maturity of the Gate 2 designs. These results will be made available upon publication of the Gate 2 Environmental Assessment Reports for the SROs.

The SAI-RAT requires a significant amount of information about options to be entered in order to assess the level of risk. As WRMP options are in an early stage of conceptualisation, the full range of information was not available for WRMP options. It is likely that a failure to complete fields in the absence of information would result in the general under-estimation of risk; therefore, an alternate approach was adopted for the assessment of INNS risk for non-SRO WRMP options. This method was adopted to find a consistent way to populate the tool for the non-SRO options with limited information available. This approach uses pre-determined default values for criteria where information is not yet available. Appropriate default ‘assumed values’ were agreed during a workshop in June 2022 (attended by water companies undertaking INNS risk assessments for WRMP24, and assessors working on their behalf). These assumed values are intended to represent the most likely or realistic input values. The use of assumed values in this way gives an estimation of a typical interaction with a pathway or asset, allowing a cautious assessment of risk to be made in the absence of specific information. Assumed values are detailed in Annex A.

The decision process for entering information into this risk assessment tool is shown below:

1. For any given criterion, if information is available for the option, then this should be entered into the tool.
2. If information is not available, ‘Unknown’ should be selected if available. Selecting ‘Unknown’ within the tool results in a median risk score being added for that criterion.
3. If ‘Unknown’ is not available to select, then an assumed value should be entered.

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[4] UK TAG WFD, 2015. UK Technical Advisory Group on the Water Framework Directive Revised classification of aquatic alien species according to their level of impact. [online]. Available at: <https://www.wfduk.org/sites/default/files/Media/Assessing%20the%20status%20of%20the%20water%20environment/UKTAG%20classification%20of%20alien%20species%20working%20paper%20v7.6.pdf> [Accessed 26th September 2022].

2.2.2 Thames to Fobney – 40Ml/d SAI-RAT input data

The WTW in this option is existing infrastructure and therefore only the new water transfer component of the option was assessed. The SAI-RAT inputs for the Thames to Fobney RWT are shown below in Table 2.4. Where information was not yet available, it has been noted within the table.

Table 2.4: SAI-RAT input data for Thames to Fobney RWT.

Criterion	River Thames to Fobney pipeline	Assumptions/comments
Source Name	River Thames	N/A
Source Management Catchment	Thames and Chilterns South Management Catchment	N/A
Source Operational Catchment	Chilterns South Operational Catchment	N/A
Source Waterbody ID	GB106039030331	N/A
Source Type	River	N/A
Number of RWT inputs into source	Unknown	Input value not known at the time of assessment
Pathway Type	Pipeline	N/A
Receptor Name	Fobney WTW	N/A
Receptor Management Catchment	Kennet and Trib Management Catchment	N/A
Receptor Operational Catchment	Kennet Operational Catchment	N/A
Receptor Waterbody ID	N/A	N/A
Receptor Type	Water treatment facility	Assumption that water will be treated at Fobney WTW
Isolated Receptor Catchment	No	N/A
Volume of Water	6-50Ml/d	N/A
Frequency of Operation	Unknown	Input value not known at the time of assessment
Transfer Distance (km)	1.1-5km	N/A
Washout/maintenance points outside of catchments	Unknown	Input value not known at the time of assessment
Details of washout/maintenance points	N/A	N/A
Source Navigable	Yes	N/A
Pathway Navigable	No	N/A
Angling at Source	Members and day ticket holders, international matches	Information collected from Reading and District Angling Association[5] Assumed worst case scenario
Angling on Pathway	No	N/A
Water sports at Source	International events	Information collected from Reading Canoe Club[6] Assumed worst case scenario
Water sports on Pathway	No	N/A
Presence of high priority INNS Source	Not surveyed-unknown	High impact INNS records not found within 1km search area defined within SAI-RAT methodology,

[5] Reading and District Angling Association, 2022. *Match Fishing* [online] Available at: <https://www.rdaa.co.uk/river-thames> [Accessed 16/09/2022]

[6] Reading Canoe Club, 2022. *Reading Canoe Club* [online] Available at: <http://reading-canoe.org.uk/> [Accessed 16/09/2022]

Criterion	River Thames to Fobney pipeline	Assumptions/comments
		though are likely to be present within the River Thames
Presence of high priority INNS Pathway	Not surveyed – unknown	N/A
Details of INNS present	N/A	N/A
Highest order site designation Receptor	None	N/A
Presence of priority habitat pathway	Not known to be present	N/A
Presence of priority habitat receptor	Not known to be present	N/A
Details of priority habitat present	N/A	N/A
Other existing connections between source and receptor	Unknown	Existing connectivity between River Thames and Fobney WTW not known
Details of other existing connections	N/A	N/A

2.2.3 Abingdon to Farmoor pipeline 24Ml/d SAI-RAT input data

The reservoir component of this option has been assessed separately in the associated SRO assessment, therefore the assessment for this option is limited to the raw water transfer (RWT) component. The SAI-RAT inputs for the Abington to Farmoor raw water transfer (RWT) are presented below in Table 2.5. Where information was not yet available, it has been noted within the table.

Table 2.5: SAI-RAT input data for Abingdon to Farmoor RWT.

Criterion	Abingdon to Farmoor pipeline	Assumptions/comments
Source Name	Abingdon reservoir	N/A
Source Management Catchment	Gloucestershire and the Vale Management Catchment	N/A
Source Operational Catchment	Ock	N/A
Source Waterbody ID	N/A	N/A
Source Type	Offline waterbody	Assumes receptor (Abingdon Reservoir) is offline when created
Number of RWT inputs into source	Unknown	Input value not known at the time of assessment
Pathway Type	Pipeline	N/A
Receptor Name	Farmoor reservoir	N/A
Receptor Management Catchment	Cotswold	N/A
Receptor Operational Catchment	Windrush	N/A
Receptor WaterbodyID	N/A	N/A
Receptor Type	Offline waterbody	N/A
Isolated Receptor Catchment	No	N/A
Volume of Water	6-50Ml/d	N/A
Frequency of Operation	Unknown	Input value not known at the time of assessment
Transfer Distance (km)	10.1-15	N/A
Washout/maintenance points outside of catchments	Unknown	Input value not known at the time of assessment
Details of washout/maintenance points	N/A	N/A

Criterion	Abingdon to Farmoor pipeline	Assumptions/comments
Source Navigable	Yes	Level of public access/recreation is not known but assumed present
Pathway Navigable	No	N/A
Angling at Source	Members and day ticket holders, international events	Assumed worst case scenario
Angling on Pathway	No	N/A
Water sports at Source	International events	Assumed worst case scenario
Water sports on Pathway	No	N/A
Presence of high priority INNS Source	Not surveyed – unknown	N/A
Presence of high priority INNS Pathway	Not surveyed – unknown	Final pipeline route not yet known
Details of INNS present	N/A	N/A
Highest order site designation Receptor	National	N/A
Presence of priority habitat pathway	Known to be present	Final pipeline route not yet known
Presence of priority habitat receptor	Not known to be present	N/A
Details of priority habitat present	Wytham Woods SSSI receptor Cotthill Fen SAC pathway	N/A
Other existing connections between source and receptor	Unknown	Input value not known at the time of assessment
Details of other existing connections	N/A	N/A

2.2.4 Lockwood to King George V Reservoir 300 Ml/d tunnel SAI-RAT input data

The pumping station and reservoir are existing structures and therefore have not been included within this assessment. The SAI-RAT inputs for the Lockwood PS to King George V Reservoir TLT extension are presented below in Table 2.6. Where information was not yet available, it has been noted within the table.

Table 2.6: SAI-RAT input data for Lockwood to King George V Reservoir tunnel RWT

Criterion	Lockwood to King George V Reservoir tunnel	Assumptions/comments
Source Name	Lockwood pumping station	N/A
Source Management Catchment	London	N/A
Source Operational Catchment	Lee Lower Rivers and Lakes	N/A
Source Waterbody ID	N/A	N/A
Source Type	River	Assumed water from Lockwood PS originates from River Lee
Number of RWT inputs into source	Unknown	Input value not known at the time of assessment
Pathway Type	Tunnel	N/A
Receptor Name	King George V Reservoir	N/A
Receptor Management Catchment	London	N/A
Receptor Operational Catchment	Lee Lower Rivers and Lakes	N/A
Receptor Waterbody ID	N/A	N/A
Receptor Type	Offline waterbody	Receptor assumed to be King George V Reservoir
Isolated Receptor Catchment	No	N/A

Criterion	**Lockwood to King George V Reservoir tunnel**	**Assumptions/comments**
Volume of Water	251Ml/d-300Ml/d	N/A
Frequency of Operation	Unknown	Input value not known at the time of assessment
Transfer Distance (km)	5.1-10km	Input value had been measured from online conceptual maps
Washout/maintenance points outside of catchments	Unknown	Input value not known at the time of assessment
Details of washout/maintenance points	Unknown	N/A
Source Navigable	Unknown	Source infrastructure is not navigable although the River Lee is navigable (source water)[7]
Pathway Navigable	No	N/A
Angling at Source	Unknown	Source infrastructure has no angling presence although angling is present on the River Lee (source water) [8]
Angling on Pathway	No	N/A
Water sports at Source	Unknown	Source infrastructure has no water sports although water sports are present on the River Lee (source water) [9]
Water sports on Pathway	No	N/A
Presence of high priority INNS Source	Known to be present	N/A
Presence of high priority INNS Pathway	Not surveyed – unknown	Final pipeline route not yet known
Details of INNS present	Canadian waterweed (*Elodea canadasis*)	N/A
Highest order site designation Receptor	National	N/A
Presence of priority habitat pathway	Known to be present	Final pipeline route not yet known
Presence of priority habitat receptor	Known to be present	N/A
Details of priority habitat present	Chingford Reservoirs SSSI	N/A
Other existing connections between source and receptor	Unknown	Input value not known at the time of assessment
Details of other existing connections	N/A	N/A

2.2.5 Dukes Cut to Farmoor 15Ml/d SAI-RAT input data

The final section of this transfer, the River Thames to Farmoor Reservoir uses existing infrastructure and is therefore not included within the scope of this assessment. The SAI-RAT inputs for the Dukes Cut to Farmoor transfer are presented below in Table 2.7. Where information was not yet available, it has been noted within the table.

[7] Canal and Rivers Trust, n.d. Lee Navigation [online] Available at:<https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-network/lee-navigation> [Accessed 03/10/2022].

[8] River Lea Anglers Club, 2014. About us. [online] Available at: <https://riverleaac.wixsite.com/river-lea-ac>. [Accessed 03/10/2022].

[9] LV Lee Valley, n.d. Lee Valley White Water Centre. Available at: <https://www.visitleevalley.org.uk/whitewater> [Accessed 03/10/2022]

Table 2.7: SAI-RAT input data for Dukes Cut to Farmoor RWT

Criterion	Dukes Cut to Farmoor	Assumptions/comments
Source Name	Oxford Canal	N/A
Source Management Catchment	Gloucestershire and the Vale Management Catchment	N/A
Source Operational Catchment	Ock Operational Catchment	N/A
Source Waterbody ID	N/A	N/A
Source Type	Canal	N/A
Number of RWT inputs into source	Unknown	Input value not known at the time of assessment
Pathway Type	Pipeline	Assumed value
Receptor Name	River Thames	Final receptor is Farmoor Reservoir, however water is transferred from the River Thames via existing transfer therefore does not fall under the scope of this assessment
Receptor Management Catchment	Cotswolds Management Catchment	N/A
Receptor Operational Catchment	Windrush Operational Catchment	N/A
Receptor Waterbody ID	GB106039030333	N/A
Receptor Type	River	N/A
Isolated Receptor Catchment	No	N/A
Volume of Water	6-50Ml/d	N/A
Frequency of Operation	Unknown	Input value not known at the time of assessment
Transfer Distance (km)	5.1-10	Distance measured using web maps and is therefore an approximation
Washout/maintenance points outside of catchments	Unknown	Input value not known at the time of assessment
Details of washout/maintenance points	N/A	N/A
Source Navigable	Yes	Information taken from Canal and River Trust[10]
Pathway Navigable	No	N/A
Angling at Source	Members and day ticket holders, international events	Present, assumed worst case scenario[11]
Angling on Pathway	No	N/A
Water sports at Source	International events	Assumed worst case scenario[12]
Water sports on Pathway	No	N/A
Presence of high priority INNS Source	Not surveyed-unknown	No records available on EA Ecology and Fish Data Explorer
Presence of high priority INNS Pathway	Known to be present	
Details of INNS present	Northern River/Florida crangonid *Crangonyx pseudogracilis/floridanus*	N/A

[10] Canal and Rivers Trust, n.d. Oxford Canal [online]. Available at: <https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-network/oxford-canal> [Accessed 21/10/22]

[11] Oxford City Council , n.d. Fishing [Online]. Available at: <https://www.oxford.gov.uk/info/20319/go_active_outdoors_-_waterways/1386/fishing#:~:text=You%20must%20hold%20a%20valid,See%20local%20signage.> [Accessed 21/10/22.]

[12] City of Oxford Rowing Club, n.d. City of Oxford Rowing Club- Homepage. Available at: <https://oxfordrowingclub.org.uk/> [Accessed 21/10/22]

Criterion	Dukes Cut to Farmoor	Assumptions/comments
	Jenkins spire shell *Potamopyrgus antipodarum* Caspian mud shrimp *Chelicorophium curvispinum* Bladder snail *Physella acuta* Signal crayfish *Pacifastacus leniusculus* Wautiers limpet *Ferrissia californica* Demon shrimp *Dikerogammarus haemobaphes* Asian clam *Corbicula fluminea* Polychaete worm *Hypania invalida* Zebra mussel *Dreissena polymorpha* Quagga mussel *Dreissena bugensis* Common carp *Cyprinus carpio* Least duckwwed *Lemna minuta* Nuttall's waterweed *Elodea nuttallii* Himalayan balsam *Impatiens glandulifera*	
Highest order site designation Receptor	National	N/A
Presence of priority habitat pathway	Known to be present	Final pipeline route not yet known
Presence of priority habitat receptor	Known to be present	N/A
Details of priority habitat present	Wytham Woods SSSI	N/A
Other existing connections between source and receptor	Unknown	Input value not known at the time of assessment
Details of other existing connections	N/A	N/A

2.2.6 London Reuse SRO- Direct River Abstraction- Teddington to Thames Lee Tunnel Shaft 75Ml/d

The Level 2 INNS assessment for Gate 2 is documented in the London Effluent Reuse SRO. INNS Assessment Report[13]. This includes a record of the input data used in the SAI-RAT.

2.2.7 Severn to Thames Transfer SRO (STT)

The Level 2 INNS assessment for Gate 2 is document in the Severn Thames Transfer (STT) Solution. INNS Assessment Report. Issue 001[14]. This includes a record of the input data used in the SAI-RAT. Treated water transfers were excluded from this assessment.

2.2.8 South East Strategic Reservoir Option (SESRO)

The Level 2 INNS assessment undertaken for Gate 2 is documented in the SESRO Environmental Assessment Report (Aquatic)[15]. This report describes the scenarios tested and includes the input data used in the SAI-RAT. This assessment involved testing of a large

[13] Ricardo, 2022. *London Effluent Reuse SRO. INNS Assessment Report. Issue 0.2.* Report for Thames Water Utilities Ltd.

[14] Ricardo, 2022. *Severn Thames transfer (STT) Solution. INNS Assessment Report. Issue 001. Report for United Utilities on behalf of the STT Group.*

[15] Thames Water and Affinity Water, n.d. *South East Strategic Reservoir Option. Technical Supporting Document B1 Environmental Appraisal Report.*

number of different scenarios of operational and recreational uses; within this report the most likely scenario risk has been reported.

2.2.9 T2ST SRO- Culham to Speen

The Level 2 INNS assessment for Gate 2 is documented in the Thames to Southern Transfer (T2ST) Environmental Appraisal Report[16]. This includes the input data used in the SAI-RAT. The Culham to Speen transfer input data was integrated within the main options associated with this SRO.

2.3 Limitations and assumptions

2.3.1 Level 1 screening

These Level 1 screening assessments are based on operational INNS transfer risk in accordance with the focus on pathways outlined within the EA position statement on raw water transfers. Construction-phase impacts are best evaluated and mitigated on a case-by-case basis and at a more advanced stage in option design and implementation. It is therefore assumed that construction-phase impacts will be assessed at the appropriate phase of option design, that any construction-phase impacts will be appropriately mitigated, and that biosecurity best practice will be followed.

In accordance with the EA position statement on raw water transfers, the Level 1 screening does not account for INNS distribution and other specific local considerations. By progressing all options screened as Low, Moderate or High risk to a Level 2 assessment, all options which may be affected by local issues such as important nature conservation sites or high impact INNS will be subject to this more detailed risk assessment. By their nature, it is unlikely that those options initially screened as presenting No additional risk or Very Low risk would be affected by such local issues, as these options will not involve the transfer of raw water likely to contain INNS.

Where no information was available regarding the frequency of water transfers for these options, it was assumed transfer frequency would be Regular, which may not provide a true reflection of the overall frequency of risk within the risk assessment but represents a precautionary approach.

2.3.2 Level 2 assessment

These Level 2 assessments are based on operational INNS transfer risk as the SAI-RAT does not account for construction-phase impacts, which are best evaluated and mitigated on a case-by-case basis at a more advanced stage in option design and implementation. It is therefore assumed that construction-phase impacts will be assessed at the appropriate phase of option design, that any construction-phase impacts will be appropriately mitigated, and that biosecurity best practice measures will be followed.

Several input values within the risk assessment tool were not known at this stage of the design and therefore the value 'Unknown' was selected. Selecting Unknown within the tool results in a median risk score being added for that criterion.

As described in section 2.2.1, 'assumed values' (detailed in Annex A) were used where 'Unknown' was not available as an option within the tool. For this purpose, it was assumed that staff visits to water treatment works will be frequent. Whilst staff visits to reservoirs may still be frequent, maintenance activities are likely to be less so.

[16] Mott MacDonald, 2022. *Thames to Southern Transfer (T2ST). Annex B1*

The overall level of risk indicated may be subject to change as further information about options become available and more representative input data can be entered. Cumulative effects from the combined risks of interacting options – such as from successive transfer pathways or additional asset maintenance schedules – have not been included in these assessments. It is noted however, that as options are taken forward and more information is available, that the potential for cumulative effects should be considered.

Recommendations for operational-phase biosecurity measures are not being considered at this stage due to the limited information available for the non-SRO options. Biosecurity recommendations for SRO options may be discussed within their respective reports.

3 Results and Discussion

3.1 Level 1 screening results

Table 3.1 below summarises the results from the INNS risk screening assessment of the 34 WRMP24 options.

Of these 34 options, 11 relate to SROs and where appropriate have been separately subjected to a Level 2 assessment.

Of the 23 non-SRO options, four options resulted in a rating of No additional risk of INNS transfer. Fifteen options were given a result of Very Low risk, as these are associated with the transfer of groundwater or treated water which are considered unlikely to contain INNS. One option was given a Low risk as it involves the movement of raw water within a pipeline, with the risk associated with potential pipe bursts. One option was given a rating of Moderate risk, as it involves the creation of a new transfer of raw water between waterbodies that are already connected. Two options were given a rating of High risk, as they involve the transfer of raw water between waterbodies.

Of the options, the four options for which screening resulted in a risk rating higher than Very Low were progressed to the more detailed Level 2 assessment.

Table 3.1: Summary of WRMP24 INNS Level 1 screening results.

Option	Description of Risk	Frequency	Severity	Risk Magnitude	Level 2 assessment advised
TWU_SWX_HI-IMP_SWX_ALL_wessextoswoxflax	Transfer of treated water within region – physical transfer of treated water (between two locations assumed currently unconnected) – no INNS risk as treated water will be free from INNS).	Regular	Very Low	1 = Very Low	No
TWU_SWX_HI-TFR_HEN_ALL_henley-swox5	Transfer of treated water within region – physical transfer of treated water (between two locations assumed currently unconnected) – no INNS risk as treated water will be free from INNS.	Regular	Very Low	1 = Very Low	No
TWU_SWX_HI-TFR_SWA_ALL_tw(swa)to(swx)con	Transfer of treated water within region – physical transfer of treated water (between two locations assumed currently unconnected) – no INNS risk as treated water will be free from INNS.	Regular	Very Low	1 = Very Low	No
TWU_GUI_HI-TFR_RZ5_ALL_sewtogui	Transfer of treated water within region – physical transfer of treated water (between two locations assumed currently unconnected) – no INNS risk as treated water will be free from INNS.	Regular	Very Low	1 = Very Low	No

Option	Description of Risk	Frequency	Severity	Risk Magnitude	Level 2 assessment advised
TWU_HEN_HI-TFR_KVZ_ALL_tw(kv)to(hen)con	Transfer of treated water within region – physical transfer of treated water (between two locations assumed currently unconnected) – no INNS risk as treated water will be free from INNS.	Regular	Very Low	1 = Very Low	No
TWU_LON_HI-TFR_LON_ALL_lockwood ps-kgv res	Change in volume of water transferred between two locations assumed to be already connected. Additional risks from pipeline washout, pipeline bursts, washwater discharge, overflows and sludge disposal.	Regular	Medium	4 = Moderate	Yes
TWU_LON_HI-TFR_LON_ALL_teddingtondrated/tlt	Physical transfer of untreated water (between two locations assumed currently unconnected). Additional risks from pipeline washout, pipeline bursts, washwater discharge, overflows and sludge disposal	N/A	N/A	N/A	Yes – London Reuse SRO[13]
TWU_KVZ_HI-TFR_T2S_ALL_t2st cul to speen	Transfer of treated water within region – physical transfer of treated water (between two locations assumed currently unconnected) – no INNS risk as treated water will be free from INNS.	N/A	N/A	N/A	Yes –T2ST SRO[16]
TWU_KVZ_HI-TFR_UTC_ALL_thamestofobney	Physical transfer of untreated water (between two locations assumed currently unconnected) – assumes any transferred INNS would be treated/removed at water treatment facility. Additional risks from pipeline washout, pipeline bursts, washwater discharge, overflows and sludge disposal.	Regular	Low	3 = Low	Yes
TWU_KVZ_RE-DRP_ALL_ALL_dp-playhatch-kv	No risk of transfer/movement of invasive or non-native species with this option type.	None	None	0 = No additional risk	No
TWU_LON_HI-GRW_ALL_ALL_addington gw	Ground water abstraction – very limited risk as the source water is likely to be entirely free of INNS. It is assumed that groundwater is free of INNS, and that accessing it will not permit any additional inputs of INNS.	Regular	Very Low	1 = Very Low	No

Option	Description of Risk	Frequency	Severity	Risk Magnitude	Level 2 assessment advised
TWU_LON_HI-GRW_ALL_ALL_s'fleet lic disagg	Ground water abstraction – very limited risk as the source water is likely to be entirely free of INNS. It is assumed that groundwater is free of INNS, and that accessing it will not permit any additional inputs of INNS.	Regular	Very Low	1 = Very Low	No
TWU_LON_HI-GRW_RE1_ALL_asrshortonkirby	Aquifer recharge/artificial recharge (AR) – physical transfer of untreated water (between two locations assumed currently already connected). Assumes that recharge is over short term and/or intermittent according to conditions, and that water will be re-extracted for use at a later date. Very limited risk as the source water is likely to be entirely free of INNS. It is assumed that groundwater is free of INNS, and that accessing it will not permit any additional inputs of INNS.	Regular	Very Low	1 = Very Low	No
WFD TWU_LON_HI-TFR_LON_ALL_hampton-battersea	Capacity expansion of treated water (no INNS risk as water will be free from INNS) – construction-phase risks only. Excluded from these assessments and assumed to be evaluated and mitigated as appropriate.	None	None	0 = No additional risk	No
TWU_LON_HI-ROC_WT1_CNO_kemptonwtw150	Increase water treatment works (WTW) capacity – no risk of transfer/movement of invasive or non-native species with this option type. Construction-phase risks only – excluded from these assessments and assumed to be evaluated and mitigated as appropriate.	None	None	0 = No additional risk	No
TWU_STR_HI-RSR_RE1_CNO_abingdon100(lon)	New reservoir – construction-phase risks only. Excluded from these assessments and assumed to be evaluated and mitigated as appropriate.	N/A	N/A	N/A	No – relates to SESRO SRO but construction risks excluded from Level 2 INNS assessment [15]
TWU_STT_HI-IMP_STT_CNO_sttpipe500(lon)	Construction-phase risks only – excluded from these assessments and assumed to be evaluated and mitigated as appropriate.	N/A	N/A	N/A	No – relates to STT SRO but construction risks excluded from Level 2 INNS assessment [14]

Option	**Description of Risk**	**Frequency**	**Severity**	**Risk Magnitude**	**Level 2 assessment advised**
TWU_STT_HI-RAB_RE1_ALL_p9-500-vyrnwy_100_b	Physical transfer of untreated water (between two locations assumed currently unconnected). Additional risks from pipeline washout, pipeline bursts, washwater discharge, overflows, and sludge disposal.	N/A	N/A	N/A	Yes – STT SRO[14]
TWU_STT_HI-REU_RE1_ALL_p5-500-neth_p35	Reclaimed water, water re-use, effluent re-use – very limited risk as the source water is likely to be entirely free of INNS.	N/A	N/A	N/A	No – STT SRO option but unlikely to create additional INNS risk, Level 2 assessment not appropriate[14]
TWU_SWA_HI-GRW_ALL_ALL_datchet do	Groundwater sources – very limited risk as the source water is likely to be entirely free of INNS. It is assumed that groundwater is free of INNS, and that accessing it will not permit any additional inputs of INNS.	Regular	Very Low	1 = Very Low	No
TWU_SWA_HI-TFR_SWX_ALL_swoxswa48	Transfer of treated water within region – physical transfer of treated water (between two locations assumed currently unconnected) – no INNS risk as treated water will be free from INNS.	Regular	Very Low	1 = Very Low	No
TWU_SWX_HI-GRW_ALL_ALL_moulsford gw	Groundwater sources – very limited risk as the source water is likely to be entirely free of INNS. It is assumed that groundwater is free of INNS, and that accessing it will not permit any additional inputs of INNS.	Regular	Very Low	1 = Very Low	No
TWU_SWX_HI-GRW_ALL_ALL_woods farm do	Groundwater sources – very limited risk as the source water is likely to be entirely free of INNS. It is assumed that groundwater is free of INNS, and that accessing it will not permit any additional inputs of INNS.	Regular	Very Low	1 = Very Low	No
TWU_SWX_HI-ROC_WT1_CNO_abingdon wtw ph1	Increase WTW capacity – construction-phase risks only. Excluded from these assessments and assumed to be evaluated and mitigated as appropriate.	N/A	N/A	N/A	No – relates to SESRO SRO but construction risks excluded from Level 2 INNS assessment[15]

Option	Description of Risk	Frequency	Severity	Risk Magnitude	Level 2 assessment advised
TWU_SWX_HI-ROC_WT2_ALL_abingdon wtw ph2	Increase WTW capacity – no risk of transfer/movement of invasive or non-native species with this option type.	N/A	N/A	N/A	Yes - SESRO SRO[15]
TWU_SWX_HI-TFR_STR_ALL_abing-farmoor pipe	Physical transfer of untreated water (between two locations assumed to be currently unconnected). Additional risks from pipeline washout, pipeline bursts, washwater discharge, overflows, and sludge disposal.	Regular	High	6 = High	Yes
TWU_SWX_RE-DRP_ALL_ALL_dp-gatehampton-swox	No risk of transfer/movement of invasive or non-native species with this option type.	None	None	0 = No additional risk	No
TWU_TED_HI-TFR_TED_ALL_teddingtondramog/ted	Physical transfer of treated water (between two locations assumed currently unconnected) – no INNS risk as treated water will be free from INNS.	N/A	N/A	N/A	No - London Reuse SRO option, unlikely to create additional INNS risk, Level 2 assessment not appropriate[13]
TWU_GUI_HI-GRW_ALL_ALL_dapdune lic disagg	Groundwater sources - very limited risk as the source water is likely to be entirely free of INNS. It is assumed that groundwater is free of INNS, and that accessing it will not permit any additional inputs of INNS.	Regular	Very Low	1 = Very Low	No
TWU_KVZ_HI-GRW_ALL_ALL_mortimer recomm	Ground water sources - very limited risk as the source water is likely to be entirely free of INNS. It is assumed that groundwater is free of INNS, and that accessing it will not permit any additional inputs of INNS.	Regular	Very Low	1 = Very Low	No
TWU_SWX_HI-GRW_RE1_ALL_britwell roc	Ground water sources - very limited risk as the source water is likely to be entirely free of INNS. It is assumed that groundwater is free of INNS, and that accessing it will not permit any additional inputs of INNS.	Regular	Very Low	1 = Very Low	No

Option	Description of Risk	Frequency	Severity	Risk Magnitude	Level 2 assessment advised
TWU_U7T_HI-RAB_RE1_ALL_p1-500-unsupported	Physical transfer of untreated water (between two locations assumed currently unconnected). Additional risks from pipeline washout, pipeline bursts, washwater discharge, overflows and sludge disposal.	N/A	N/A	N/A	Yes - STT SRO
TWU_TED_HI-RAB_RE1_CNO_teddington dra 75	Construction-phase risks only - excluded from these assessments and assumed to be evaluated and mitigated through as appropriate.	N/A	N/A	N/A	No - London Reuse SRO option but construction risks excluded from Level 2 INNS assessment [13]
TWU_SWX_HI-TFR_SWX_ALL_dukescut-farmoor	Physical transfer of untreated water (between two locations assumed to be currently unconnected). Additional risks from pipeline washout, pipeline bursts, washwater discharge, overflows, and sludge disposal.	Regular	High	6 = High	Yes

3.2 Level 2 assessment results

3.2.1 Non-SROs

A summary for the Level 2 assessment results for options are presented below in Table 3.2.

The River Thames to Fobney transfer option assessment resulted in an INNS risk score of 37.60%. This assessment was based upon unknown connectivity between the River Thames and Fobney WTW, which had the effect of selecting a median risk score in the SAI-RAT. The overall risk level was somewhat increased by known recreational uses within the River Thames (navigation and angling). Given the input data used, the possible risk scores generated by SAI-RAT for this option would range from 35.60% (>3 connections between source and receptor) to 39.60% (no connections between source and receptor). The principal risk of this scheme would be the potential spread of INNS through pipe bursts between source and receptor. The only waterbody likely to be at risk from pipe bursts would be the Holy Brook, which flows into the River Kennet (which then joins the River Thames) further downstream. Holy Brook is culverted for long sections, so the extent of its current ecological connectivity to the River Kennet and Thames catchments is currently unclear, and a pipe burst may functionally create a new connection.

The Abingdon to Farmoor pipeline option was assessed as having a risk score of 38.63%. The principal risk relating to this option is the creation of a pathway between reservoir waterbodies, which could facilitate the movement of INNS between these waterbodies and potentially increase the rate of INNS spread within the wider environment.

The Lockwood PS to King George V Reservoir option was assessed as having a risk score of 49.75%. The principal risk relating to this option is the creation of a pathway between waterbodies, which could facilitate the movement of INNS between these waterbodies and potentially increase the rate of INNS spread within the wider environment. However, as these reservoirs and River Lee form a network at this location, it is likely that a common INNS community is present throughout.

Dukes Cut to Farmoor transfer option assessment resulted in an INNS risk score of 59.25%. This assessment generated a higher risk score due to the source and receptor both being open waterbodies with potential for high levels of recreational activity, which increases the chance of new INNS being introduced. Though the existing level of connectivity between these two waterbodies is unknown, any additional connections between these waterbodies is likely to introduce the likelihood of INNS transference between waterbodies. There is also additional risk of the potential spread of INNS through pipe bursts between source and receptor – as this option crosses several ditches and streams, and the River Evenload. While it is not clear of the level of connection between the Oxford canal and these waterbodies, a pipe burst may functionally create a new connection.

Table 3.2: Level 2 INNS risk assessment results.

Option ID	Option name	Level 1 Risk Magnitude	Component(s)	Level 2 risk score
TWU_KVZ_HI-TFR_UTC_ALL_thamestofobney	River Thames to Fobney transfer	Low	River Thames to Fobney transfer	37.60%
TWU_SWX_HI-TFR_STR_ALL_abing-farmoor pipe	Abingdon to Farmoor pipeline	High	Abingdon to Farmoor transfer	38.63%
TWU_LON_HI-TFR_LON_ALL_lockwood ps-kgv res	Lockwood PS to King George V Reservoir tunnel	Moderate	Lockwood PS to King George V Reservoir transfer	49.75%
TWU_SWX_HI-TFR_SVE_ALL_dukescut-farmoor	Dukes Cut to Farmoor	High	Oxford Canal to River Thames transfer	59.25%

3.2.2 SROs

Of the 11 options related to SROs, four were deemed to only have construction-phase risks and therefore a Level 2 INNS assessment was not undertaken. Two options were not subject to a Level 2 assessment due to the options involving treated water or water re-use, which are unlikely to contain INNS. Five options related to SROs were subject to a Level 2 assessment – these are summarised below in Table 3.3.

For the London Reuse SRO, only the Teddington DRA scheme was subject to a Level 2 INNS assessment – this option assessment resulted in a risk score of 56.88%. The risk level is slightly lower than the current abstraction on the Thames (Hampton intake) via the TLT, which has the same source and destination as the transfer proposed for Teddington DRA. The risk is higher for the existing abstraction because it is in continuous operation and has a higher average volume than the 150Ml/d Teddington DRA option (though the 75 is what is reported in the dWRMP24 report)[13].

For the Severn to Thames Transfer SRO, two of the six options were subject to Level 2 assessments: the Vyrnwy Reservoir river release (75 Mld) and 25 Mld of Bypass (105Mld), and the Deerhurst (River Severn) to Culham (River Thames) transfer. For the Vyrnwy Reservoir river release and bypass option, a Level 2 assessment was undertaken for the bypass element based on both 180Ml/d and 205 Ml/d options – resulting in risk scores of 51.50% and 52.50%, respectively. The Deerhurst to Culham transfer option resulted in a risk score of 49.73%, scoring slightly lower than the Vyrnwy Bypass options[14].

The SESRO SRO required the assessment of one option (TWU_SWX_HI-ROC_WT2_ALL_abingdon wtw ph2), which resulted in a risk score of 57.90% for the assets and 61.63% transfer components under most likely scenarios. Scenarios have taken into consideration different variations of INNS pathway-frequency to understand how this will alter risk. This included most likely (baseline) scenarios and a range of other scenarios; from no recreational activities at the site to 'worst-case scenarios' in which all INNS pathways are identified as present at maximum frequency.

In relation to the risk assessment of the asset (the proposed SESRO reservoir), under 'baseline' conditions, the site was assessed to have a final asset risk score of 57.90 %. The full removal of recreation (terrestrial and aquatic), as well as the removal of aquatic recreation only, would result in the reservoir having a final asset risk score of 21.27 % or 33.65 %, respectively. Conversely, should all recreational activities (e.g., angling, water sports, boating and walking) occur, or all pathways be set to maximum frequency of occurrence; the final asset risk score would become 78.28 % or 88.46 %, respectively. It is highly unlikely that recreational access to SESRO, in all its forms, would be excluded purely on the basis of INNS risk management requirements – therefore some INNS risks will inevitably remain within the final plans for SESRO, balanced against wider aspirations for the use of the asset, and mitigated where possible based on available biosecurity measures[15].

The Culham to Speen transfer option was assessed as part of the T2ST SRO. As this transfer is a spur from the main pipeline and involves the transfer of treated water over a very short distance, it was not assessed as a separate component as the risk of INNS transfer from this individual section was deemed negligible. The transfer components of the T2ST SRO resulted in risk scores of 35.73%, and risk scores of 10.94% for the WTW asset components. As water transfer Option B and Option C do not differ significantly in their conceptual design, the data and information input to the EA INNS risk assessment tool were identical for the two options and as such there was no difference in the resulting risk scores. The Medium risk score of 35.73% is considered to be an overestimate of the INNS risk, as treatment of raw water at the new WTW at the intake location prior to transfer will eliminate any INNS at source (which is not accounted for within the SAI-RAT). Additionally, transfer via a pipeline rather than an open water course will reduce the likelihood the introduction of INNS along the transfer route. At no point during the normal operation of the T2ST transfer will raw or treated water be discharged to an open waterbody. Treated water may occasionally be discharged to nearby water courses or waterbodies from washout or maintenance points along the pipeline route, which could facilitate the spread of existing INNS downstream. Therefore, consideration should be given to the incorporation of INNS mitigation measures in the design and operation of washout and maintenance points along the pipeline route[16].

Table 3.3: Level 2 SRO SAI_RAT INNS risk assessment results.

Option ID	Option name	Level 1 Risk Magnitude	Component(s)	Level 2 risk score
TWU_LON_HI-TFR_LON_ALL_teddingtondrated/tlt	Direct River Abstraction - Teddington to Thames Lee Tunnel Shaft 75 MLD (London Reuse SRO)[13]	N/A (SRO)	Assessment for Teddington DRA scheme	56.88%
TWU_STT_HI-RAB_RE1_ALL_p9-500-vyrnwy_100_b	Severn to Thames Transfer SRO (STT)[1414]	N/A (SRO)	Assessment for River Vyrnwy Bypass (Shrewsbury – Option 27) – 180Ml/d option	51.50%
			Assessment for River Vyrnwy Bypass (Shrewsbury – Option 27) – 205Ml/d option	52.50%

Option ID	Option name	Level 1 Risk Magnitude	Component(s)	Level 2 risk score
TWU_U7T_HI-RAB_RE1_ALL_p1-500-unsupported	Severn to Thames Transfer SRO (STT)[1414]	N/A (SRO)	Assessment for part-time, unsupported abstraction up to 500Ml/d from the River Severn at Deerhurst and transferred to the River Thames at Culham	49.73%
TWU_SWX_HI-ROC_WT2_ALL_abingdon wtw ph2	SESRO SRO[1515]	N/A (SRO)	Assets	57.90% (most likely scenario)
			River Thames to reservoir	61.63%- (most likely scenario)
TWU_KVZ_HI-TFR_T2S_ALL_t2st cul to speen	T2ST Culham to Speen transfer option (as part of full T2ST SRO transfer options)[1616]	N/A (SRO)	Option B transfer	35.73%
			Option B asset (WTW)	10.94%
			Option C transfer	35.73%
			Option C asset (WTW)	10.94%

4 Conclusions and Recommendations

4.1 Conclusions

4.1.1 Level 1 screening

The following key conclusions are taken from the Level 1 INNS screening:

- The Thames Water WRMP24 plans included 23 options not related to SROs, which were subject to Level 1 screenings for INNS risk.
- Four options presented No additional risk of INNS transfer.
- 15 options were given a Very Low risk of INNS transfer as these involve the movement of groundwater or treated water which are considered unlikely to contain INNS.
- The River Thames to Fobney transfer option scored a Risk Magnitude of Low and therefore was progressed to a Level 2 INNS risk assessment.
- The Lockwood PS to King George V Reservoir tunnel transfer option scored a Risk Magnitude of Moderate and therefore was progressed to a Level 2 INNS risk assessment.
- The Abingdon to Farmoor pipeline option scored a Risk Magnitude of High and therefore was progressed to a Level 2 INNS risk assessment.
- The Dukes Cut to Farmoor transfer option scored a Risk Magnitude of High and therefore was progressed to a Level 2 INNS risk assessment.
- A further 11 WRMP24 options are related to SROs and were not subjected to a Level 1 assessment as these automatically require a more detailed Level 2 assessment. Some options were excluded from assessment as these involved only treated water or construction effects. The results of five assessed options related to the SROs are presented within this report.

4.1.2 Level 2 assessment

The following conclusions have been drawn from the results of the Level 2 assessment of the options not related to SROs:

- The River Thames to Fobney option assessment resulted in a risk score of 37.60% using the SAI-RAT. The principal risk of this option would be from potential pipe bursts, though the ecological impact of this scenario is uncertain due to complex connectivity between the River Thames and the watercourse most likely to be affected, Holy Brook.
- The Abingdon to Farmoor pipeline option was given a risk score of 38.63%. The principal risk associated with this option is the creation of a pathway between reservoir waterbodies, which could facilitate the movement of INNS between these waterbodies and potentially increase INNS spread through the wider environment.
- The Lockwood PS to King George V Reservoir tunnel transfer option assessment resulted in a risk score of 49.75%. The principal risk associated with this transfer is the additional movement of raw water which could create a pathway and facilitate the movement of INNS. However, this risk is slightly reduced due to all reservoirs in this complex having pre-existing connections.
- Dukes Cut to Farmoor transfer option assessment resulted in an INNS risk score of 59.25%. The principal risk associated with this option is the transfer of water between an online (river) source and receptor with potential high levels of recreational activity.

The results of the options related to SROs have been subject to separate assessments (where appropriate), with the headline results provided within this report. The key points are as follows:

- Four options were related to the construction-phase of SROs and therefore a Level 2 assessment was not undertaken. It is assumed that construction-phase risks will be appropriately evaluated and mitigated at the appropriate stage in planning and development.
- Two SRO-related options involve treated water or water re-use and so were not subject to a Level 2 assessment.
- For the London Reuse SRO, only the Direct River Abstraction option was considered necessary and appropriate for INNS assessment, and this assessment resulted in a risk score of 56.88%.
- Two options relating to the Severn to Thames Transfer were subject to a Level 2 assessment:
  - The River Vyrnwy bypass, which under 180Ml/d and 205Ml/d options were assessed as 51.50% and 52.50% respectively.
  - The Deerhurst (Severn) to Culham (Thames) transfer, which was given a risk score of 49.73%.
- The SESRO SRO required the assessment of one option, which was given a risk score of 57.90% for the assets and 61.63% for the baseline transfer components.
- The Culham to Speen transfer option was assessed as part of the T2ST SRO and resulted in risk scores of 35.73% for the transfer component, and 10.94% for the asset component (for both Option B and C).

4.2 Recommendations

It is recommended that the INNS risk assessment is revised using the SAI-RAT for options which are taken forward as more information becomes available. Given the current uncertainty surrounding the final scheme design, several inputs into the tool are ‘Unknown’ and therefore an average score has been generated to mitigate for the uncertainty surrounding these values. This however may be a slight under or over representation of the risk assessment score of the final scheme design, and final risk score values may be subject to change as information is updated.

When more information is available, it is recommended that options are re-assessed using the SAI-RAT biosecurity tab to identity potential biosecurity measures which should be considered as part of scheme design.

Appropriate mitigation of INNS risk should be considered for all options which are progressed, including asset and water transfer elements. The River Thames to Fobney option is currently under development and mitigation will be explored as the option plan is finalised. The Abingdon to Farmoor and Dukes Cut to Farmoor options currently have mitigation included as part of the option design but this will be developed further as the plans are finalised. Options which have been assessed as having a higher risk score will be of the highest priority for mitigation and may not be considered appropriate if this level of risk cannot be mitigated. In addition to standard mitigation practices adopted by water companies, it is recommended that engagement with the Canal and River Trust, the Environment Agency, and angling clubs is considered to help to identify those measures which are most appropriate.

For options which are likely to be implemented, the INNS risk associated with the construction phase should be considered and mitigated through best practice.

It is acknowledged that cumulative effects arising from the interaction of options may arise – such as from successive water transfers or risks of increased use of assets. It is therefore advised that for options being implemented, further consideration is given on a case-by-case basis to the potential for cumulative effects through interaction with other options being taken forward. These updated assessments should account for both inter- and intra-regional effects.

Annex A: Assumed Values for SAI-RAT

With respect to staff visits and maintenance activities at assets, the SAI-RAT requires an estimate of frequency to be entered. The options are the same for each criterion, as follows:

- 0 – never
- 0.5 – rarely (once every 2 years)
- 1 – annually
- 1.5 – monthly
- 2 – weekly

It is likely that the frequency of such visits would vary according to asset type; therefore the 'assumed value' for each activity and asset type within the SAI-RAT is shown in Table A.1 below.

Table A. 1: Assumed values for staff visit and maintenance activities at assets.

Asset type	Visit or maintenance activity	Assumed value (frequency)	Comment/rationale
Reservoir	Staff site visit (not entering water)	2 (weekly)	Assumes visit frequency should be at least weekly
	Staff site visit entering or in contact with raw water	2 (weekly)	Assumes visit frequency should be at least weekly
	Road vehicle site visit	2 (weekly)	Aligned with staff visits, assuming arrival is most likely to be by road vehicle
	Maintenance not entering water	1 (annually)	Assumes maintenance visits would be relatively infrequent
	Maintenance in water	1 (annually)	Assumes maintenance visits within water would be relatively infrequent
	Transfer of waste sludge to land	0 (never)	Sludge removal not associated with this asset type
Water treatment works	Staff site visit (not entering water)	2 (weekly)	Assumes visit frequency should be at least weekly
	Staff site visit entering or in contact with raw water	2 (weekly)	Assumes visit frequency should be at least weekly
	Road vehicle site visit	2 (weekly)	Aligned with staff visits, assuming arrival is most likely to be by road vehicle
	Maintenance not entering water	2 (weekly)	Assumes maintenance would need to be at least weekly
	Maintenance in water	2 (weekly)	Assumes maintenance would need to be at least weekly
	Transfer of waste sludge to land	1 (annually)	Sludge removal occasionally likely to be needed
Sealed water tank	Staff site visit (not entering water)	1.5 (monthly)	Assumes visit frequency should be at least monthly

Asset type	Visit or maintenance activity	Assumed value (frequency)	Comment/rationale
	Staff site visit entering or in contact with raw water	0 (never)	Sealed water tanks are likely to be used to store treated rather than raw water
	Road vehicle site visit	1.5 (monthly)	Aligned with staff visits, assuming arrival is most likely to be by road vehicle
	Maintenance not entering water	1.5 (monthly)	Assumes relatively frequent maintenance
	Maintenance in water	0 (never)	Maintenance should not involve contact with treated water
	Transfer of waste sludge to land	0 (never)	Asset type should not generate sludge
Wastewater treatment site	Staff site visit (not entering water)	2 (weekly)	Assumes visit frequency should be at least weekly
Wastewater treatment site	Staff site visit entering or in contact with raw water	2 (weekly)	Assumes visit frequency should be at least weekly
Wastewater treatment site	Road vehicle site visit	2 (weekly)	Aligned with staff visits, assuming arrival is most likely to be by road vehicle
Wastewater treatment site	Maintenance not entering water frequency	2 (weekly)	Assumes maintenance would need to be at least weekly
Wastewater treatment site	Maintenance in water frequency	2 (weekly)	Assumes maintenance would need to be at least weekly
Wastewater treatment site	Transfer of waste sludge to land frequency	0.5 (rarely)	Sludge removal occasionally likely to be needed
Sewerage treatment works	Staff site visit (not entering water) frequency	2 (weekly)	Assumes visit frequency should be at least weekly
Sewerage treatment works	Staff site visit entering or in contact with raw water frequency	2 (weekly)	Assumes visit frequency should be at least weekly
Sewerage treatment works	Road vehicle site visit frequency	2 (weekly)	Aligned with staff visits, assuming arrival is most likely to be by road vehicle
Sewerage treatment works	Maintenance not entering water frequency	2 (weekly)	Assumes maintenance would need to be at least weekly
Sewerage treatment works	Maintenance in water frequency	2 (weekly)	Assumes maintenance would need to be at least weekly
Sewerage treatment works	Transfer of waste sludge to land frequency	0.5 (rarely)	Sludge removal occasionally likely to be needed

Assets also require assessment for recreational use within the SAI-RAT. In practice, four of the five asset types included (water treatment works, sealed water tank, wastewater treatment site, sewerage treatment works) are unlikely to be accessible for recreational use or by wildlife. Therefore, these asset types should be assigned a value of 0 (‘never’) for all recreational activities.

Reservoirs are frequently host to recreational activities and accessible by wildlife, though the extent of this is likely to be variable. In the potential absence of available information, the assumed values for activities relating to recreation or wildlife are shown in Table A.2 below.

Table A. 2: Assumed values for recreational activities at assets.

Asset	**Asset recreational or associated activity**	**Assumed value (frequency)**	**Comment/rationale**
Reservoir	Angling equipment	2 (weekly)	Angling is a relatively common activity at reservoirs. If permitted at a reservoir, likely to occur frequently
	Live bait	0 (never)	Live bait is not typically allowed at reservoirs
	Fish stocking	1 (annually)	Considered a typical stocking frequency
	Large vessels (over 28ft)	0.5 (rarely)	Vessels of this large size are rarely likely to be brought onto a reservoir
	Small vessels (under 28ft)	2 (weekly)	Boating is a relatively common activity at reservoirs. If permitted at a reservoir, likely to occur frequently
	Water sports equipment (Stand-up paddleboards, canoe, kayaks)	2 (weekly)	Boating is a relatively common activity at reservoirs. If permitted at a reservoir, likely to occur frequently
	Water safety equipment (temporary moorings, jetties, inflatables, buoys)	0.5 (rarely)	It is considered that such equipment is rarely brought to a reservoir
	Mammals/waterfowl on-site	2 (weekly)	If a reservoir is accessible to mammals and waterfowl, they are likely to access the asset frequently
	Recreational walker/jogger/runner	2 (weekly)	Relatively common activities at reservoirs. If reservoir is accessible for this purpose, likely to occur frequently
Water treatment works Sealed water tank Wastewater Treatment site Sewerage Treatment works	Angling equipment	0 (never)	Angling not expected at these asset types
	Live bait	0 (never)	Angling not expected at these asset types
	Fish stocking	0 (never)	Angling not expected at these asset types
	Large vessels (over 28ft)	0 (never)	Boating not expected at these asset types
	Small vessels (under 28ft)	0 (never)	Boating not expected at these asset types
	Water sports equipment (SUPs, Canoe, Kayaks)	0 (never)	Water sports not expected at these asset types
	Water safety equipment (temporary moorings, jetties, inflatables, buoys)	0 (never)	Associated activities not expected at these asset types
	Mammals/waterfowl on-site	0 (never)	Mammals/waterfowl unlikely to access these asset types
	Recreational walker/jogger/runner	0 (never)	Walking/jogging/running not expected at these asset types