ANNEX B3.2.4

INNS Assessment

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

Grand Union Canal Transfer SRO

Affinity Water, Severn Trent Water, Canal & River Trust

MOTT MACDONALD

Grand Union Canal Strategic Resource Option

Invasive and Non-Native Species Risk Assessment

August 2022

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1 Introduction

1.1 Background

Ofwat, the economic regulator for the water and sewerage sectors in England and Wales, has identified the potential for water companies to jointly deliver strategic water resource schemes to secure long-term water supply resilience while protecting the environment.

To support the progression of these Strategic Resource Options (SROs), the Regulatory Alliance for Progressing Infrastructure Development (RAPID) has been established, comprised of representatives from Ofwat, the Environment Agency and the Drinking Water Inspectorate. RAPID has produced guidance for progressing each SRO which is aligned to a formal gated process to ensure that at each gate:

- Companies are progressing strategic water resource solutions that have been allocated funding at PR19 or have subsequently joined the programme.
- Costs incurred in doing so are efficient.
- Solutions merit continued investigation and development during the period 2020 to 2025.

The timelines for the assessment gates are shown in Figure 1.1 below; the Grand Union Canal (GUC) SRO is on the standard gate timeline and is currently at Gate 2.

Figure 1.1: Gated process for potential strategic regional water resource solutions[1]

[1] Source: Regulators' Alliance for Progressing Infrastructure Development, Forward programme 2021-22, March 2021, available online at https://www.ofwat.gov.uk/wp-content/uploads/2021/03/RAPID-Forward-programme-2021_22.pdf, accessed 07/03/2022.

1.2 Grand Union Canal SRO

The GUC SRO has been jointly developed in partnership between Severn Trent Water (STW), Affinity Water (AW) and the Canal and River Trust (the Trust). At the start of Gate 1 a long-list of sub-option routes were derived for the GUC SRO. The discharge options were then shortlisted to three route options by the start of Gate 2 based on the following criteria: environmental and societal impacts; operational flexibility and resilience; operational and embedded carbon; and cost. Of these, Option Route 3 was selected. Optioneering was also undertaken with regards to abstraction locations. A site at Leighton Buzzard was ultimately selected, further details on the optioneering process can be found in the Gate 2 submission.

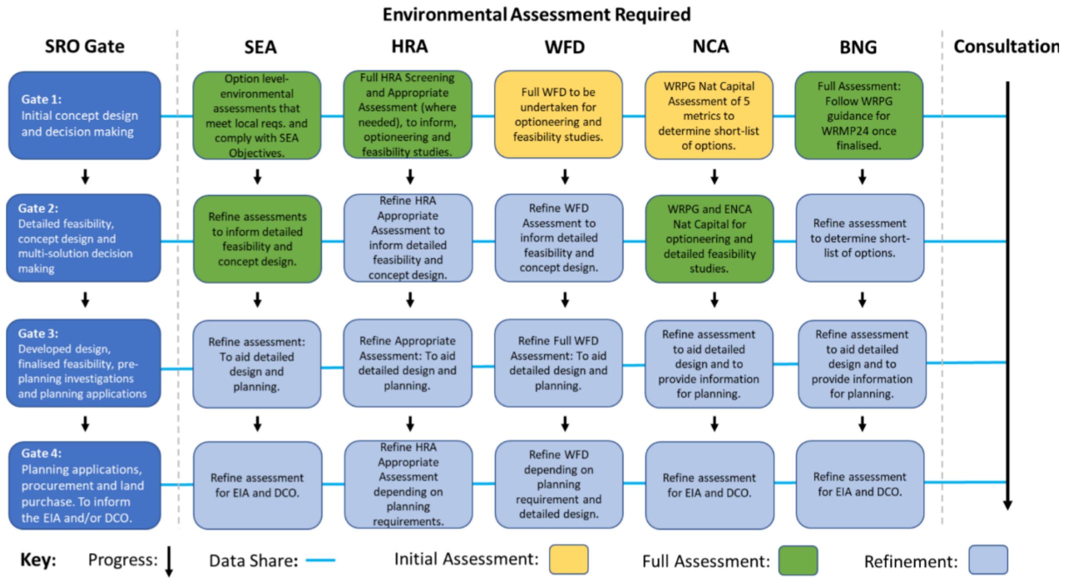
The single solution assessed at Gate 2 includes the pipeline from Minworth to Atherstone (Route 3), the canal transfer to Leighton Buzzard and the abstraction and treatment works at this location (hereafter referred to as 'the scheme') and will be assessed in the following Gate 2 Environmental assessments:

- Natural Capital (NC) and Biodiversity Net Gain (BNG) (Annex B3.3.2)
- Environmental Appraisal Report (EAR) (Annex B3.3.5)
- Fish survey report (Annex B2.3.2)
- Habitats and protected species desk study (Annex B3.2.6)
- Habitats Regulations Assessment (HRA) (Annex B3.3.3)
- Invasive and non-native species (INNS) risk assessment report (Annex B3.2.4)
- Sediment report (Annex B3.2.5)
- Strategic Environmental Assessment (SEA) (Annex 3.3.1)
- Waterbody connections report (B3.2.1)
- Water Framework Directive Assessment (WFD) (B3.3.4)

This report forms the INNS risk assessment report. Figure 1.2 below shows the integration of the statutory assessment reports (i.e. SEA, HRA, WFD, NCA/BNG) with the RAPID gated process. This schematic is taken from the All Companies Working Group (ACWG) guidance that was released in Gate 1. While this is still largely relevant and followed, it has been somewhat superseded by the RAPID Gate 2 guidance[2], which the Gate 2 assessments have followed. In addition to the statutory assessments listed in Figure 1.2, the scheme has also carried out additional assessments, including this INNS risk assessment report.

[2] Strategic regional water resource solutions guidance for gate two, Regulators' Alliance for Progressing Infrastructure Development, February 2022, available online at https://www.ofwat.gov.uk/wp-content/uploads/2022/02/Strategic-regional-water-resource-solutions-guidance-for-gate-two_Feb_2022.pdf, accessed 09/02/2022.

Figure 1.2: Environmental Assessment Integration with SRO Gates[3]



A

1.3 Scheme description

The scheme is shown below in Figure 1.3 and described in detail in the Annex A1, Engineering CDR (WSP, 2022). It will comprise a transfer rising main from Minworth Wastewater Treatment Works (WwTW) to the Coventry Canal at the top of Atherstone lock flight. Once outside the Minworth site, and past the M42 and HS2 corridors, the rising main will pass through agricultural land until reaching the outskirts of Atherstone, a small market town within North Warwickshire. The rising main will discharge to the canal side at Coleshill Road, via a new discharge structure sized to avoid deleterious flow velocities and shears.

Transferred water will then progress along the Coventry Canal by gravity into the Oxford Canal at Hawkesbury Lock. Flows will need to bypass the Hawkesbury lock via a low lift pumping station.

The Oxford Canal will then convey the water to the Grand Union Canal at Braunston. The majority of the flow along the Oxford Canal will be by gravity, however a pumping station will be required to bypass the locks at Hillmorton.

At Braunston a bypass pumping station will be required to lift flows from near Braunston Marina to the top lock just before Braunston Tunnel. From Braunston to the abstraction and treatment site at Leighton Buzzard, four additional lock bypass pumping stations will be required south of Milton Keynes at Fenny Stratford, Stoke Hammond, Three Locks and Leighton. The Grand Union Canal section will also require eight gravity bypasses around “downflow” locks at the Wilton Marine Lock Flight, Stoke Bruerne Lock Flight and Cosgrove Lock.

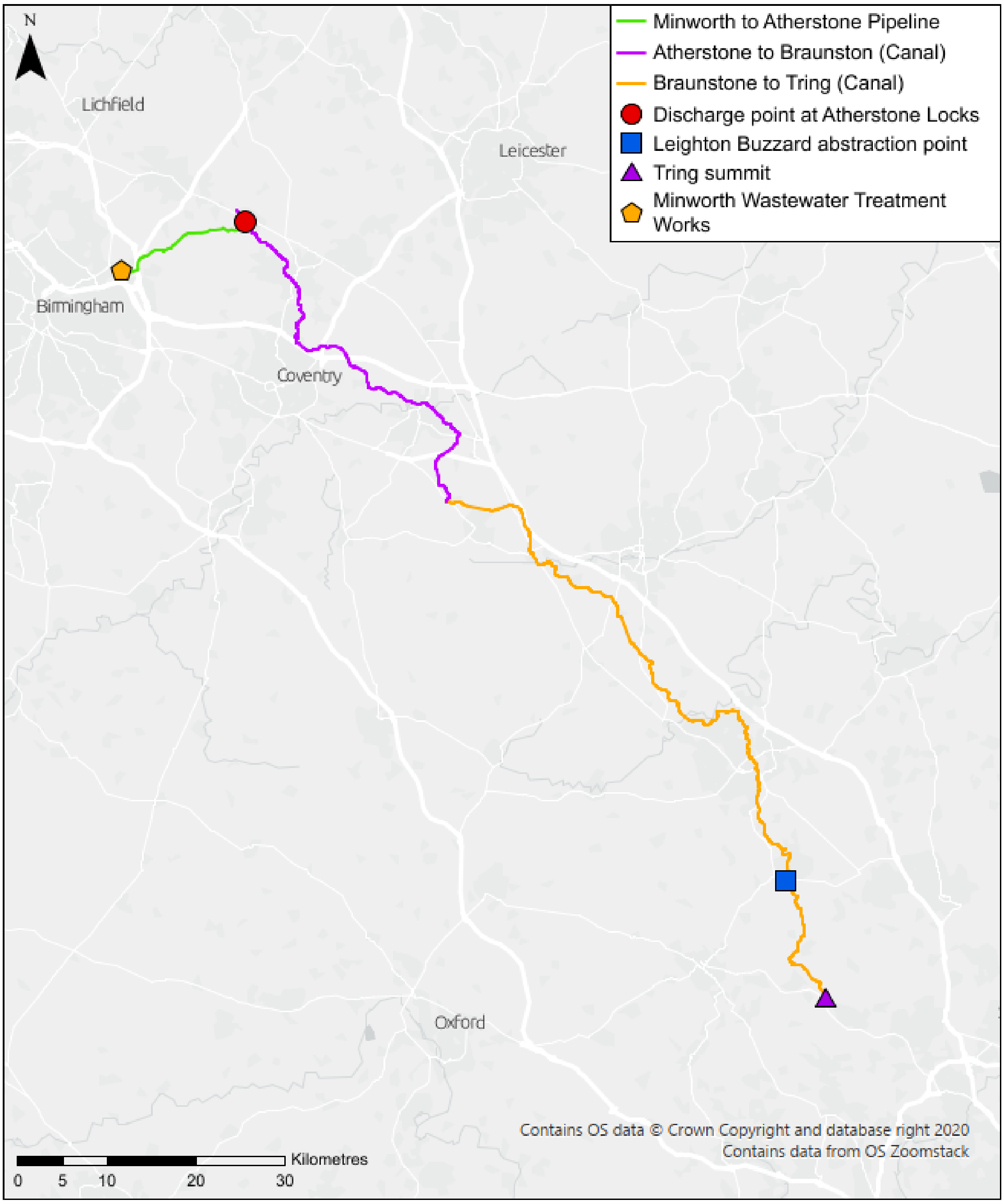
Flow will be abstracted from the Grand Union Canal just south of the A4146 bridge, after the River Ouzel. The site currently proposed at Gate 2 for the treatment works is on relatively flat land slightly raised from the river and canal, although further investigations will be carried out at Gate 2/3 to determine the precise location. Flow will therefore need to cross the River Ouzel within a new, short pipeline and be pumped into an operational raw water storage reservoir before gravitating into the first stage of treatment. Additional interstage pumping in the treatment

[3] Source: All Companies Working Group, WRMP environmental assessment guidance and applicability with SROs, Mott MacDonald, October 2020

works will be required with final high lift pumps transferring potable treated water to a new clean water holding tank at the existing Chaul End Water Supply Reservoir (WSR).

During the option selection process, it was determined this option would have the least overall cost, lowest environmental impact and greatest opportunity for net gain and public benefit. The slightly higher operational cost when compared to Route 1, due to longer transfer from Minworth to Atherstone, can be partially offset by energy recovery from the break tank to outfall.

Figure 1.3: The scheme



1.4 Assumptions

The following assumptions have been used within the assessment:

- The design assumptions stated in the WSP Gate 2 Position Paper – Route Selection technical note[4] can be applied to the Gate 2 Environmental Assessments, including assumption that >50mm depth change requires towpath raising is valid.
- The assessment is based on a 'worst-case' 100% utilisation of the SRO.
- Tring represents the SE limit of influence of the SRO.
- The volume of water passing NW (after discharging from pipeline) due to the locks opening at Atherstone is deemed to be of minimal change.
- The risk of fish and INNS travelling NW of Atherstone is not increased due to the scheme.
- It has been assumed that there would be no measurable change to flows to connected water bodies through linkages such as waste weirs. This is assumed on the basis that the scheme would be designed to retain additional water within the route rather than it being lost to other water bodies. However, this assumption should be revisited in future iterations of the risk assessment in light of evolving scheme design and ongoing hydrological modelling work.

[4] Gate 2 Position Paper – Route Selection, WSP Technical Note, 25 January 2022

2 Methodology

2.1 Background

The transfer of water from one location to another may increase the risk of spreading INNS. The introduction of INNS to a waterbody can have a detrimental effect on ecosystem structure and functioning, as well as jeopardising compliance with environmental legislation. For example, INNS pose a threat to achieving WFD objectives, with over 70% of WFD waterbodies at risk of deterioration due to INNS pressures by 2027[5]. Additionally, the presence of INNS in water company assets may compromise the supply of drinking water and the safe return of treated wastewater to the environment. It is therefore essential that water companies understand the key pathways of INNS spread between their assets and the wider environment in order to implement appropriate mitigation measures.

2.2 Assessment Objectives

The overall aim of this report was to present an assessment of the potential increase in INNS risk arising from the scheme. This overall aim was underpinned by the following objectives:

1. To establish if the scheme will introduce a hydrological connection between previously isolated catchments.
2. To identify INNS within an appropriate study area to understand the current INNS distribution.
3. To outline legislative context of INNS risk assessment.
4. To use the SRO Aquatic INNS Risk Assessment Tool[6] (SAI-RAT) developed by APEM Ltd on behalf of the Environment Agency to quantify the INNS risk associated with the scheme based on the conceptual design information currently available.
5. To review potential biosecurity options for implementation by the client and other relevant stakeholders to mitigate the INNS risk associated with the scheme.

2.3 Legislative Context

The translocation of INNS is subject to regulation under the following national legislation:

- Under the Wildlife and Countryside Act 1981 (as amended), it may be an offence to release or allow to escape into the wild any animal which 'is of a kind which is not ordinarily resident in and is not a regular visitor to Great Britain in a wild state'; or is included in Part I of Schedule 9.
- Under the Wildlife and Countryside Act 1981 (as amended), it may be an offence to plant or otherwise cause 'to grow in the wild any plant which is included in Part II of Schedule 9'.
- The INNS (Amendment etc.) (EU Exit) Regulations 2019 ensures the continued operability of EU legislation which provides for a set of measures to combat the spread of INNS on the list of EU concern, through prevention, early detection and eradication, and management.
- Under the Invasive Alien Species (Enforcement & Permitting) Order 2019, it may be an offence to release, cause to escape, plant, or grow species of animal or plant 'not ordinarily resident in' and 'not a regular visitor to Great Britain in a wild state', or otherwise listed in Schedule 2.

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[5] Hiley & Renals (2017). Price Review 2019 (PR19) Driver Guidance. Driver Name: Invasive Non-Native Species (INNS).

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

- Waterbodies initially classified as 'High Status' (representing near-natural conditions) under the Water Environment (WFD) (England and Wales) Directive 2017, will be reclassified to the lesser 'Good Status' if populations of High Impact INNS are introduced. High Impact INNS are identified on the current aquatic alien species list produced by the Water Framework Directive UK Technical Advisory Group (WFD-UKTAG, 2015).

The proposed water source for the scheme is Minworth WwTW. Consequently, water added to the canal network will be treated (details to be confirmed at later Gate stages), and it is assumed for the purposes of this assessment that it is therefore not likely to introduce any new INNS to the receiving waterbodies. The risk of contravening INNS legislation for the transfer of water from Minworth to Atherstone via a pipeline is therefore considered to be low.

The input of treated water to the canal network will increase flow between the discharge point at Minworth and the abstraction point at Leighton Buzzard. This increase in flow could facilitate the spread of INNS already present in the canal network to unimpacted sites further downstream. Species listed in the Wildlife and Countryside Act (as amended) 1981 Schedule 9, INNS (Amendment etc.) (EU Exit) Regulations 2019 and Invasive Alien Species (Enforcement & Permitting) Order 2019 have been recorded within the study area. However, many of the species listed in the relevant legislation are already well established in the canal network.

It is assumed for the purpose of this study that the scheme will not cause increased water flow into connected waterbodies as this would present a risk to any WFD High Status river waterbodies not currently containing High-Impact INNS. However, this risk should be re-evaluated once other investigations have assessed this.

2.4 Study Area

As described in Section 2, the scheme involves the transfer of treated wastewater from Minworth WwTW to Leighton Buzzard via pipeline from Minworth to Atherstone then transfer via the Coventry Canal and GUC. The route was divided into the following two sections for the purposes of this risk assessment:

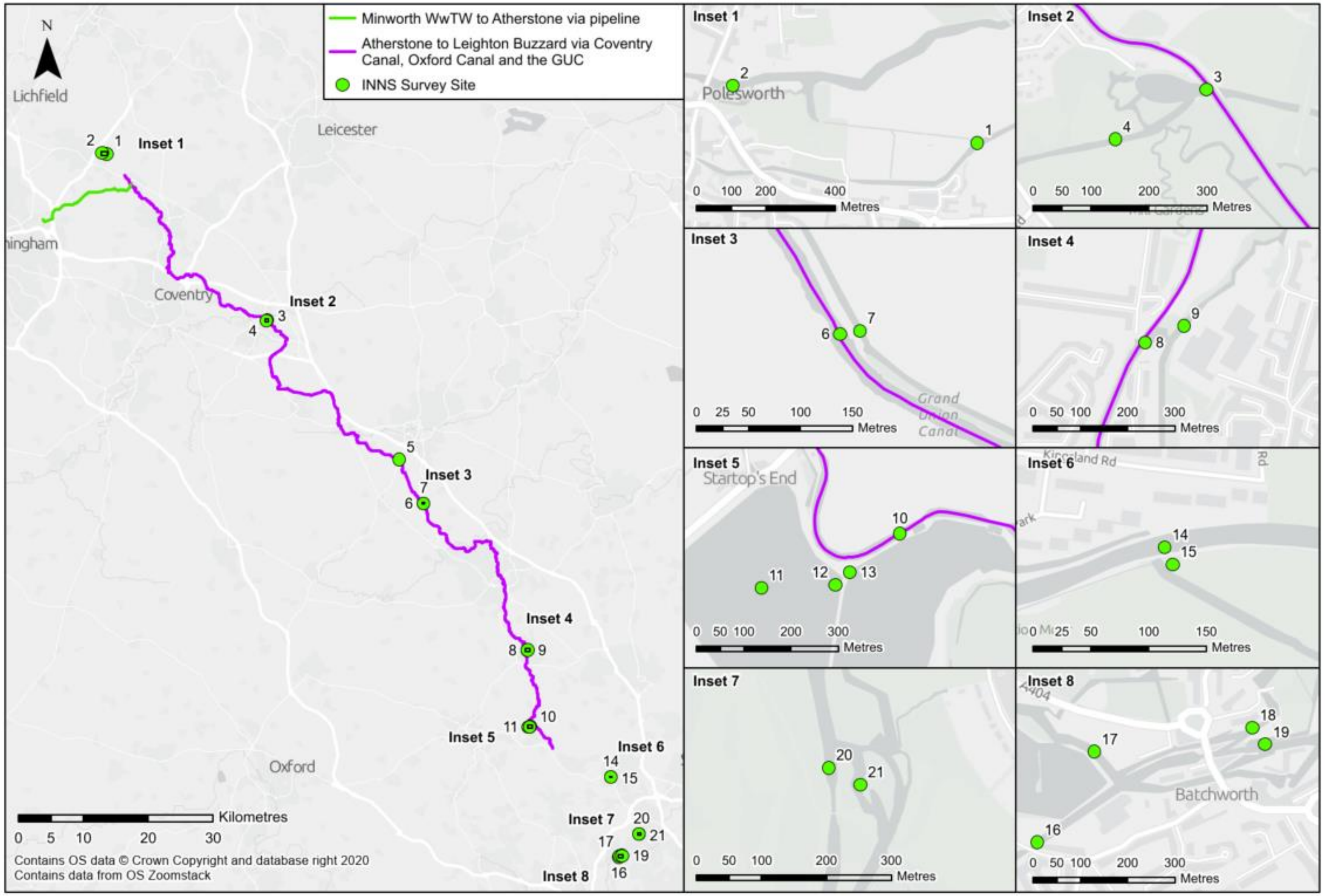
- Minworth WwTW to Atherstone via a pipeline.
- Atherstone to Leighton Buzzard via the Coventry Canal, Oxford Canal and the GUC.

Environment Agency guidance for SRO INNS risk assessments specifies that the study area should be a 1km buffer zone either side of the proposed water transfer route.

As part of this risk assessment, two new assets, Leighton Buzzard Storage Reservoir and Leighton Buzzard WTW were also evaluated.

The route is shown in Figure 1.3 survey sites are shown in Figure 2.1, noting that survey design preceded the preferred route selection and therefore includes sites from a wider area.

Figure 2.1: GUC SRO INNS risk assessment study area.



2.5 High Level Screening Against EA Guidance

The Environment Agency position statement Managing the Risk of Spread of Invasive Non-Native Species Through Raw Water Transfers[7] outlines the organisation's position on how it will manage INNS risks associated with raw water transfers. The key points of relevance to this report are as follows:

- The focus of the Environment Agency's approach is on the pathways that the transfers create, not on current INNS distribution.
- New schemes that create a hydrological connection between isolated catchments must have mitigation measures in place to ensure INNS cannot be spread by the new transfer.
- Where water transfer into another watercourse remains the preferred solution, mitigation will need to be fail safe, resilient, and completely effective for all life stages and forms (e.g., plant propagules, animals, microscopic organisms and larval stages).
- Where catchments are already connected, a risk assessment will be required, which the Environment Agency will use to decide whether subsequent mitigation is required, to ensure the risk of INNS transfer is not significantly increased.

The scheme was screened to determine if it will create a link between isolated catchments, as mapped in the Environment Agency document Invasive Non-Native Species Isolated Catchment Mapping[8].

2.6 Desk Study

Open-source macroinvertebrate, macrophyte and fish data for the period 1965 to 2020 were obtained for the study area as relevant to the preferred route option from the Environment Agency Ecology and Fish Data Explorer app[9] and the National Biodiversity Network (NBN) Atlas online records[10]. The data were screened against Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) and WFD-UKTAG guidance[11] to identify INNS present within the study area.

In considering the likely distribution of invasive species, as discussed in Section 3.5, these records were considered alongside the following sources:

- Gate 1 ecological literature review and gap analysis (Grand Union Canal Project Management Board (GUC PMB), 2021).[12]
- INNS surveys undertaken by Mott MacDonald during November 2021 and April 2022 (see Sections 2.7 and 3.3).
- Ecological surveys undertaken by APEM Ltd in 2021 (see Sections 2.8 and 3.4).

[7] Environment Agency (2017). Managing the Risk of Spread of Invasive Non-Native Species Through Raw Water Transfers. Position 1321_16.
[8] Environment Agency (2018). Invasive Non-Native Species Isolated Catchment Mapping. v3.

[9] EA Ecology and Fish Data Explorer app available online at: https://environment.data.gov.uk/ecology/explorer/
[10] NBN Atlas available online at: https://nbnatlas.org/
[11] WFD-UKTAG (2015). UK Technical Advisory Group on the Water Framework Directive. Revised classification of aquatic alien species according to their level of impact. Public working draft.
[12] Grand Union Canal PMB (2021). Grand Union Canal Strategic Transfer – Ecological Literature Review and Gap Analysis. Summary Report. Report Reference: 33201527 RSRD3. Draft.

2.7 Field Surveys

2.7.1 Survey Design

Field surveys were undertaken by Mott MacDonald during November 2021 and April 2022 with the aim of detecting INNS and generating positive records which could be considered alongside any existing data.

Survey design took place prior to selection of a preferred route, therefore some sites scoped in for survey are now outside of the current scheme area (see Table 2.1). Many of these sites were located in south of the GUC where survey sites were heavily clustered due to the extensive connectivity with chalk streams and potentially high numbers of invasive species found with this urbanised area. Despite this, all survey results remain useful for understanding INNS distribution and dispersal within the canal network.

The distribution of sites was intended to capture possible connections between the canal network and other major waterbodies, in particular potential connections to major river catchments. The three reservoirs at Tring (Startopsend, Tringford and Marsworth) were also sampled for eDNA due to possible connectivity to the GUC. At the time of survey design, potential connectivity between the canal network and other waterbodies was being investigated, and the INNS survey design was based primarily on the use of open-source aerial imagery and mapping to indicate possible connections.

As shown in Table 2.1 and Fig. 2.1, surveys were planned at nine locations along the canal network (locations A to I). At each of these locations, between one and four survey sites were located, representing the canal and potentially connected waterbodies, to give a network of 21 survey sites.

Grid references for continued monitoring locations redacted

Table 2.1: INNS field survey sites

Location	Site no.	Site description	NGR	Survey date
A: Polesworth*	1*	GUC near River Anker connection*	[redacted]	06/04/2022
A. Polesworth*	2*	River Anker near GUC connection*	[redacted]	06/04/2022
B. Rugby	3	Oxford Canal near River (Warwickshire) Avon crossing	[redacted]	05/04/2022
B. Rugby	4	River (Warwickshire) Avon near Oxford Canal crossing	[redacted]	05/04/2022
C. Nr. Northampton	5	GUC near Northampton Arm intersection	[redacted]	08/11/2021
D. Nr. Stoke Bruerne	6	GUC near River Tove crossing	[redacted]	05/04/2022
D. Nr. Stoke Bruerne	7	River Tove near GUC crossing	[redacted]	05/04/2022
E. Leighton Buzzard	8	GUC near River Ouzel connection	[redacted]	08/11/2021
E. Leighton Buzzard	9	River Ouzel near GUC connection	[redacted]	08/11/2021
F. Tring	10	GUC at Tring	[redacted]	09/11/2021
F. Tring	11	Startopsend Reservoir	[redacted]	09/11/2021
F. Tring	12	Tringford Reservoir	[redacted]	09/11/2021
F. Tring	13	Marsworth Reservoir	[redacted]	09/11/2021
G. Hemel Hempstead*	14*	GUC near River Bulbourne connection*	[redacted]	09/11/2021
G. Hemel Hempstead*	15*	River Bulbourne near GUC connection*	[redacted]	09/11/2021
H. Rickmansworth*	16*	GUC near River Colne connection*	[redacted]	10/11/2021
H. Rickmansworth*	17*	River Colne near GUC connection*	[redacted]	10/11/2012
H. Rickmansworth*	18*	River Chess near GUC connection*	[redacted]	10/11/2021
H. Rickmansworth*	19*	GUC near River Chess connection*	[redacted]	10/11/2021
I. Watford*	20*	River Gade near GUC connection*	[redacted]	11/11/2021
I. Watford*	21*	GUC near River Gade connection*	[redacted]	11/11/2021

* Survey site is located outside of the scheme area

2.7.2 Physical Survey Overview

At each canal and river site, the Mott MacDonald survey comprised the following elements:

- Collection of two environmental DNA (eDNA) samples: one to detect fish species, and one to detect bivalve molluscs and signal crayfish (*Pacifastacus leniusculus*).
- Manual search for non-native aquatic invertebrates using a long-handled pond net.
- Visual search for non-native aquatic and riparian plants.

At the three reservoir sites, eDNA samples to detect fish species, bivalve molluscs and signal crayfish were collected.

Surveys were planned to avoid the winter period (December-February) to avoid low temperature conditions and increase the chances of detecting species. Due to access restrictions, six of the nine planned survey locations (comprising 15 survey sites), were surveyed in November 2021, whilst the remaining three locations (comprising six survey sites) were surveyed in April 2022 when temperatures were sufficiently elevated. Survey dates are detailed in Table 2.1.

2.7.2.1 Environmental DNA

Environmental DNA (eDNA) sampling kits were provided by NatureMetrics and the samples were collected in accordance with the instructions provided. In summary, up to 1,000mL of sampled water was filtered through an encapsulated disk filter immediately upon collection using a syringe. A preservative solution was then added to the filter units and they were promptly sent to NatureMetrics for analysis.

For river sites, filtered samples comprised five sub-samples that were collected from different parts of the flow along a 50m survey reach. As canals are usually poorly mixed, sampling of canal sites involved collection and subsequent mixing of 20 sub-samples from the water's edge at a range of locations along a 50m sample reach. Reservoir sampling involved the collection of 20 sub-samples of water at approximately evenly-spaced points around the waterbody perimeter, where access allowed.

2.7.2.2 Macroinvertebrates

Macroinvertebrates were sampled with a standard pond net. At each site a number of samples were collected to represent the range of habitats present along a minimum 50m river/canal survey reach. Sample collection typically involved 15 to 60 seconds of active net sampling to collect an appropriate sample volume for examination. Upon collection, individual samples were examined in the field in a white plastic tray until the analyst was sufficiently confident in the likely presence or absence of INNS.

2.7.2.3 Plants

Aquatic and riparian non-native plant species observed within the 50m river/canal survey reach were recorded. A grapnel was used to aid the collection of any potential non-native aquatic plant species requiring closer examination.

2.7.3 Biosecurity Considerations

Biosecurity measures were implemented to prevent the spread of pathogens and INNS between survey sites. Different sampling equipment was used in each waterbody. Substrate (for example silt or sand) and plant fragments were removed from survey equipment and personal protective equipment (including waders) between visits to different survey locations. Additionally, all equipment was washed using Virkon® Aquatic disinfectant between sites, in accordance with the manufacturer's instructions.

2.7.4 Laboratory Processing

Laboratory processing of eDNA samples was conducted by NatureMetrics. Commercially available extraction kits were used to extract eDNA from the disk filters and to purify the extractant to remove inhibitors. Analysis of all samples included 12 replicates per sample, in the presence of positive and negative controls.

Signal crayfish were targeted using species-specific primers and probes, and amplified by quantitative polymerase chain reaction (qPCR).

For fish and bivalve molluscs, purified DNAs were amplified with polymerase chain reaction (PCR) using an appropriate gene region (12S rRNA for fish and 16S rRNA for venerid mussels). Following successful DNA amplification for fish and bivalve molluscs, the replicates were pooled and purified, and sequencing adapters were added. The final library was sequenced using an Illumina MiSeq V3 kit at 10 pM with a 20% PhiX spike in. The resulting sequence data were then processed using a custom bioinformatic pipeline for taxonomic assignment.

2.8 APEM Ltd Ecological Monitoring 2021

In support of the scheme, aquatic ecological monitoring was undertaken by APEM Ltd in 2021[13]. Field surveys for INNS were undertaken at nine locations along the upper, middle and lower sections of the GUC. Surveys comprised the following elements:

- Pond net sampling by scraping of the canal wall and associated structures.
- Multi-habitat pond net sampling.
- Sampling of substrate using pond nets or net hauls as appropriate for channel depth.
- 100m surveys of aquatic and riparian non-native macrophytes using a grapnel to sample to open water canal habitats.

Survey locations are presented in Table 2.2 below.

Table 2.2: APEM Ltd INNS survey locations

Grid references for continued monitoring locations redacted

Location ID	Location Name	Grid Reference	Notes
IN-01	Birmingham & Fazeley Canal Minworth	[redacted]	Possible discharge location
IN-02	GUC, Atherstone	[redacted]	Possible discharge location
IN-03	GUC, Leamington Trough Pound	[redacted]	Possible discharge location
IN-04	GUC, River Tove	[redacted]	At River Tove
IN-05	GUC, River Ouzel	[redacted]	At River Ouzel
IN-06	GUC, Tring	[redacted]	U/S all chalk stream interaction
IN-07	GUC, River Bulbourne	[redacted]	At River Bulbourne
IN-08	GUC, Hemel Hempstead	[redacted]	At River Gade
IN-09	GUC, Batchworth Lock	[redacted]	At three rivers: Gade, Chess, Colne

[13] APEM (2022) Grand Union Canal Strategic Transfer - Ecological Monitoring: Phase 2 Report. DRAFT. 330201428R2D1

2.9 Risk Assessment

2.9.1 Tool Overview

The SRO Aquatic INNS Risk Assessment Tool (SAI-RAT) used for this investigation was developed by APEM Ltd on behalf of the EA. The tool builds upon other assessment tools such as the Northumbrian Water Group (NWG) raw water transfer assessment tool and the Wessex Water asset assessment tool, to provide a standardised approach to quantifying the INNS risk associated with SROs.

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. An extended functional group mechanism has been included in the tool to account for future risks rather than only examining species known to be currently present within the vicinity of transfer routes and assets. These functional groups are listed in Table 2.3.

Table 2.3: INNS functional groups

Animals	Plants
Mobile, juveniles < 1mm, eggs	Seed, aquatic, annual
Sessile, juveniles < 1mm, eggs	Vegetative, aquatic, annual
Mobile, juveniles > 1mm, eggs	Seed + vegetative, aquatic, annual
Sessile, juveniles > 1mm, eggs	Seed, riparian, annual
Mobile, juveniles < 1mm, no eggs	Vegetative, riparian, annual
Sessile, juveniles < 1mm, no eggs	Seed + vegetative, riparian, annual
Mobile, juveniles > 1mm, no eggs	Seed, aquatic, perennial
Sessile, juveniles > 1mm, no eggs	Vegetative, aquatic, perennial
	Seed + vegetative, aquatic, perennial
	Seed, riparian, perennial
	Vegetative, riparian, perennial
	Seed + vegetative, riparian, perennial
	Seed, aquatic + riparian, annual
	Vegetative, aquatic + riparian, annual
	Seed + vegetative, aquatic + riparian, annual
	Seed, aquatic + riparian, perennial
	Vegetative, aquatic + riparian, perennial
	Seed + vegetative, aquatic + riparian, perennial

The risk assessment matrix tool takes the form of a Microsoft Excel spreadsheet, into which data and information about SRO water transfers and asset options are entered by the assessor to automatically generate a 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. Risk scores are categorised as Low, Medium or High, as shown in Table 2.4.

Grid references for continued monitoring locations redacted

Table 2.4: Risk score categories

Percentage (%)	Category
0 - 33	Low
34 - 66	Medium
67 - 100	High

Detailed instructions for use of the tool are provided in the SRO Aquatic INNS Risk Assessment Tool (SAI-RAT) – User Guide[14].

2.9.2 Tool Input Data

The information and data entered into the INNS risk assessment tool for each of the two raw water transfer (RWT) route sections are detailed in Table 2.5.

Table 2.5: INNS risk assessment tool input data for water transfer route

Input variable	Minworth WwTW to Atherstone via pipeline	Atherstone to Leighton Buzzard via the canal network
Source	Minworth WwTW	Coventry Canal
Source easting	41[redacted]	43[redacted]
Source northing	29[redacted]	28[redacted]
Source management catchment	Tame Anker and Mease	Humber Artificial Waterbodies (AWB)
Source operational catchment	Tame Lower Rivers and Lakes	Blythe Canals
Source waterbody	N/A	Coventry and Ashby Canals (ID: GB70410212)
Source type	Wastewater treatment site	Wastewater treatment site*
Number of raw water transfers into source	None	>3**
Pathway type	Pipeline	Canal
Receptor name	Coventry Canal	GUC
Receptor easting	43[redacted]	49[redacted]
Receptor northing	28[redacted]	21[redacted]
Receptor management catchment	Humber AWB	Anglian AWB
Receptor operational catchment	Blythe Canals	Grand Union Canal
Waterbody	Coventry and Ashby Canals (ID: GB70410212)	Tring Summit to Milton Keynes (ID: GB70510191) GB70510193 - Grand Union Canal, Braunston summit GB70510251 - Grand Union Canal, Milton Keynes to Braunston summit GB70510192 - Grand Union Canal, Milton Keynes trough pound GB70510191 - Grand Union Canal, Tring summit to Milton Keynes
Receptor type	Canal	Canal
Isolated receptor catchment	No	No
Volumetric rate of transfer (Ml/d)	51 – 100	51 – 100
Frequency of transfer	Year round - intermittent	Year round - intermittent
Distance of transfer (km)	15.1 – 20	>30 (this represents the highest distance category in the tool)

[14] SRO Aquatic INNS Risk Assessment Tool (SAI-RAT) – User Guide, APEM Ltd, 2021.

Grid references for continued monitoring locations redacted

Asset size redacted

Input variable	Minworth WwTW to Atherstone via pipeline	Atherstone to Leighton Buzzard via the canal network
Washout/maintenance points along route	None	None
Source navigable	No	Yes
Pathway navigable	No	Yes
Angling at source	No	Members and day ticket holders, international events***
Angling on pathway	No	Members and day ticket holders, international events
Water sports at source	No	Casual use by individuals/clubs
Water sports along pathway	No	Casual use by individuals/clubs
High Impact INNS at source	No	No
High Impact INNS along pathway	No	Known to be present
Highest order site designation within 1km of receptor	National	National
Presence of priority habitats within 1km of pathway	Known to be present	Known to be present
Presence of priority habitats within 1km of receptor****	Known to be present	Known to be present
Other existing connections present between source and receptor	None	None

* Although the starting point of the Atherstone to Leighton Buzzard section of the transfer is the Coventry Canal, the source type was selected as wastewater treatment site in the tool. This was to account for the fact that the additional flow is treated water rather than raw water and will therefore not act as a source of INNS to the canal network.

**For further information refer to the GUC Gate 1 Submission.

*** There are no known restrictions to angling along the route of the transfer. The input option that was considered to best represent the accessibility of canals to anglers was 'members and day ticket holders, international events.'

**** For further information about priority habitats refer to Annex B3.2.6.

reservoir, any additional potential risk was assessed using the asset tab of the SAI-RAT tool. Input data used are shown in Table 2.6 below.

Table 2.6: INNS risk assessment tool water input data for proposed assets

Input variable	Leighton Buzzard Storage Reservoir	Leighton Buzzard WTW
Asset type	Reservoir	Water Treatment works
Asset location	Leighton Buzzard (South)	Leighton Buzzard (South)
Asset easting	49[redacted]	49[redacted]
Asset northing	22[redacted]	22[redacted]
Asset size (m^2)	[redacted]	
Existing High Impact INNS records on site/area of proposed site		
	Known to be present	Known to be present

Input variable	Leighton Buzzard Storage Reservoir	Leighton Buzzard WTW
Existing priority habitats on site	Known to be present	Known to be present
Highest order site designation of asset	National	National
Frequency of personnel site visits	Annual	Weekly
Frequency of personnel entering or in contact with raw water	None	None
Frequency of road vehicles on site	None	Weekly
Frequency of maintenance operations not requiring personnel to enter water	None	Annual
Frequency of maintenance operations requiring personnel to enter water	None	None
Frequency of recreational activity (including, angling, water sports and vessels)	None	None
Frequency of mammals/waterfowl entering site	Daily	None

2.9.3 Biosecurity Assessment

The INNS risk assessment tool includes a high-level, qualitative assessment of biosecurity measures. Following input of proposed water transfer details to the tool (as outlined in Section 2.9.2), various biosecurity measures are presented based on the identified pathways of INNS spread. Each of the presented biosecurity measures in the tool is assigned a confidence rating of either High, Medium or Low based on their overall robustness at reducing risk in relation to the corresponding pathway.

As biosecurity has not yet been considered in the design and operation of the GUC SRO, the measures presented in the tool were reviewed to identify those that would most effectively prevent the spread of INNS via the pathways introduced by the proposed water transfer options.

2.10 Limitations

2.10.1 Survey Limitations

At the time of survey design, a full understanding of hydrological connectivity between the transfer route and other water bodies had not been established. Survey sites were primarily selected using open-source mapping and aerial imagery, therefore connections not readily visible by these means may not have been considered. The waterbody connections report completed in 2022[15] provides an indicative schematic of watercourse connections and it is recommended that this is used to inform further surveys and investigations.

It is recommended that samples for eDNA analysis are collected on at least two occasions to increase the probability of detecting species and to provide validation of results. Only an autumn 2021 sample was initially planned due to the timeframe of this project, though subsequently some samples were delayed until April 2022 due to land access constraints. eDNA sampling was therefore only undertaken on one occasion at each site; however, this sampling yielded useful results including species not detected by other means.

With respect to eDNA analysis, unidentified or misidentified taxa can result from incomplete or incorrect reference databases, and taxa may be missed due to low quality DNA, environmental contaminants, or the dominance of other species in the sample. Negative records should not be

[15] Annex 3.2.1, Waterbody connections report, 100105044 | GUC-MMD-ZZZ-XX-RP-N-0001 | AB |, Mott MacDonald (2022).

interpreted as confirming absence, and positive records should be considered alongside other information such as environmental suitability and physical records to assess their likely accuracy.

Signal crayfish were targeted using a single-species assay during the processing of eDNA samples. An effective multi-species crayfish metabarcoding assay is currently not available. Although signal crayfish are the most likely species to be encountered, it is acknowledged that it is possible that other crayfish species could be present in the canal network or connected waterbodies, particularly to the south of the scheme.

Macrophytes are typically surveyed in the peak growing season of June to September inclusive. As field surveys were undertaken outside of this window due to the Gate 2 timescales, the full range of species that grow at survey sites may not have been identifiable. As such, it is possible that some species of non-native aquatic plants went unrecorded.

2.10.2 Risk Assessment Limitations

The Environment Agency does not routinely survey the GUC. The Environment Agency taxonomic data presented in Section 3.2 were collected in waterbodies within a 1km radius of the scheme, rather than from with the GUC itself. It is possible that the Environment Agency records presented do not provide a true reflection of the INNS present within the GUC. However, as taxonomic data were also retrieved from NBN Atlas, which does not face the same constraints, the overall data set is sufficient to provide a high confidence indication of the INNS present within the canal network along the route of the proposed transfer.

The tool used in this assessment quantifies the risk associated with the operational phase of a water transfer option, rather than the construction phase. The scheme would involve the construction of a new pipeline, which poses the risk of INNS being spread through the movement of personnel, vehicles and equipment to and from construction sites, as well as the excavation and disposal of materials (e.g., sediment and vegetation). As the conceptual design is developed, construction-phase risks relating to INNS should also be considered.

The data and information entered into the INNS risk assessment tool were based on the latest available conceptual design. As the conceptual design is still in development, these details may be subject to change. The INNS risk assessment should be revised during the design process to capture the effect of changes on the INNS risk scores.

3 Results

3.1 High Level Screening Against EA Guidance

The transfer source, Minworth WwTW, falls within area 97 of the Environment Agency's Invasive Non-Native Species Isolated Catchment Mapping v3[16] (EA, 2018). This area is classified as 'Canal – CRT' within the SAI-RAT tool, meaning that it is connected to navigable canals controlled by the Trust. The transfer receptor, the GUC, spans several areas of the Environment Agency map, all of which are classified as 'Canal – CRT'. Therefore, it is concluded that the scheme will not create a link between 'isolated' catchments, other than the connection between Minworth and the GUC.

The Environment Agency guidance for raw water transfers states: 'where catchments are already connected, a risk assessment will be required, which the Environment Agency will use to decide whether subsequent mitigation is required, to ensure the risk of INNS transfer is not significantly increased'. The INNS risk assessment presented in this report fulfils this requirement at Gate 2. The output suggests that the scheme would not significantly increase the risk of INNS transfer. However, this conclusion is subject to the assumptions and limitations detailed in Section 2.10 and should be taken under advisement from the Environment Agency.

3.2 Desk Study

A total of 32 non-native aquatic species were identified in the Environment Agency and NBN Atlas records for the study area. Five invasive fish species were identified, including the High Impact common carp (*Cyprinus carpio*). Thirteen invasive macroinvertebrates species have been recorded in the study area, of which four are High Impact species. Fourteen invasive aquatic and riparian plant species have been recorded, including 10 High Impact species.

The presence of crucian carp (*Carassius carassius*) was also identified within the GUC. The species is generally regarded as native, though recent evidence suggests that the species was introduced in England during the 15th century (Jeffries *et. al* (2017)[17]. In the context of the canal network which is a series of artificial waters, the species was not treated as invasive or non-native, as this species does not appear on the UKTAG list of non-native species and would not be considered a recent introduction of a non-native species.

[16] Invasive Non-Native Species Isolated Catchment Mapping v3, Environment Agency, 2018.

[17] Jeffries, D. L, Copp, G. H., Maes, G. E., Handley, L. L., Sayer, C. D., and Hänfling, B. (2017). Ecology and Evolution 2017:7 pp.2871-2882.

Table 3.1: Invasive non-native fish species identified in Environment Agency (✓) and NBN Atlas (✓) records within 1km of the transfer route.

Common name	Scientific name	Functional group	Non-native status	Minworth to Atherstone via canal	Atherstone to Leighton Buzzard via canal
Common carp	***Cyprinus carpio***	Mobile, juvenile >1mm, eggs	UKTAG – High[18]	✓ ✓	✓ ✓
Rainbow trout	*Oncorhynchus mykiss*	Mobile, juvenile >1mm, eggs	UKTAG – Low	✓ ✓	✓
Grass Carp	*Ctenopharyngodon idella*	Mobile, juvenile >1mm, eggs	UKTAG-Low		✓
Wels Catfish	*Silurus glanis*	Mobile, juvenile >1mm, eggs	UKTAG – Low WACA 1981 Sch. 9[19]		✓
Zander	*Sander lucioperca*	Mobile, juvenile >1mm, eggs	UKTAG – Moderate WACA 1981 Sch. 9		✓

Table 3.2: Invasive non-native macroinvertebrate species identified in Environment Agency (✓) and NBN Atlas (✓) records within 1km of the transfer route

Common name	Scientific name	Functional group	Non-native status	Minworth to Atherstone via pipeline	Atherstone to Leighton Buzzard via canal
Bladder snail	*Physella acuta*	Mobile, juvenile <1mm, no eggs	UKTAG - Unknown		✓ ✓
Bloody red mysid	***Hemimysis anomala***	Mobile, juvenile >1mm, no eggs	UKTAG – High		✓
Caspian mud shrimp	*Chelicorophium curvispinum*	Mobile, juvenile >1mm, no eggs	UKTAG – Unknown	✓ ✓	✓ ✓
Demon shrimp	***Dikerogammarus haemobaphes***	Mobile, juvenile >1mm, no eggs	UKTAG – High	✓ ✓	✓ ✓
Freshwater amphipod	*Cryptorchestia cavimana*	Mobile, juvenile >1mm, no eggs	UKTAG – Unknown		✓
Jenkins' spire snail	*Potamopyrgus antipodarum*	Mobile, juvenile <1mm, no eggs	UKTAG – Moderate	✓ ✓	✓ ✓
Northern river / Florida crangonyctid	*Crangonyx pseudogracilis/ floridanus*	Mobile, juvenile >1mm, no eggs	UKTAG – Unknown	✓ ✓	✓
Oblong orb mussel	*Sphaerium transversum*	Sessile, juvenile <1mm, eggs	UKTAG – Unknown		✓
Side swimmer	*Gammarus tigrinus*	Mobile, juvenile >1mm, no eggs	UKTAG – Unknown		✓ ✓
Signal crayfish	***Pacifastacus leniusculus***	Mobile, juvenile >1mm, no eggs	UKTAG – High WACA 1981 Sch. 9		✓ ✓

[18] WFD-UKTAG listed INNS, categorised as High / Medium / Low / Unknown Impact

[19] Listed on Schedule 9 of the Wildlife & Countryside Act 1981

Common name	Scientific name	Functional group	Non-native status	Minworth to Atherstone via pipeline	Atherstone to Leighton Buzzard via canal
			EU species of special concern[20] IAS Order 2019 Sch. 2[21]		
Tadpole physa	*Physella gyrina*	Mobile, juvenile <1mm, no eggs	UKTAG – Unknown		✓ ✓
Wautier's limpet	*Ferrissia wautieri*	Sessile, juvenile <1mm, eggs	UKTAG - Unknown		✓ ✓
Zebra mussel	***Dreissena polymorpha***	**Sessile, juvenile <1mm, eggs**	UKTAG – High		✓ ✓

Table 3.3: Invasive non-native plant species identified in Environment Agency (✓) and NBN Atlas (✓) records within 1km of the transfer route

Common name	Scientific name	Functional group	Non-native status	Minworth to Atherstone via canal	Atherstone to Leighton Buzzard via canal
Canadian pondweed	*Elodea canadensis*	Vegetative, aquatic, perennial	UKTAG – Moderate WACA 1981 Sch. 9		✓ ✓
Curly water-thyme	***Lagarosiphon major***	Seed + vegetative, aquatic, perennial	UKTAG – High WACA 1981 Sch. 9 IAS Order 2019 Sch. 2		✓
Floating pennywort	***Hydrocotyle ranunculoides***	Seed + vegetative, aquatic, perennial	UKTAG – High EU species of special concern WACA 1981 Sch. 9 IAS Order 2019 Sch. 2		✓ ✓
Giant Hogweed	***Heracleum mantegazzianum***	Seed, riparian, perennial	UKTAG - High WACA 1981 Sch. 9 IAS Order 2019 Sch. 2	✓	✓
Giant knotweed	***Fallopia sachalinensis***	Vegetative, riparian, perennial	UKTAG – High WACA 1981 Sch. 9		✓
Japanese knotweed / giant knotweed hybrid	*Fallopia x bohemica*	Vegetative, riparian, perennial	UKTAG - Unknown WACA 1981 Sch. 9		✓
Himalayan balsam	***Impatiens glandulifera***	Seed, riparian, annual	UKTAG - High EU species of special concern	✓ ✓	✓ ✓

[20] Invasive Non-Native Species (Amendment etc.) (EU Exit) Regulations 2019 – listed as an 'invasive alien species of union concern'

[21] Listed on Schedule 2 of the Invasive Alien Species (Enforcement and Permitting) Order 2019

Common name	Scientific name	Functional group	Non-native status	Minworth to Atherstone via canal	Atherstone to Leighton Buzzard via canal
			WACA 1981 Sch. 9 IAS Order 2019 Sch. 2		
Japanese knotweed	***Fallopia japonica***	Vegetative, riparian, perennial	UKTAG – High WACA 1981 Sch. 9	✓ ✓	✓
Least duckweed	*Lemna minuta*	Vegetative, aquatic, perennial	UKTAG – Moderate	✓ ✓	✓ ✓
New Zealand Pigmyweed	***Crassula helmsii***	Seed + vegetative, aquatic, perennial	UKTAG – High WACA 1981 Sch. 9		✓
Nuttall's pondweed	***Elodea nuttallii***	Vegetative, aquatic, perennial	UKTAG – High EU species of special concern WACA 1981 Sch. 9 IAS Order 2019 Sch. 2		✓ ✓
Orange Balsam	*Impatiens capensis*	Seed, riparian, annual	UKTAG – Low		✓✓
Parrot's feather	***Myriophyllum aquaticum***	Vegetative, aquatic, perennial	UKTAG – High WACA 1981 Sch. 9 IAS Order 2019 Sch.2		✓
Water fern	***Azolla filiculoides***	Seed + vegetative, aquatic, perennial	UKTAG – High Impact WACA 1981 Sch. 9		✓

3.3 Field Surveys

Four invasive non-native fish species were recorded in the study area using eDNA metabarcoding. Of those, Common Carp appears to be the most widely spread as it was detected in samples taken from 12 of the 15 sites surveyed in 2021 and 2022. Zander (*Sander lucioperca)* detected in samples from three sites. Rainbow Trout (*Oncorhynchus mykiss*) was detected in samples from two sites. Wels catfish (*Silurus glanis)* was detected in a single sample. Species from the *Cyprinidae* family were also recorded in samples collected from 11 of the survey sites. Some species of the *Cyprinidae* family are invasive to the UK, however many are native and as the eDNA results can't specify beyond family level, it is not possible to identify the presence of INNS. The eDNA metabarcoding results are presented in Table 3.4.

Seven invertebrate and three aquatic plant species were identified by physical observation across the fifteen sites surveyed during 2021 and 2022. The macroinvertebrate and aquatic plant field survey results are presented in Table 3.5 and Table 3.6, respectively.

eDNA of two High Impact bivalve mollusc species were recorded for the first time in this vicinity during field surveys. Quagga mussel (*Dreissena rostriformis)* was detected in the GUC at Rickmansworth near a connection with the River Chess, the GUC near a connection with the River Anker, the GUC near a crossing with the River Tove, the River Colne, and the River Gade. These detections may indicate an expanded distribution of the species though no physical specimens were found to validate the results. These locations are within the vicinity of the southern chalk streams and outside of the current preferred route, with the exception of the

GUC near the River Tove crossing. Asian clam (*Corbicula fluminea*) was detected in the GUC near a connection with the River Anker, the GUC near a connection with the River Tove and the Oxford Canal near a River (Warwickshire) Avon crossing. These detections may indicate a previously unrecorded population of the species, though these detections cannot be validated through physical specimens.

Two of the locations in which these species have been recorded are within the current preferred route and therefore there is a risk that the reach of these species could be increased downstream with the presence of additional flows.

All other INNS identified by either eDNA analysis or physical observation had previously been recorded within the study area by the Environment Agency and/or NBN Atlas.

Table 3.4 Positive fish INNS field survey results (eDNA) (✓)

Species	Survey site																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Brook charr *Salvelinus fontinalis*																	✓				
Common Carp ***Cyprinus carpio***								✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Carp family Cyprinidae species					✓			✓					✓	✓	✓	✓	✓	✓	✓	✓	✓
Rainbow trout *Oncorhynchus mykiss*														✓			✓				
Wels Catfish *Silurus glanis*													✓								
Zander *Sander lucioperca*	✓					✓		✓													

High Impact species are shown in **Bold**

Table 3.5: Positive invertebrate INNS field survey results physical survey (✓) and eDNA results (✓)

Species	Survey site																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Asian clam ***Corbicula fluminea***	✓		✓			✓															
Bladder snail *Physella* sp.		✓		✓											✓			✓			
Bloody red mysid *Hemimysis anomala*																	✓			✓	✓
Caspian mud shrimp	✓		✓		✓	✓		✓								✓	✓			✓	✓

Species	Survey site																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Chelicorophium curvispinum																					
Demon shrimp *Dikerogammarus haemobaphes*	✓		✓	✓	✓	✓		✓	✓					✓		✓	✓		✓	✓	✓
Jenkin's spire snail *Potamopyrgus antipodarum*	✓		✓							✓				✓						✓	✓
Northern River / Florida crangonyctid *Crangonyx pseudogracilis / floridanus*				✓			✓		✓	✓					✓	✓		✓			
Signal crayfish ***Pacifastacus leniusculus***	✓				✓	✓							✓	✓	✓	✓	✓	✓	✓	✓✓	✓
Quagga mussel ***Dreissena rostriformis***	✓					✓											✓		✓	✓	
Zebra mussel ***Dreissena polymorpha***	✓✓		✓			✓✓		✓							✓	✓	✓		✓✓	✓	

High Impact species are shown in **Bold**

Table 3.6: Positive riparian and aquatic non-native plants recorded during physical survey

Species	Survey site																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Floating pennywort ***Hydrocotyle ranunculoides***															✓						
Himalayan balsam ***Impatiens glandulifera***									✓												

	Survey site																				
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Nuttall's waterweed ***Elodea nuttallii***				✓							✓	✓									

High Impact species are show in **Bold**

3.4 APEM Ltd Ecological Monitoring 2021

Several INNS species were recorded in the Phase 2 monitoring programme (Annex B2.1) including several High Impact invertebrate and macrophyte species. Results are summarised in Table 3.7 below. Demon shrimp (*Dikerogammarus haemobaphes)* was found to be widespread through the canal network being recorded at six of the nine sampling occasions. Zebra mussel (*Dreissena polymorpha*) was also widespread and was identified at five of the nine locations. Other High Impact species recorded during these surreys include signal crayfish (*Pacifastacus leniusculus),* which was recorded at site IN-01 (Birmingham & Fazeley Canal at Minworth), and bloody-red mysid (*Hemimysis anomala*) which was recorded at site IN-04 (GUC at River Tove).

Two invasive non-native macrophyte taxa were recorded including the High Impact Canadian/ Nuttall's waterweed (*Elodea canadensis/ nuttallii*), which was recorded at site IN-07 (GUC at near the River Bulbourne) and IN-08 GUC at Hemel Hempstead. Orange balsam (*Impatiens capensis*) was also frequently recorded along the bankside at sites IN-02 (Coventry Canal at Atherstone), IN-03 (GUC at Leamington Trough Pound), IN-04 (GUC at River Tove), IN-08 (GUC at Hemel Hempstead).

Table 3.7: Summary of INNS records from APEM Ltd ecological monitoring in 2021.

Site	IN-01	IN-02	IN-03	IN-04	IN-05	IN-06	IN-07	IN-08	IN-09
Demon shrimp *Dikerogammarus haemobaphes*	✓	✓	✓	✓				✓	✓
Zebra Mussel *Dreissena polymorpha*		✓	✓	✓	✓	✓			
Bloody-red mysid *Hemimysis anomala*				✓					
Orange balsam *Impatiens capensis*		✓	✓	✓				✓	✓
Signal crayfish *Pacifastacus leniusculus*	✓								
Canadian/ Nuttall's waterweed *Elodea canadensis/ nuttalii*							✓	✓	
Snowberry *Symphoricarpos albus*	✓								
Montbretia *Montbretia crocosmia x crocosmiiflora*							✓		
Himalayan balsam *Impatiens glandulifera*									✓
Japanese knotweed *Reynoutria japonica*									✓

High Impact species are shown in **Bold**

3.5 Species Distribution

3.5.1 Fish

The possible distribution of non-native fish species within the study area, based upon all information sources considered in this assessment, is summarised in Table 3.8 below. High Impact species are shown in **Bold**.

Table 3.8: Summary of Fish Distribution within Canal Network

Species	Distribution within canal network
Brook char *Salvelinus fontinalis*	One positive eDNA record was found in Mott MacDonald surveys on the GUC, close to the southern end of the route. No other records of brook char were found within the study area. . It is unclear whether the species is present in the canal network, or whether its detection is due to contamination (for example from a nearby fishery or as a foodstuff).
Common carp ***Cyprinus carpio***	Common carp have been recorded along the northern section of the route in the River Tame and the River Anker, close to the proposed Minworth to Atherstone pipeline. The species has also been found in the River Tove and River Ouzel. The species was also detected by eDNA sampling within mid to lower section of the GUC (from Northampton area southwards) and adjacent rivers, as well as the Tring group of reservoirs. This is corroborated by the findings of the Gate 1 gap analysis.
Carp family Cyprinidae species	Positive eDNA records for fish within the family Cyprinidae were found in Mott MacDonald surveys along the middle and lower section of this route in the GUC and adjacent rivers and reservoirs. Further determination of these eDNA records to species level was not possible.
Rainbow trout *Oncorhynchus mykiss*	There is one Environment Agency record for rainbow trout found in a lake close to the pipeline between Minworth and Atherstone. Additionally, two positive eDNA records were found in Mott MacDonald surveys on the GUC, close to the southern end of the route. No records of Rainbow Trout were found in the in middle section of the route between Atherstone and Leighton Buzzard via Coventry Canal and Oxford Canal. It is unclear whether the species is present in the canal network, or whether its detection is due to contamination (for example from a nearby fishery or as a foodstuff).
Wels catfish *Silurus glanis*	One positive eDNA record for wels catfish was found in Mott MacDonald surveys in Marsworth Reservoir, close to Leighton Buzzard. Additionally, one record for wels catfish was recorded on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard, indicating this species is either not present or not widespread within the canal network itself.
Zander *Sander lucioperca*	Positive eDNA records for Zander were found in Mott MacDonald surveys at three sites in the GUC, in Leighton Buzzard, the GUC near a connection with the River Anker and the GUC near a crossing with the River Tove. Additionally, 88 records for Zander were recorded on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard and the species may be much more widespread than indicated by eDNA sampling. This corroborates the Gate 1 which highlighted its presence in the Coventry and Oxford Canals.

3.5.2 Macroinvertebrates

The potential distribution of non-native macroinvertebrate species within the study area, based upon all information sources considered in this assessment, is summarised in Table 3.9 below. High Impact species are shown in **Bold.**

Table 3.9: Summary of non-native macroinvertebrate distribution within canal network

Species	Distribution within survey area
Asian Clam ***Corbicula fluminea***	Field surveys undertaken by Mott MacDonald found eDNA of this High Impact bivalve mollusc species at three sites – the GUC near a connection with the River Anker, the GUC near a connection with the River Tove and the Oxford Canal near a

Species	Distribution within survey area
	River (Warwickshire) Avon crossing. These results indicate the first record of this species within in this vicinity, though no specimens were found during physical surveys and so these detections remain unvalidated.
Bladder snail *Physella* spp.	Field surveys undertaken by Mott MacDonald found *Physella* spp. in the River Chess near Rickmansworth and the River Bulbourne. Multiple Environment Agency records of this species were found in rivers adjacent to the mid-section of the scheme between Rugby and Milton Keynes. No records were found between Minworth to Atherstone. *Physella gyrina* was recorded by the Environment Agency at 1 site (a drainage ditch) close to the River Ouzel, located within the Braunstone to Tring section of the scheme.
Bloody red mysid ***Hemimysis anomala***	Field surveys undertaken by Mott MacDonald and APEM Ltd found Bloody red mysid in the GUC within the Braunston to Tring section of the scheme near Northampton (site IN04) and north of Watford (MM site 21). The species was also found in the River Chess and the River Gade. No records for this species were found in the Minworth to Atherstone and Atherstone to Braunston sections of the scheme indicating this species may be more prevalent in the GUC and connecting rivers.
Caspian mud shrimp *Chelicorophium curvispinum*	Field surveys undertaken by MM found Caspian mud shrimp at several locations along the GUC and Oxford Canal, as well adjacent rivers in the Braunstone to Tring section of the scheme. Caspian mud shrimp has also been recorded by the Environment Agency in several rivers in the Minworth to Atherstone and Atherstone to Braunston sections of the scheme. The Gate 1 gap analysis indicated records on the Coventry Canal and the GUC around Milton Keynes. Overall, it appears likely that the species widespread within the canal route.
Demon shrimp ***Dikerogammarus haemobaphes***	Records found during the Gate 1 gap analysis were fairly sparse, including only the River Tame and the GUC around Milton Keynes. However the species was found during field surveys undertaken by Mott MacDonald and APEM Ltd at several locations across the GUC and Coventry canal and the adjacent rivers, and this is corroborated by the most recent Environment Agency open-source data. It is likely this species is widespread throughout the canal route and within many connected river systems.
Freshwater amphipod *Cryptorchestia cavimana*	Two records for *Cryptorchestia cavimana* were found on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard. The species was not discovered on any field survey and may be either absent or limited within the study area.
Jenkins' spire snail *Potamopyrgus antipodarum*	Jenkins' spire snail was recorded in Mott MacDonald surveys at four sites between Leighton Buzzard and Rickmansworth, in both the GUC (Mott MacDonald sites 10, 14 and 21) and the River Gade (MM site 20). Multiple Environment Agency records for Jenkins' spire snail have been found in all sections of the scheme, indicating this species is likely widespread throughout the canal system
Northern River / Florida crangonyctid *Crangonyx pseudogracilis/ floridanus*	Environment Agency records of the Northern River / Florida crangonyctid are widespread in the river systems which run adjacent to the scheme. Although no Northern River / Florida crangonyctid were identified during field surveys, it is likely species coverage includes the adjacent canal network.
Oblong orb mussel *Sphaerium transversum*	One record for oblong orb mussel was recorded on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard. The species was also tentatively detected by eDNA at the two sites in the GUC in Rickmansworth. The species was not observed during any survey. If present within the canal network, it may have a limited distribution.
Quagga mussel ***Dreissena rostriformis***	eDNA of this High Impact bivalve mollusc species was detected at five sites – the GUC near a connection to the River Anker, the GUC near a crossing with the River Tove, the GUC at Rickmansworth near a connection with the River Chess, the River Colne and the River Gade. These results indicate the presence of the species in this vicinity, though no specimens were found during physical surveys and so these detections remain unvalidated. Most of these sites are outside the preferred route option, though highlight the potential presence and future spread of the species within the canal network.
Side swimmer *Gammarus tigrinus*	Two records of Side swimmer were found in the River Avon and Coventry Canal located in the Atherstone to Braunstone section of the scheme. Side swimmer was not discovered on any field survey. The species may have a limited distribution in the canal network.

Species	Distribution within survey area
Signal crayfish ***Pacifastacus leniusculus***	Signal crayfish were recorded during field surveys by Mott MacDonald and APEM Ltd close to Minworth within the Birmingham and Fazeley Canal (site IN01), and in the River Gade (MM site 20). Additionally positive eDNA samples were recorded at sites 1, 5 and 6, and sites 13-21, within the GUC and connected watercourses from the River Tove connection southwards. This corroborates the distribution indicated by the Gate 1 gap analysis. Environment Agency records also indicate signal crayfish are found further upstream in the rivers adjacent to the Atherstone to Braunstone section of the scheme. Signal crayfish are therefore likely to be present throughout the canal route, with a large presence southwards of the River Tove connection,
Wautier's limpet *Ferrissia wautieri*	Wautier's limpet was recorded by the Environment Agency at two sites, one located in a drainage ditch adjoining the River Ouzel, within the Braunstone to Tring section of the scheme: the other located in the Oxford Canal at the lower end of the Atherstone to Braunstone section of the scheme. Wautier's limpet was not recorded during the site visits. The species appears to have a limited distribution within the study area.
Zebra mussel ***Dreissena polymorpha***	Zebra mussel were recorded throughout the survey sites, including the preferred route by Mott MacDonald and APEM Ltd. In the vicinity of the southern chalk streams, detections were predominated by eDNA rather than physical observation. It is highly likely the species is present throughout the current preferred route.

3.5.3 Macrophytes

The potential distribution of non-native macrophyte species within the study area, based upon all information sources considered in this assessment, is summarised in Table 3.10 below. High Impact species are shown in **Bold**.

Table 3.10: Summary of non-native macrophyte distribution within the study area

Species	Distribution within canal network
Floating pennywort ***Hydrocotyle ranunculoides***	Floating pennywort was found on the River Bulbourne downstream some GUC connections. Additionally, there have been two Environment Agency recordings on the river Anker close to Atherstone. Although these records are sparse, they show that there is potential for widespread distribution within the route.
Canadian pondweed *Elodea canadensis*	One Environment Agency record of Canadian pondweed was found in a small stream adjacent to the River Anker, located towards the northern section of the Atherstone to Braunstone route near Nuneaton. No other records were found along the route, suggesting the species is absent or limited within the canal itself.
Nuttall's pondweed ***Elodea nuttallii***	Nuttall’s pondweed was recorded at two sites during MM surveys: Startopsend Reservoir and Marsworth Reservoir. Nuttall’s pondweed was also recorded by the Environment Agency in several rivers adjacent to the northern half of the scheme, though its present in the canal is unconfirmed.
Curly water-thyme ***Lagarosiphon major***	Three records for curly water-thyme were found on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard, though the species was not observed during surveys. The species may therefore be present within the canal transfer route though this is unconfirmed.
Giant hogweed ***Heracleum mantegazzianum***	Two records of Giant hogweed were found on NBN Atlas within 1km of the Minworth to Atherstone pipeline. Seventeen records were found on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard. The species was not found during any recent survey though the large number of records suggests it may be present along the route.
Giant knotweed ***Fallopia sachalinensis***	Two records for giant knotweed were found on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard, though the species was not observed during surveys. If the species is present along the canal route it may have a limited distribution.
Himalayan balsam ***Impatiens glandulifera***	Several EA records for Himalayan balsam were found around the Minworth to Atherstone pipeline section of the route. Several records were also found around the northern part of the Atherstone to Braunston section in Nuneaton. Additionally, Himalayan balsam was noted during the Mott MacDonald survey of the River Ouzel

Species	Distribution within canal network
	(Site 9) and during the APEM Ltd survey of the GUC (site IN09). The Gate 1 gap analysis report indicated that the species was particularly widespread on the GUC between Milton Keynes and Leighton Buzzard.
Japanese knotweed ***Fallopia japonica***	Japanese knotweed has been recorded by the Environment Agency along the route of the pipeline from Minworth to Atherstone. Additionally, Japanese knotweed was recorded in the vicinity of the GUC near Rickmansworth (site IN09) during surveys undertaken by APEM Ltd.
Least duckweed *Lemna minuta*	Least duckweed was recorded by the Environment Agency along the entire route of the scheme, though the species was not recorded during Mott MacDonald and APEM Ltd surveys.
New Zealand pigmyweed ***Crassula helmsii***	126 records of New Zealand pigmyweed were found on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard. New Zealand pigmyweed was not discovered on any field survey, however this high number of records suggests its transfer along the route presents a risk.
Orange balsam *Impatiens capensis*	Orange balsam was recorded at five sites during surveys undertaken by APEM Ltd and was found to be widely spread across the length of the scheme. Orange balsam was also recorded by the Environment Agency in several rivers adjacent to the northern section of the scheme.
Parrot's feather ***Myriophyllum aquaticum***	Two records of Parrot's feather were found on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard. Parrot's feather was not discovered on any field survey indicating this species may either be limited or absent within the canal itself.
Water fern ***Azolla filiculoides***	Four records of Water fern were found on NBN Atlas within 1km of the route between Atherstone and Leighton Buzzard. Water fern was not discovered on any field survey. The distribution and coverage of the species can be highly variable and its current distribution within the study area is uncertain.

3.6 Risk Assessment

The INNS risk assessment results of the RWT as derived from the Environment Agency tool are summarised in Table 3.11 below. It should be noted that these scores do not take into account any engineering interventions that may be required as mitigation to prevent the spread of INNS.

Table 3.11: INNS risk assessment scores for RWT components

Transfer route section	Risk score	Risk score category
Minworth WwTW to Atherstone via a pipeline	30.25	Low
Atherstone to Leighton Buzzard via the Coventry Canal, Oxford Canal and the GUC	52.13	Medium

Of the two sections of water transfer assessed the Atherstone to Leighton Buzzard canal transfer was determined to have the highest associated INNS risk, with a score of 52.13, which falls into the Medium risk category. The Minworth WwTW to Atherstone pipeline transfer generated a risk score of 30.25, which falls into the Low risk category. Pipeline pathways incur a lower score in the risk assessment tool than canal pathways, because INNS can spread more easily to/from an open water course than a closed pipeline. Additionally, pipelines do not present the same opportunity as canals for INNS spread via navigation and recreation pathways. These results suggest that the pipeline section of the route presents the lower risk with respect to INNS transfer.

The water source is considered to be the Minworth WwTW, and will involve the transfer of treated water rather than raw water (this is acknowledged in the risk assessment tool through the selection of source type as ‘wastewater treatment site’). It is therefore assumed that this source will not increase the risk of INNS introduction to the pathway or receptor.

The principal INNS risks associated with the scheme has been identified as an increase in flow in the canal network and the potential for that to facilitate the spread of INNS already present in the system to unimpacted areas further downstream. As discussed in Section 3.7, it is assumed that mitigation measures will be put in place to prevent increased flows through connections such as waste weirs, therefore the risk of INNS being spread outside of the canal pathway is considered to be low.

Depending on design and accessibility, any additional storage areas created which are connected the canals could act as sinks for INNS from which they could disperse into the wider environment. Results of the new assets INNS risk assessment are summarised in

Table 3.12 below.

Table 3.12 INNS risk assessment scores for assets

Asset Name	Risk Score (%)	Risk Score Category
Leighton Buzzard Service Reservoir	13.04	Low
Leighton Buzzard WTW	14.72	Low

Generation of asset risk scores within the EA tool was largely based on assumptions about operational processes (e.g., frequency of personnel visits and maintenance).

The INNS risk score generated by the Leighton Buzzard Service Reservoir was 13.04%, which equates to a Low risk. The greatest risk associated with Leighton Buzzard Service Reservoir is the transfer of raw water and storage in an open system. There is potential for visiting birds and mammals to act as a vector for the transfer of INNS between this reservoir and other locations. The reservoir would be in a controlled setting with infrequent maintenance visits and no planned recreational use. Water filling this reservoir would subsequently be directly transferred to Leighton Buzzard WTW. Therefore, the overall risk associated with this asset was assessed as being Low.

The Leighton Buzzard WTW generated a similar score of 14.72%, also equivalent to Low risk. Operational visits would be more frequent than for the reservoir, and the most likely pathway of INNS spread associated with the asset may be the movement of personnel and vehicles from the site following contact with untreated water. As more frequent operational visits are planned for Leighton Buzzard WTW, there is a slightly greater emphasis on additional mitigation measures as discussed in the Biosecurity Assessment (Section 3.7).

3.7 Biosecurity Assessment

The risk assessment tool identified a range of biosecurity measures to mitigate the risk associated with key pathways of INNS spread that would be introduced by the proposed water transfers and assets. Potential biosecurity measures specific to transfer pathway type are presented in Table 3.13, biosecurity measures for navigation are presented in Table 3.14, biosecurity measures for recreational activities are presented in Table 3.15 and biosecurity measures specific to each asset type are presented in Table 3.16.

The biosecurity measures with a 'High' confidence rating are those most likely to reduce INNS risk associated with the corresponding pathway. More details about the biosecurity measures can be found in the risk assessment tool user guide (APEM Ltd, 2021).

Table 3.13: Potential biosecurity measures for pathway types

Biosecurity measure	Description	Applicable to pathway type(s)	Confidence
Biosecurity strategy	Biosecurity measures incorporated into water company standard operating procedure.	Canal and pipeline	Medium

Biosecurity measure	Description	Applicable to pathway type(s)	Confidence
Chlorination	Chlorination of transferred water using hypochlorite, chlorine gas or chlorine dioxide. Suggested pipeline concentration of 1mg Cl/L over 10 days of continuous dosing.	Canal and pipeline	High
Chemical treatment	Could include coagulation and flocculation, OZONE treatment, pH or salinity alteration, or application of an herbicide.	Canal and pipeline	High
Anti-fouling paints	Paint applied to surfaces of pipeline to create toxic/unfavourable substrate for bio-fouling INNS.	Pipeline	Medium
UV treatment	UV is transmitted through water as it flows through a specialised chamber. The radiation damages cells and DNA and causes mortality in the exposed organisms.	Pipeline	Medium
Active filtration	Active filtration using screen filters, bed filters or other pumped filtration methods.	Pipeline	Medium
Passive filtration	Installation of fish screens, rundown screens or conveyor screens to prevent the passage of suspended matter and organisms.	Canal and pipeline	Low

Given the prevalence of navigation with the canal network and its likely importance as a vector for the spread of INNS, promotion of biosecurity measures relating to navigation (see Table 3.14) with a Medium or High confidence may be considered a high priority. The highest priority would be any measures to prevent the transfer of attached INNS between the canal network and other waterbodies. Limiting boat movements would be considered the most effective measure, however, may not necessarily be feasible. Anti-fouling paints could reduce the risk of transfer by this critical pathway and should be encouraged wherever possible.

Table 3.14: Potential biosecurity measures for navigation

Biosecurity measure	Description	Confidence
Check, clean, dry (CCD)	Promotion CCD protocol amongst water company operative and recreational user of the canal network.	Medium
Biosecurity strategy	Biosecurity measures incorporated into water company standard operating procedure.	Medium
Site-specific boats / vessels	Boats and vessels not to be transported between waterbodies*. Use restricted to one site to prevent spread of INNS.	High
Manual cleaning with cold water	Cleaning of boats and vessels with high-pressure cold water	Low
Manual cleaning with hot water	Cleaning of boats and vessels with high-pressure hot water	Medium
Anti-fouling paints	Paint applied hulls of boats to create toxic/unfavourable substrate for bio-fouling INNS.	Medium

* It should be noted that some of these proposed measures are unlikely to be feasible on operational waterways.

Similarly to navigation, recreation (in particular angling) is prevalent within the canal network. Angling on the canal is typically controlled by either The Trust or an angling club; therefore such organisations provide a mechanism for disseminating biosecurity information and influencing practices. As shown in Table 3.15 below, there are a number of potential options which are likely to vary in their feasibility and effectiveness. This assessment indicates that live bait restrictions, and either prevention or thorough drying of equipment being transported between waterbodies would be the most effective measures. It is however uncertain how feasible such options may be. It is possible that the Trust, the Environment Agency and angling clubs, would be best placed to advise on mitigation options which are likely to be adopted.

Table 3.15: Potential biosecurity measures for recreational activities

Biosecurity measure	Description	Applicable to activities	Confidence
Check, clean, dry (CCD)	Promotion of CCD protocol amongst recreational user of the canal network.	Angling and water sports	Medium
Biosecurity strategy	Biosecurity strategy developed by canal recreational user groups.	Angling and water sports	Medium
Event management	A reduction in the number of events or scale of events. Increased biosecurity during events.	Angling and water sports	Medium
Site-specific recreational equipment	Equipment not to be transported between waterbodies. Use restricted to one site to prevent spread of INNS.	Angling and water sports	High
Live bait restrictions	Either prohibiting the use of live bait entirely, or managing live bait use, ensuring source from site only.	Angling	High
Equipment and personal protective equipment (PPE) cleaning (dry)	Installation of waterless cleaning stations. May involve the use of brushes to decontaminate dirty equipment.	Angling and water sports	Low
Static water wash equipment and PPE (cold)	Water < 35°C to aid manual removal of INNS (ambient temperature water will not cause mortality of INNS). May involve use of dip tank.	Angling and water sports	Low
Static water wash equipment and PPE (hot)	A temperature of > 35°C for 15 minutes, or > 45°C for 1 second has been proven effective against many invasive invertebrate species. May involve use of dip tank.	Angling and water sports	Medium
Pressure wash equipment (cold)	High-pressure cold water can be effective against invertebrate INNS; however, efficacy (mortality endpoint) is reduced in comparison to pressurised hot water.	Water sports	Low
Pressure wash equipment (hot)	High-pressure, hot water can be very effective against invertebrate INNS.	Water sports	Medium
Drying	Allowing equipment to completely dry ensures that hitchhiker INNS are rendered nonviable. Providing a drying room or other designated area for this purpose would allow PPE to be stored and dried at the same location.	Angling and water sports	High

The overall INNS risk associated with the operation of assets is low as staff and equipment entering the raw water is not planned as part of routine operation. The greatest risks are associated with INNS being introduced from outside sources such as on personnel and vehicles entering the site and INNS being transferred from the asset. Promotion of High and Medium confidence biosecurity measures would reduce the risk of further spread of INNS from other sources.

Table 3.16 Table Potential biosecurity measures for implementation at assets

Biosecurity measure	Description	Confidence
Check, clean, dry (CCD)	Promotion of CCD protocol amongst WTW personnel.	Medium
Biosecurity strategy	Biosecurity strategy developed by water company.	Medium
Site-specific operational equipment	Provision of site-specific operational equipment (e.g., pontoons, buoys, vehicles) to reduce the inter-site movement of INNS.	High
Equipment and personal protective equipment (PPE) cleaning (dry)	Installation of waterless cleaning stations. May involve the use of brushes to decontaminate dirty equipment.	Low

Biosecurity measure	Description	Confidence
Static water wash equipment and PPE (cold)	Water < 35°C to aid manual removal of INNS (ambient temperature water will not cause mortality of INNS). May involve use of dip tank.	Low
Static water wash equipment and PPE (hot)	A temperature of > 35°C for 15 minutes, or > 45°C for 1 second has been proven effective against many invasive invertebrate species. May involve use of dip tank.	Medium
Running water (cold)	Running water can be effective against invertebrate INNS. However, efficacy (mortality endpoint) is reduced in comparison to pressurised water. Efficacy is dependent on the method and effort of cleaning	Low
Running water (hot)	Running water can be effective against invertebrate INNS; however, efficacy (mortality endpoint) is reduced in comparison to pressurised water. Efficacy is dependent on the method and effort of cleaning	Medium
PPE cleaning (dry)	Boot brushing/cleaning stations are a simple approach to decontamination of footwear. Can be a simple brush or boot scraper. All waste should be treated as hazardous and disposed of accordingly.	Low
PPE cleaning (dip tank or sink, cold)	A dip tank or sink to allow total immersion of PPE. Brushes and cleaning tools would be a requirement. Ambient temperature water will not cause direct mortality in INNS (unless of much different salinity), so cleaning relies on manual action (scrubbing and drying). Wastewater would be contaminated, so appropriate disposal needed	Low
PPE cleaning (dip tank or sink, hot)	A dip tank or sink to allow total immersion of PPE. A temperature of >35°C for 15 minutes, or >45°C for 1 second has been proven effective against many INNS. The efficacy of hot water against invasive non-native plant species (mortality endpoint) is not as high as for invertebrates, so it is important that equipment is treated for sufficient time; immersion of equipment at 50°C for 5 minutes is recommended to achieve high INN plant mortality.	Medium
Pressure wash (cold)	High-pressure cold water can be effective against invertebrate INNS. However, efficacy (mortality endpoint) is reduced in comparison to pressurised hot water. Efficacy is dependent on the method of application of the spray, regarding duration and distance from surface.	Low
Pressure wash (hot)	High-pressure, hot water can be very effective against invertebrate INNS. However, the efficacy is dependent on the method of application of the spray, regarding duration and distance from surface	Medium
Drying	Allowing equipment to completely dry ensures that hitchhiker INNS are rendered non-viable. Providing a drying room or other designated area on site for this purpose would allow PPE to be stored and dried at the same location.	High

The highest INNS risks associated with the scheme are likely to be potential increases in connectivity to other waterbodies. In principle, this could result from increased water levels and flows within the system which cause increased flows through direct connections and indirect connections such as waste weirs. In particular, flows over waste weirs could in theory increase in volume and frequency as a result of the scheme. In order to mitigate this risk, these connections should be thoroughly investigated to understand how they currently function, how they would function under scheme operation and how associated risks can be mitigated.

Recreational canal users have the potential to facilitate the spread of INNS within and beyond the areas which may be directly affected by the scheme, such as the Coventry Canal north of Atherstone, and the GUC south of Tring. Promotion of biosecurity best practice amongst such users is advised to limit the associated risks.

Regular monitoring of the canal network and connected waterbodies would offer the best chance of identifying new invasions at an early stage so that further actions can be implemented.

Critically, there is an alignment between the objectives to retain and transfer water within the canal network, and to mitigate INNS risk. In principle, connections such as waste weirs could be modified to reduce flows relative to the baseline such that there is an overall reduction in INNS risk, although this would only be undertaken with agreement from the Trust’s water engineers and hydrologists. This may be aspirational and would need wider considerations taking into account factors such as engineering feasibility and flood risk management.

4 Conclusions and Recommendations

4.1 Results Summary

The results of the appraisal of the scheme using the EA SAI-RAT INNS risk assessment tool are summarised for RWT components and assets in Table 4.1 and Table 4.2 respectively.

With respect to the RWT components, the Minworth to Atherstone via pipeline generated a Risk Score of 30.25. This translates to a Low Risk, though the Risk Score itself is considered to be an over-estimate given that that it would involve the transfer of treated water within a closed system. The Atherstone to Leighton Buzzard via canal component generated a Risk score of 52.13, equivalent to a Medium Risk.

With regards to assets, the proposed new WTW and storage reservoir at Leighton Buzzard generated Risk Scores of 13.04 and 14.72 respectively, both of which equate to a Low Risk. This is considered a reasonable estimate of the broad risk level given that this would involve the removal of INNS through water treatment and storage within an enclosed reservoir.

The overall SRO risk score, which is represents the combined average of all the RWT and asset components, is 27.53%.

Table 4.1: INNS assessments results summary

Assessment component	Minworth to Atherstone via pipeline	Atherstone to Leighton Buzzard via canal
Transfer of raw water between isolated catchments	No	No
Risk Score	30.25	52.13
Risk Score Category	Low	Medium

Table 4.2 INNS assessment asset result summary

Assessment component	Leighton Buzzard Service Reservoir	Leighton Buzzard WTW
Risk Score	13.04	14.72
Risk Score Category	Low	Low

4.2 Conclusions

The following conclusions have been drawn from the results of the INNS risk assessment of the scheme:

- The proposed transfers will not introduce a new hydrological connection between previously isolated catchments.
- The proposed transfer route and hydrologically connected waterbodies within an approximately 1km radius already host a range of aquatic INNS, including a number of High Impact species. This includes one High Impact fish species, six High Impact macroinvertebrate species and ten High Impact macrophyte species.
- Although the addition of treated water from a WwTW will not introduce new INNS to the canal network, the resulting increase in flows may facilitate the downstream spread of INNS already present in the receiving waterbody.
- It is critical that the potential risk associated with increased flows through connections such as waste weirs are properly mitigated.

- The proposed pipeline section of the scheme presents a lower risk than the open canal section.
- The overall SRO risk score, which is represents the combined average of all the RWT and asset components, is 27.53%.
- Creation and operation of new assets is unlikely to create a new pathway for INNS introduction, biosecurity measures should be considered to prevent additional INNS introduction.

4.3 Recommendations

4.3.1 Further Investigative Actions

The data and information entered into the INNS risk assessment tool were based on the latest available SRO conceptual design. It is recommended that the INNS risk assessment is reviewed upon finalisation of the conceptual design to account for any changes that may introduce INNS risk.

Measures to mitigate the INNS risk have not yet been incorporated into the conceptual design or operation protocol for the scheme. It is recommended that the design team review the pathway-specific biosecurity measures identified by the Environment Agency risk assessment tool with the aim of incorporating Medium and High confidence biosecurity measures into transfer design and operational protocol.

It is recommended that further field surveys are undertaken in the summer (June to September inclusive) to capture the full range of INNS present along the transfer route and within hydrologically connected waterbodies. Further surveys should take into account the preferred route, evolving scheme understanding and relevant parallel studies. The survey design should include a combination of new and repeated survey sites to increase both coverage and confidence in the understanding of INNS distribution and dispersal.

4.3.2 Biosecurity and Mitigation

Given the prevalence of navigation and angling within the canal network, all opportunities to improve biosecurity practices amongst canal users should be encouraged. Not all potential biosecurity and mitigation options are likely to be feasible and it is recommended that engagement with the Trust, the Environment Agency, and angling clubs may identify those which are most appropriate.

Although these principles may not be universally adopted, promotion of check-clean-dry principles should be included in any biosecurity strategy.

Modifications to exiting connections such as waste weirs which reduce flows from the canal to connecting waterbodies should be fully investigated and implemented. This would benefit ecology whilst retaining water in the system for public use, and in principle could reduce INNS risk overall.