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United Utilities

Water for the North West

United Utilities

North West Transfer Strategic Resource Option

Invasive Non-Native Species Assessment

Wood Environment & Infrastructure Solutions UK Limited – November 2022

Report for

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1. Introduction

1.1 Purpose of this Report

The purpose of this document is to present the assessment of the risks relating to invasive non-native species (INNS) associated with United Utilities' (UU's) North West Transfer (NWT) scheme. The assessment is presented to inform the Gate 2 submission to RAPID (described below), and focusses on key risks that could influence the feasibility of the scheme. These risks could include the potential for the options to spread or establish invasive non-native species (INNS) or to create pathways which may increase the likelihood of spreading INNS beyond their current known range.

INNS are considered to be one of the significant pressures that could prevent a water body from meeting its environmental objectives of achieving good ecological status under the Water Framework Directive (WFD). The WFD came into force on 22 December 2000 and was transposed into UK law in 2003, and subsequently replaced by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. This Directive imposes standards for the improvement of all aspects of water environments, requiring surface water to be of good quality by 2027.

This assessment builds on the INNS assessment of UU's SRO reported at Gate 1. Key changes since Gate 1 include:

- The options being taken forward at Gate 2 including updated design information;
- Regulator feedback (during Gate 1 including RAPID's Gate 1 decision and during the preparation of the Gate 2 submission);
- In addition to the methodology applied at Gate 1, the Environment Agency's Aquatic INNS Risk Assessment Tool (SAI-RAT) has also been used, as required by RAPID's Gate 2 guidance[1];

Further topic-specific evidence collection and assessment work[2].

1.2 The North West Transfer SRO

The United Utilities (UU's) North West Transfer (NWT) Strategic Resource Option (SRO) is one of 17 schemes promoted by Ofwat in the PR19 Final Determination to identify new strategic water resources to meet projected supply deficits as a consequence of population growth and climate change. The NWT SRO is a combination of the United Utilities Sources (UUS) and Vyrnwy Aqueduct (UUVA) SROs. Both the UUS and UUVA SROs have progressed through Gate 1 (July 2021) of the Regulators' Alliance for Progressing Infrastructure Development's (RAPID) gated process, and UU is now preparing its Gate 2 submission for a combined NWT SRO.

[1] Regulators' Alliance for Progressing Infrastructure Development April 2022. Strategic regional water resource solutions guidance for gate two. https://www.ofwat.gov.uk/wp-content/uploads/2022/02/Strategic-regional-water-resource-solutions-guidance-for-gate-two_RAPID.pdf

[2] Wood (2022a) *Assessment of Options involving Groundwater Abstractions* and Wood (2022b) *Assessment of Options involving River Abstractions*

The NWT SRO solution promotes cost efficient source options, selected to facilitate transfer volumes by the release of raw water directly from Lake Vyrnwy into River Vyrnwy or transferred through a new River Vyrnwy bypass pipeline into the River Severn as part of the Severn Thames Transfer (STT) SRO. The NWT SRO provides new sources to be brought online if water were to be transferred out of region, maintaining resilience for customers in the North West. The NWT SRO comprises two principal components:

- new sources to offset water transferred out of region from Lake Vyrnwy as part of the STT SRO; and
- enabling works on the Vyrnwy Aqueduct to allow treated water from regional UU sources to be transferred by pumping into the Vyrnwy Aqueduct to maintain customer supplies (for transfer volumes greater than 50 Ml/d).

The purpose of Gate 2 is to enable detailed feasibility, concept design and multi-solution decision making, building on the work undertaken during Gate 1 to further develop the NWT SRO programme and option design. To inform concept solution designs and reduce uncertainty in costs and benefits, the potential environmental effects of the NWT SRO identified in Gate 1 are considered further in a series of updated overarching assessments, including this INNS assessment.

As of June 2022, a total of 14 options are proposed for the NWT SRO (13 supply options and one enabling works option). The source options are geographically spread across UU's supply area (as shown in **Figure 1.1**), and include groundwater and river abstractions. Of the 13 source options, nine are included in the NWT Full Solution, with the remaining four held in reserve. The options are summarised in **Table 1.1** and shown on **Figure 1.1**.

Table 1.1 Options included in the NWT scheme

Option ID	Option name	Description	Capacity (Ml/d)	Part of NWT Full Solution?
WR015	[✂]	[✂]	40	Yes
WR049d	[✂]	[✂]	40	Yes
WR076	[✂]	[✂]	25	Yes
WR102b	[✂]	[✂]	17	Yes
WR105a1	[✂]	[✂]	4.5	No
WR106b	[✂]	[✂]	8.5	No
WR107a2	[✂]	[✂]	10	Yes
WR107b	[✂]	[✂]	12	Yes
WR111	[✂]	[✂]	9	Yes
WR113	[✂]	[✂]	3	Yes
WR144	[✂]	[✂]	5	No
WR149	[✂]	[✂]	13	Yes

Option ID	Option name	Description	Capacity (Ml/d)	Part of NWT Full Solution?
STT041b	[✂]	[✂]	58	No
STTA4	[✂]	[✂]	n/a	Yes

1.3 Invasive Non-native Species - Overview

Invasive non-native species are defined as any species introduced outside of its natural range (past or present) which may negatively impact upon the environment, the economy, or human health[3].

Both within the UK and internationally, INNS are considered the second largest threat to biodiversity, after the loss and destruction of habitat[4][5]. The Environment Agency (EA) estimate the economic consequences of INNS within England to be of the order of £1.7 billion per year (2010 costs[6]).

In order to protect and improve the ecological and chemical health of the UKs surface and groundwater bodies the UK government, in 2003 transposed into English Law the EU Water Framework Directive (WFD) (2000/60/EC). The Directive required member states to put in place River Basin Management Plans that required a holistic approach to the management of water bodies, looking at the water within the wider ecosystem. The Directive (and its subsequent amendments) has subsequently been retained in English law following the UK's exit from Europe. Although not explicitly mentioned within the Water Framework Directive, UK government administrations have accepted that INNS should be considered as a pressure on water bodies that needs to be considered when implementing the Directive. River basin management plans are therefore required to consider INNS where they are considered to be causing (or contributing to) sites to fail to achieve good ecological status.

Given that most species are difficult or impossible to control or eradicate once introduced into the wild the prevention of their introduction is considered a priority. The EA expects water companies to prevent the deterioration of natural water bodies by reducing the risks of spread of INNS and reducing the impacts of INNS[7].

A list of aquatic alien species classified according to their potential level of impact is published by the UK Technical Advisory Group (UK TAG)[8] along with an Alarm List identifying those species thought to pose a risk to surface waters and their WFD ecological status, but whose presence has

[3] Environment Agency (2019) 2021 River Basin Management Plans – Invasive non-native species challenge
[4] Environment Agency (2022) Managing the risk of spread of Invasive Non-Native Species through raw water transfers. Position Statement April 2022
[5] Environment Agency 2021. Invasive non-native species: challenges for the water environment. < https://www.gov.uk/government/publications/invasive-non-native-species-challenges-for-the-water-environment> Accessed 05 October 2022.
[6] Environment Agency (2013) Water industry strategic environmental requirements (WISER). Strategic steer to water companies on the environment, resilience and flood risk for business planning purposes.
[7] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (the Water Framework Directive).
[8] UKTAG (2015) UK Technical Advisory Group on the Water Framework Directive. Revised classification of aquatic alien species according to their level of impact.

not yet been recorded in Great Britain. Species identified by UK TAG currently frequenting freshwater environments, along with their classification have been provided in **Appendix A**.

Within England and Wales, there are a number of further statutory obligations regulating the control of INNS, primarily Section 14 of the Wildlife and Countryside Act 1981 and more recently the Alien Species (Enforcement and Permitting) Order 2019. A comprehensive review of legislation, regulations and Directives designed to control the release and subsequent spread of INNS species within England and Wales is provided by GB Non-Native Species Secretariat[9].

1.1 This Technical Note

This Technical Note presents the findings of the INNS Screening Assessment for the NWT options. The remainder of this Technical Note is structured as follows:

- **Section 2:** Outlines the methodology for the INNS Screening Assessment;
- **Section 3:** Describes the results of the INNS Screening Assessment and the premise on which these were made; and
- **Section 4:** Presents a summary of the assessment and the conclusions of the INNS Screening Assessments to inform UU's Gate 2 submission.

[9] GB Non-Native Species Secretariat - http://www.nonnativespecies.org/home/ [Accessed 15 July 2022]

2. Assessment Approach

2.1 Data and Evidence

The assessment is based on freely available data sources that include NBN Atlas[10], Defra's MAGIC Map[11], the EA's Ecology & Fish Data Explorer website[12], as well as peer reviewed or grey literature such as Gallardo and Aldridge (2013)[13]. The scope of engineering works required for each source option has been provided by UU.

The findings within this report have also been informed in part by Appendix C to (Wood, 2022) *Assessment of Options involving River Abstractions*, which characterises the local physical structure of river and stream channels as well as providing notes on land use and observations of any INNS recorded on the day of the survey along watercourses associated with each of the options. Appendix E (Assessment of impacts of surface water abstractions on macroinvertebrates) and Appendix F (Assessment of impacts of surface water abstractions on macrophytes) have also informed the assessments.

It is recognised that data sets drawn from sources such as routine or ad hoc temporal baselines survey programmes e.g., the EA's Data Explorer, rather than from targeted INNS monitoring, may be subject to limitations. In addition, licence conditions stipulated by data providers can be restrictive with regard to the sharing of derived data and other repositories and may only represent 50% of all available data due contributor concerns around both commercial sensitivity and exploitation of data and other political issues[14].

2.2 Aquatic INNS Risk Assessment Tool

An assessment of the potential risk posed by each of the options for the introduction and spread of aquatic INNS was undertaken using the Environment Agency's Aquatic INNS Risk Assessment Tool (SAI-RAT).

The SAI-RAT tool accounts for a wide range of different types of assets and raw water transfers that may comprise any one option and has adopted the use of functional groups of taxa (**Appendix B**) rather than a species-based approach, which is considered to provide a degree of future- proofing within the assessment against the risk from INNS not yet present or recorded within the source waters. The modular tool provides a quantitative score of the relative risk based on a source-pathway-receptor approach that has been derived from other assessment tools that include both the Northumbrian Water Group Raw Water Transfer assessment tool and the Wessex Water asset assessment tool.

[10] https://nbnatlas.org/
[11] https://magic.defra.gov.uk/
[12] https://environment.data.gov.uk/ecology/explorer/
[13] Gallardo B, Aldridge DC. Priority setting for invasive species management: risk assessment of Ponto-Caspian invasive species into Great Britain. Ecol Appl. 2013 Mar;23(2):352-64.
[14] Hassall, I., Cheffings, C., Robinson, A. & Robinson, P. 2020. Review of biodiversity data use in the Country Nature Conservation Bodies. JNCC Report No. 670, JNCC, Peterborough, ISSN 0963-8091.

The tool provides a risk score for each option presented as a percentage of the highest potential score, with a higher score (closer to 100%) signifying increased risk of introducing and transferring INNS.

2.3 RAG Assessment

Under Gate 1 an assessment was undertaken to identify the likelihood of each of the options contributing to the potential spread of INNS species based on a matrix comprising the likelihood of the potential INNS transfer and the impact upon the receiving water. The assessment adopted a Red/Amber/Green (RAG) scoring matrix to identify sites most at risk from propagating INNS. Given the lack of significance ascribed to risk scores within the SAI-RAT tool, (e.g. is a risk score or 15% significant for species such as *Dikerogammarus villosus?)*, this approach has again been adopted under Gate 2 to enable a level of significance to be ascribed to each of the options.

An assessment based on a matrix comprising the **likelihood** of the potential INNS transfer and the **impact** upon the receiving water was adopted to identify the options most at risk of transferring INNS between water bodies.

Likelihood

The likelihood considers the potential for transfer and the probability of the impact occurring. This assessment takes into account the prevalence and category of INNS in the source supply. The presence of an INNS species within the source water was based on known occurrence within a 1km radius of the abstraction coordinates.

Species can be spread from place to place through a variety of methods, that can be grouped into common pathways, that include e.g., recreational activities, vehicle, operative and plant movements, sludge transfer and raw water transfer. Consideration of these aspects for each option has contributed to the assessment of likelihood.

Where water is abstracted direct from a borehole, it has been assumed that no aquatic INNS are present within the source water and that the risk of direct transfer is, therefore, 'Low'. However increased site access by operatives and their vehicles does open up potential pathways for the transfer of terrestrial species that may be present within the locale of the source.

Where water is pumped from a surface water source directly to a WTW located within the source water catchment (and subject to coarse screening, coagulations, flocculation, settlements, and fine filtration), the potential impact is also considered '**Low**'. However, where the WTW lies outside of the source catchment area or within an upstream waterbody within the same catchment, the risk of transferring species has the potential to be '**Medium**' as water may on occasion bypass the treatment facilities e.g. via break-pressure tanks, start-up to waste and wash-outs (throughout the document wash-out has been used as a generic term for these aspects).

Impact

The potential for impact of INNS species has been categorised by UKTAG[15]. Where the potential impact of a species has yet to be categorised then a classification of 'High' (worst case) has been

[15] UKTAG (2015) UK Technical Advisory Group on the Water Framework Directive. Revised classification of aquatic alien species according to their level of impact.

assumed. The impact considers the sensitivity of the receiving water body, taking into account both the prevalence of INNS in the receiving water course and any pertinent conservation designation or protected species present within the receiving water body.

Biosecurity

The assessment of likelihood assumes that all reasonable mitigation will be put in place to prevent the spread of INNS species. A comprehensive review of transfer pathways and appropriate biosecurity measures have been provided by the GB Non-native Species Secretariat[16] and includes the following:

- Check, clean, dry procedures should be adopted.
- Plant such as pumps should be cleaned prior to moving. Any heavy encrustations and holdfasts should be removed with scrapers, prior to pressure-washing. Particular attention should be paid to parts of the structure where access is difficult. Washings must not be allowed to enter the water environment. Waste produced from the cleaning process must be disposed of appropriately.
- Footwear should be clean (visually free from soil and debris) before operatives leave site. Where necessary footwear should be disinfected.
- Vehicles should be kept clean – in particular, any accumulated mud should be removed before the vehicle moves off the site. Where necessary wheel arches should be disinfected.
- At high-risk sites, access should be kept to a minimum. Vehicles should be parked on hard standing.
- Where multiple sites are visited, high risk sites should be the last to be visited in the day.

Where a new raw water transfer scheme creates a hydrological pathway between water bodies not already connected, or where a proposed scheme increases the risk between locations already linked, the only mitigation available may comprise treatment processes to remove all life stages of potential INNS.

Measures adopted or trialled elsewhere for the control or eradication of INNS from raw water abstractions (although not necessarily for public water supply) include chemical treatment e.g. chlorination, or introduction of piscicides (such as antimycin A, rotenone and salicylanilide l), ultra-violet light treatment and the use of electric gradients to euthanise e.g. fish. Comprehensive guidance on biosecurity measures has been provided by the GB non-native species secretariat[17].

Mitigation has not been identified for washouts where this consists of raw water and where there is a potential pathway for transmission to waterbodies outside of the source catchment. Where feasible, provision should be made to divert washout to a temporary containment facility prior to treatment.

[16] GB Non-native Species Secretariat - https://www.nonnativespecies.org/biosecurity/ [Accessed 15 July 2022]
[17] https://www.nonnativespecies.org/biosecurity/#

Risk Assessment

The likely risk presented by INNS at each of the NWT options has been assigned based on the matrix tool described in **Figure 2.1** and **Table 2.1** below.

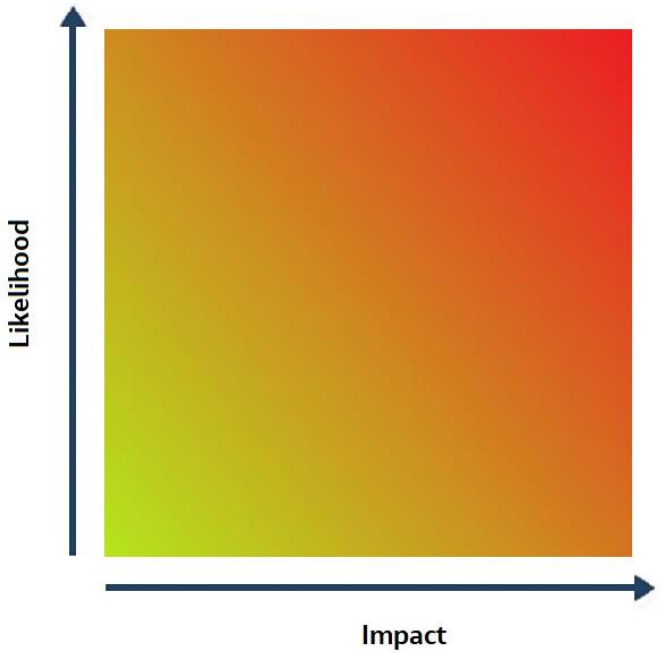

Figure 2.1 Matrix tool adopted in the assessment of INNS

Table 2.1 Risk Classification Categories

Level of Risk	Description
Low	Likelihood of INNS present in source water low e.g. source water drawn from a borehole. Impact classification of INNS species found in or near (1km) source water considered 'Low' and/or transmission pathway low risk e.g., water processed through WTW (secondary treatment) within catchment adjacent to source. Receiving water in catchment and not designated as a priority habitat above local level. Green RAG status implies that the potential risk of transferring INNS from the stated source via the stated pathway is low. It is however recommended that all reasonable biosecurity measures are adopted.
Medium	Impact classification of INNS species found in or near (1km) the source water ≤ High, transmission pathway risk considered 'Low' e.g., water processed and / or washout points within same operational catchment. or Impact classification of INNS species found in or near (1km) the source water ≤ Medium and transmission pathway risk considered ≤ Medium e.g., primary treatment only and / or washout points within transmission pathway outside of catchment or in upstream waterbodies of same catchment. Amber RAG status implies the option provides a potential pathway for the transfer of non-native species outside of their current range however, the risk to the receiving body of water is not considered High, or where the species is considered to present a High risk the likelihood of transfer is considered to be low given the infrastructure proposed. It is however recommended that all reasonable biosecurity measures are adopted.

Level of Risk	Description
High	Impact classification of INNS species found in or near (1km) source water 'High' or a GB NNSS alert species. At some sites the INNS species present may also present a risk of fouling to UU's infrastructure e.g., Zebra mussel (*Dreissena polymorpha*). There is a high risk that the option may facilitate the expansion of the known range of high impact INNS either through *inter alia* direct transmission (treatment works or washout points outside of catchment or in upstream waterbodies of same catchment), on site operational or maintenance activities or third party activities. Receiving water designated as a priority habitat/species. A red RAG status implies that without incorporating stringent biosecurity measures into the design of the scheme there is a risk of transferring high impact INNS species to the receiving waterbody catchment. The Environment Agency consider that there should be high confidence in the overall robustness of the biosecurity measure to reduce the risk in relation to the corresponding pathway and that these measures should be carried out with commitment.

3. Risk Assessment

Each of the NWT options have been assessed in Error! Reference source not found. using the approach described in **Section 2**. Where there was uncertainty over an option, a worst-case scenario approach has been used (e.g., the assessments have assumed a risk category of 'High'), but this has been followed by a second phase of assessment where assumed bio-security measures are taken into account. Where assumptions have been made, they have been highlighted within the text.

Table 3.1 INNS Screening Risk Assessments for NWT Options

Option Number	Name	Source water	Receiving water	Pathway for transfer	High Risk INNS present within source water catchment (within 1 km of abstraction point).	Presence of priority habitat in open channel pathway and/or receptor	Overall SAI-RAT Risk Score (%)	RAG Risk Assessment Unmitigated (Biosecurity Measures)	RAG Risk Assessment Including Recommended Biosecurity Measures
STT041b	[✂]	[✂]	[✂]	[✂]	**River Roch** Yes **River Irwell** Yes	No	25.45	High Impact INNS present within 1km of R.Roch source. Water transfer from R.Roch remains in catchment. High Impact INNS recorded within 1km of R. Irwell source. Raw water transfer from R. Irwell lies within separate operational catchment. Water transferred via new WTW adjacent to open, lined service reservoir (isolated water body). Three potential washout points at pumping stations; one at each abstraction, and a third at the WTW.	New 58 ml/d 3 stage treatment works to be constructed adjacent to service reservoir (to include microstrainers and biobullet dosing) within the same catchment as R.Roch abstraction to incorporate biosecurity measures into the design that may include but are not necessarily limited to the following: Site specific Biosecurity Strategy; All operatives should adhere to general Check Clean Dry procedures; Provision of site-specific operational equipment; Manual pressurised washer should be available onsite; and All arisings from treatment processes should be disposed of as biological waste. A comprehensive list of biosecurity options can be found in EA (2021), SRO Aquatic INNS Risk Assessment Tool) – User guide
WR015	[✂]	[✂]	[✂]	[✂]	Yes	No	36.17	High impact INNS recorded within 1km of source. Water treatment process out of operational catchment. Receiving WTW service reservoir open and isolated. Two potential washout points at pumping stations; one at abstraction (in immediate catchment) and a second at the WTW (outside of operational catchment).	New 58 ml/d 3 stage treatment works to be constructed adjacent to service reservoir to incorporate biosecurity measures into the design that may include but are not necessarily limited to the following: Site specific Biosecurity Strategy; All operatives should adhere to general Check Clean Dry procedures; Provision of site-specific operational equipment; Manual pressurised washer should be available onsite; and All arisings from treatment processes should be disposed of as biological waste. No records of High Risk INNS were noted in the locale of the proposed R.Irwell abstraction at the time of the assessment however their presence in the source water should be kept under review and biosecurity measures adopted as necessary. A comprehensive list of biosecurity options can be found in EA (2021), SRO Aquatic INNS Risk Assessment Tool) – User guide

Option Number	Name	Source water	Receiving water	Pathway for transfer	High Risk INNS present within source water catchment (within 1 km of abstraction point).	Presence of priority habitat in open channel pathway and/or receptor	Overall SAI-RAT Risk Score (%)	RAG Risk Assessment Unmitigated (Biosecurity Measures)	RAG Risk Assessment Including Recommended Biosecurity Measures
WR049d[18]	[✂]	[✂]	[✂]	[✂]	Yes	West Pennine Moors SSSI adjacent to Rivington Reservoir upstream of receptor.	35.45	High Impact INNS present within source water. High impact species include *inter alia* water fern (*Azolla filiculoides*), parrots feather (*Myriophyllum aquaticum*), zebra mussel (*Dreissena polymorpha*) and demon shrimp (*Dikerogammarus haemobaphes*), which are not present in the locale of the receptor waterbody. Raw water transferred to WTW out of catchment. Potential wash out points located at interstage pumping station at Coup Green (out of source water catchment) and at WTW (out of source water catchment). Receiving waterbody adjacent to SSSI designated site.	New 40Ml/d treatment capacity at Rivington WTW to include 120ML/d second stage filters and associated chemical dosing and downstream pumping improvements to enable blending with the indigenous Rivington flows. The new WTW to incorporate biosecurity measures into the design that may include but are not necessarily limited to the following: Site specific Biosecurity Strategy; All operatives should adhere to general Check Clean Dry procedures; Provision of site-specific operational equipment; Manual pressurised washer should be available onsite; and All arisings from treatment processes should be disposed of as biological waste. Given the potential for biofouling organisms to be present in the source water consideration should be given to the introduction of a biocide at the intake. A comprehensive list of biosecurity options can be found in EA (2021), SRO Aquatic INNS Risk Assessment Tool) – User guide
WR076	[✂]	[✂]	[✂]	[✂]	Yes	No	30.30	High risk INNS present within source water. New WTW and service reservoir to be located adjacent to abstraction (within same catchment/river reach). Treated water to be fed into to the existing treated water main from Lymm WTW.	This option is considered Low Risk for the transfer of INNS outside of the source catchment however it is recommended that all reasonable biosecurity measures are adopted to include a site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff and general check, clean, dry protocols.
WR102b	[✂]	[✂]	[✂]	[✂]	Belle Vale BH Yes Greensbridge Lane BH Yes	No	18.09	Borehole source low risk of aquatic INNS. Option includes treatment processes within catchment sufficient to remove all life stages of potential aquatic INNS. Assume biosecurity good practice measures adopted.	This option is considered Low Risk for the transfer of INNS outside of the source catchment however it is recommended that all reasonable biosecurity measures are adopted to include a site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff and general check, clean, dry protocols.
WR105A	[✂]	[✂]	[✂]	[✂]	Yes	Woolston Eyes SSSI is at 1km distance from the receptor.	16.49	High impact INNS recorded within 1km of source however low risk of INNS within source water (borehole). Option includes treatment processes within catchment sufficient to remove all life stages of potential aquatic INNS.	This option is considered Low Risk for the transfer of INNS outside of the source catchment however it is recommended that all reasonable biosecurity measures are adopted to include a site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff and general check, clean, dry protocols.

[18] Note that at Gate 1, this option involved a discharge to Anglezarke reservoir, with subsequent abstraction from the reservoir to Rivington WTW. The option now involves direct transfer from the Ribble to Rivington, with no pathway to Angelzarke.

Option Number	Name	Source water	Receiving water	Pathway for transfer	High Risk INNS present within source water catchment (within 1 km of abstraction point).	Presence of priority habitat in open channel pathway and/or receptor	Overall SAI-RAT Risk Score (%)	RAG Risk Assessment Unmitigated (Biosecurity Measures)	RAG Risk Assessment Including Recommended Biosecurity Measures
WR106B	[✂]	[✂]	[✂]	[✂]	Walton BH Yes Daresbury BH No	No	15.94	High impact INNS recorded within 1km of source however low risk of INNS within source water (borehole). Option includes treatment processes within catchment at Appleton WTW sufficient to remove all life stages of potential aquatic INNS. Potential wash out point located at WTW which lies within catchment and at Cliff Hill service reservoir, also in catchment.	This option is considered Low Risk for the transfer of INNS outside of the source catchment however it is recommended that all reasonable biosecurity measures are adopted to include a site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff and general check, clean, dry protocols.
WR107A	[✂]	[✂]	[✂]	[✂]	Aughton Park BH Yes Moss End BH Yes	No	16.38	High impact INNS recorded within 1km of source however low risk of INNS within source water (borehole). Option includes treatment processes within catchment sufficient to remove all life stages of potential aquatic INNS. Potential wash out point located at WTW which lies within catchment.	This option is considered Low Risk for the transfer of INNS outside of the source catchment however it is recommended that all reasonable biosecurity measures are adopted to include a site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff and general check, clean, dry protocols.
WR107B	[✂]	[✂]	[✂]	[✂]	Randles Bridge BH Yes Knowsley BH Yes Primrose Hill BH Yes	No	18.46	High impact INNS recorded within 1km of source however low risk of INNS within source water (borehole). Option includes treatment processes within catchment (Randles Bridge and Knowsley Borehole) and outside (Primrose Hill Borehole) sufficient to remove all life stages of potential aquatic INNS. Potential wash out points located at WTW which lies within catchment (Randles Bridge and Knowsley Borehole) and outside catchment (Primrose Hill Borehole) and at Blundell House (Primrose Hill Borehole).	This option is considered Low Risk for the transfer of INNS outside of the source catchment however it is recommended that all reasonable biosecurity measures are adopted to include a site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff and general check, clean, dry protocols.
WR111	[✂]	[✂]	[✂]	[✂]	No	No	16.45	High impact INNS recorded within 1km of source however low risk of INNS within source water (borehole). Option includes treatment processes within catchment sufficient to remove all life stages of potential aquatic INNS. Potential wash out point located at WTW which lies outside of immediate catchment.	This option is considered Low Risk for the transfer of INNS outside of the source catchment however it is recommended that all reasonable biosecurity measures are adopted to include a site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff and general check, clean, dry protocols.
WR113	[✂]	[✂]	[✂]	[✂]	No	No	16	High impact INNS recorded within 1km of source however low risk of INNS within source water (borehole). Option includes treatment processes within catchment sufficient to remove potential aquatic INNS with effluent passing to covered and isolated service reservoir.	This option is considered Low Risk for the transfer of INNS outside of the source catchment however it is recommended that all reasonable biosecurity measures are adopted to include a site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff and general check, clean, dry protocols.

Option Number	Name	Source water	Receiving water	Pathway for transfer	High Risk INNS present within source water catchment (within 1 km of abstraction point).	Presence of priority habitat in open channel pathway and/or receptor	Overall SAI-RAT Risk Score (%)	RAG Risk Assessment Unmitigated (Biosecurity Measures)	RAG Risk Assessment Including Recommended Biosecurity Measures
WR144	[✂]	[✂]	[✂]	[✂]	Yes	No	29.8	High risk INNS present in source/receptor water catchment. New WTW located c. 1.5 km from source, within same catchment. All washout maintenance points within catchment.	Abstracted water transferred by existing raw water main to existing WTW facility. WTW to be modified with new upfront treatment process in order to treat final effluent to potable WQ standards. Works to include the following biosecurity measures into the design: Site specific Biosecurity Strategy; All operatives to adhere to general Check Clean Dry procedures; Provision of site-specific operational equipment; Manual pressurised washer to be available onsite; and All arisings from treatment processes to be disposed of as biological waste. A comprehensive list of biosecurity options can be found in EA (2021), SRO Aquatic INNS Risk Assessment Tool) – User guide
WR149	[✂]	[✂]	[✂]	[✂]	No	No	14.97	High impact INNS recorded within 1km of source however low risk of INNS within source water (borehole). Option includes treatment processes within catchment (Lightshaw borehole) and outside (Croft & Kenyon boreholes) sufficient to remove all life stages of potential aquatic INNS. Potential wash out points located at Croft PS (Kenyon & Croft boreholes) and WTW which lies within catchment (Lightshaw borehole) and outside catchment (Kenyon & Croft boreholes).	This option is considered Low Risk for the transfer of INNS outside of the source catchment however it is recommended that all reasonable biosecurity measures are adopted to include a site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff and general check, clean, dry protocols.
STTA4	[✂]	[✂]	[✂]	[✂]	No	No	n/a*	This option will facilitate the potential to reverse flow within the existing **treated water** section of the Vyrnwy Aqueduct between Norton Tower and Oswestry WTW. Treated water from the Dee Aqueduct will be pumped via existing, buried break pressure tanks within the Vyrnwy Aqueduct as far as Oswestry WTW.	This option is considered Low Risk for the transfer of INNS however it is recommended that all reasonable biosecurity measures are adopted to include site specific biosecurity strategy that will include improved awareness of INNS amongst all operational staff moving between operational sites.

*SAI-RAT risk assessment not undertaken as operational phase of this option involves only the movement of treated water, within existing buried pipelines, presenting no pathway for INNS contamination.

4. Summary of Assessment Results

An INNS screening assessment has been undertaken of the 14 NWT supply options.

One source option (WR049D) was considered to present a potentially **High** risk of INNS transfer (Table 4.1) although it is considered the risk can be mitigated to **Medium** through site specific biosecurity measures. A further two source options (STT041B & WR015) were considered to present a potentially **Medium** risk of INNS transfer (Table 4.2) although the risk was reduced to **Low** with the introduction of site specific biosecurity measures. The remaining eleven source options were considered to have a **Low** risk of INNS transfer.

Assigning a High or Medium level of risk to an option means that the activities that form part of the option pose a potential risk of either (i) deterioration of WFD status and/or (ii) the inability of a water body to attain its target status. In such cases, further assessment is required to provide a more option-specific and robust conclusion, which may include the requirement for bespoke design measures and/or environmental mitigation in order to ensure that WFD objectives are not compromised.

Table 4.1 NWT option that has a potential un-mitigated 'High' risk of spreading INNS from the source water

Option Number	Option Name	Comments
WR049D	[✂]	[✂]

Table 4.2 NWT options that have a potential un-mitigated 'Medium' risk of spreading INNS from the source water

Option Number	Option Name	Comments
STT041B	[✂]	[✂]
WR015	[✂]	[✂]

Appendix A
INNS found in the UK

Table A.3 Classification of aquatic alien species found in the UK in terms of their potential impact on native habitats and biota (Source UKTAG, 2013)

	Common Name	Species	Plant/ Animal	Habitat	Species with updated risk assessments by GBNNSS
High Impact	Australian swamp stonecrop	*Crassula helmsii*	P	L	Yes
	Floating pennywort	*Hydrocotyle ranunculoides*	P	R	Yes
	Water fern	*Azolla filiculoides*	P	R/L	Yes
	Parrot's feather	*Myriophyllum aquaticum*	P	L	Yes
	Curly water-thyme	*Lagarosiphon major*	P	L	Yes
	Water primrose	*Ludwigia grandiflora*	P	L	Yes
	Canadian pondweed	*Elodea canadensis*	P	R/L	Pending
	Nuttall's pondweed	*Elodea nuttallii*	P	R/L	Pending
	Japanese knotweed	*Fallopia japonica*	P	R	Yes
	Giant knotweed	*Fallopia sachalinensis*	P	R	Yes
	Japanese knotweed/ Giant knotweed hybrid	*Fallopia x bohemica*	P	R	No
	Himalayan balsam	*Impatiens glandulifera*	P	R	Pending
	Giant hogweed	*Heracleum mantegazzianum*	P	R	Pending
	Rhododendron	*Rhododendron ponticum* (+ hybrids)	P	R	No
	North American signal crayfish	*Pacifastacus leniusculus*	A	R/L	Yes
	Red swamp crayfish	*Procambarus clarkii*	A	R/L	Yes
	Virile crayfish	*Orconectes virilis*	A	R/L	Yes
	Freshwater amphipod	*Dikerogammarus villosus*	A	R/L	Yes
	Freshwater amphipod	*Dikerogammarus haemobaphes*	A	R/L	Yes
	Mysid crustacean	*Hemimysis anomala*	A	R/L	No
	Chinese mitten crab	*Eriocheir sinensis*	A	R/T/C	Yes
	Zebra mussel	*Dreissena polymorpha*	A	R/L	Yes
	Asiatic clam	*Corbicula fluminea*	A	R/L	Yes
	Topmouth gudgeon	*Pseudorasbora parva*	A	L	Yes
	Goldfish	*Carassius auratus*	A	R/L	No
Moderate Impact	Carolina water-shield	*Cabomba caroliniana*	P	R/L	Yes
	Large-flowered water-thyme	*Egeria densa*	P	L	Yes
	Marbled crayfish	*Procambarus* spp.	A	R/L	Yes
	Spiny cheeked crayfish	*Orconectes limosus*	A	R/L	Yes
	Pikeperch (zander)	*Sander lucioperca*	A	R/L	Yes
	Jenkins' spire shell	*Potamopyrgus antipodarum*	A	R/L/T/C	Yes

	Common Name	Species	Plant/ Animal	Habitat	Species with updated risk assessments by GBNNSS
Low Impact	Sweetflag	*Acorus calamus*	P	R	No
	Montbretia	*Crocosmia x crocosmiiflora*	P	R	No
	Orange balsam	*Impatiens capensis*	P	R	No
	Lupin	*Lupinus nootkatensis*	P	R	No
	Pink purslane	*Montia sibirica*	P	R	No
	Cape pondweed	*Aponogeton distachyos*	P	L	No
	Water hyacinth	*Eichhornia crassipes*	P	L	Yes
	Giant butterbur	*Petasites japonicus*	P	R/L	Pending
	Tapegrass	*Vallisneria spiralis*	P	R	No
	Orfe	*Leuciscus idus*	A	R/L	No
	Freshwater amphipod	*Crangonyx pseudogracilis*	A	R/L	Yes
	Noble crayfish	*Astacus astacus*	A	R/L	Yes
	Narrow-clawed (Turkish) crayfish	*Astacus leptodactylus*	A	R/L	Yes
	Pumpkinseed	*Lepomis gibbosus*	A	R/L	Pending
	Rainbow trout	*Oncorhynchus mykiss*	A	R/L	No
	Grass carp	*Ctenopharyngodon idella*	A	R/L	No
Unknown Impact [Considered High]	Least duckweed	*Lemna minuta (minuscula)*	P	R/L	Pending
	Monkey-flower	*Mimulus cupreus,* *M. guttatus and hybrids*	P	R	Pending
	Other non-native *Myriophyllum* species		P	L	Pending
	Freshwater coelenterate	*Craspedacusta sowerbyi*	A	R/L	No
	Freshwater triclads	*Dugesia tigrina* *Phagocata woodworthi* *Planaria torva*	A	R/L	No
	Freshwater mollusc - Asiatic clam	*Corbicula fluminea*	A	R/L	Pending
	Freshwater molluscs	*Ferissia wautieri* *Marstoniopsis scholtzi* *Menetus dilatatus* *Musculium transversum* *Physa acuta* *Physa gyrina* *Physa heterostropha*	A	R/L	No
	Freshwater oligochaetes	*Branchiura sowerbyi* *Limnodrilus cervix*	A	R/L	No
	Polychaete	*Hypania invalida*	A	R/L/T	No
	Freshwater copepods	*Achtheres percarum* *Ergasilus briani* *Ergasilus sieboldi* *Neoergasilus japonicus* *Tracheliastes polycolpus*	A	R/L	No
	Other freshwater malacostracans	*Asellus communis* *Corophium curvispinum*	A	R/L	No
	Brook charr	*Salvelinus fontinalis*	A	R/L	No
	Black bullhead	*Ameiurus melas*	A	R/L	Pending
	Sunbleak	*Leucaspius delineatus*	A	L	Pending
	Bitterling	*Rhodeus amarus*	A	R/L	No

	Common Name	Species	Plant/ Animal	Habitat	Species with updated risk assessments by GBNNSS
	Sterlet/Sturgeons	All species except *A. sturio*, which is protected on Schedule 5 of the Wildlife & Countryside Act	A	R/T/C	Pending
	European (wels) catfish	*Silurus glanis*	A	R/L	Pending
	South American waterweed	*Elodea callitrichoides/Hydrocharis callitrichoides*	P	R/L	No
	Swordleaf rush	*Juncus ensifolius*	P	R/L	No
	Floating primrose willow	*Ludwigia peploides*	P	R/L	No
	Freshwater amphipod	*Echinogammarus ischnus*	P	R/L/T	No
	Freshwater amphipod	*Echinogammarus trichiatus*	P	R/L/T	No
	White river crayfish	*Procambarus acutus*	P	R/L	Pending
	Freshwater cnidarian	*Cordylophora caspia*	P	R/L/T/C	No
Waiting List	Water Fern – high impact	*Azolla caroliniana*	P	R/L	Pending
	American skunk-cabbage – high impact	*Lysichiton americanus*	P	R/L	Yes
	Common carp – high impact	*Cyprinus carpio*	A	R/L	Pending
	Quagga mussel – high impact	*Dreissena rostriformis bugensis*	A	R/L	Yes

Habitat classification: R, rivers; L, lakes; T, transitional waters; C, coastal waters

Appendix B
Functional groups

The following table provide the list of functional groups. This information is provided for both animal and plant categories (juv = juvenile, veg = vegetative)[19].

Functional group categories (animals)	Functional group categories (plants)
Mobile, juv <1mm, eggs	Seed, aquatic, annual
Sessile, juv <1mm, eggs	Veg, aquatic, annual
Mobile, juv >1mm, eggs	Seed + veg, aquatic, annual
Sessile, juv >1mm, eggs	Seed, riparian, annual
Mobile, juv <1mm, no eggs	Veg, riparian, annual
Sessile, juv <1mm, no eggs	Seed + veg, riparian, annual
Mobile, juv >1mm, no eggs	Seed, aquatic, perennial
Sessile, juv >1mm, no eggs	Veg, aquatic, perennial
	Seed + veg, aquatic, perennial
	Seed, riparian, perennial
	Veg, riparian, perennial
	Seed + veg, riparian, perennial
	Seed, aquatic + riparian, perennial
	Seed, aquatic + riparian, annual
	Veg, aquatic + riparian, perennial
	Veg, aquatic + riparian, annual
	Seed + veg, aquatic + riparian, perennial
	Seed + veg, aquatic + riparian, annual

[19] Environment Agency 2021. SRO Aquatic INNS Risk Assessment Tool.