[redacted]

Water Quality Monitoring

The content of this document is draft and relates to material [or data] which is still in the course of completion in travel to Gate 2 and should not be relied upon at this early stage of development. We continue to develop our thinking and our approach to the issues raised in the document in preparation for Gate 2.

Grand Union Canal Transfer SRO

Affinity Water, Severn Trent Water, Canal & River Trust

Grand Union Canal Transfer SRO Water Quality Stages 1 & 2

Severn Trent Water Limited & Affinity Water

[redacted]

April 2021

[redacted]

The content of this document is draft and relates to material [or data] which is still in the course of completion in travel to Gate 2 and should not be relied upon at this early stage of development. We continue to develop our thinking and our approach to the issues raised in the document in preparation for Gate 2.

Client: **Severn Trent Water Limited**

Address: **2 St John's Street**

Coventry

CV1 2LZ

Project reference: [redacted]

Date of issue: **April 2021**

Project Director:

Project Manager:

Other:

[redacted]

APEM Ltd
Riverview
A17 Embankment Business Park
Heaton Mersey
Stockport
SK4 3GN

Tel: 0161 442 8938
Fax: 0161 432 6083

Registered in England No. 02530851

Report should be cited as:

"APEM (2021). Grand Union Canal Transfer SRO Water Quality Stages 1 & 2. APEM Scientific Report [redacted]. Severn Trent Water Limited & Affinity Water, April 2021, v1.0 Final, 30 pp."

Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by
1	11/2/2021	All	All	Draft issued for client comments	[redacted]
2	12/2/2021	All	All	Second draft issued to client following comments on version 1	
3	17/2/2021	All	All	Third draft issued following client comments on version 2	
4	19/2/2021	All	All	Draft version issued following client comments on version 3	
5	26/2/2021	All	All	Draft version with Stage 2 included issued for client comments	
6	12/3/2021	All	All	Second draft issued to client following comments on version 5	
7	22/3/2021	All	All	Draft issued for client review following comments on version 6	
8	1/4/2021	All	All	Final report issued	

Contents

List of Figures

List of Tables

1. Introduction

1.1 Background

The Grand Union Canal (GUC) Project Management Board (PMB), formed by Severn Trent Water Limited (STWL), Affinity Water and The Canal & River Trust, commissioned the GUC Strategic Resource Option (SRO). This is a scheme to transfer up to 100Ml/d of water from Minworth Wastewater Treatment Works (WwTW) in Birmingham to an abstraction point owned by Affinity Water in South East England. This water source would be potentially subject to further treatment before being transferred via the canal. The transfer would be via the Midlands canal network close to Minworth WwTW and subsequently into the GUC.

The impact this scheme may have on the Water Framework Directive (WFD) status of receiving water bodies will be to be investigated in this report to ensure that the transfer does not breach the WFD water quality standards or the Environment Agency (EA) no-deterioration guidance. The water body status of canals was first determined approximately 10 years ago but it has been updated in 2019 by the regulator. In this work, new data is being analysed against the WFD environmental quality standards (EQS).

The 2019 WFD classification status for all the sites associated with the potential transfer was Moderate overall, but Good for the Ecological quality elements, Fail for Priority Hazardous Substances and Good for Priority Substances.

As part of the GUC SRO scheme, the GUC PMB started a dedicated water quality monitoring programme. The first samples were collected in May 2020 from sites including Minworth WwTW discharge and several potential discharge locations in the canals around Birmingham (and River Tame). Monitoring is continuing and the sampling locations are presented in Table 1.1 and Figure 1.

Table 1.1 GUC SRO Scheme Sites, Water Quality Sampling locations and 2019 classification of the related water bodies.

Site Option Name	Grid Reference	Comment on Sample Point	Sample Point	Sub-Option Number
Birmingham & Fazeley Canal Minworth	[redacted]	Discharge from Minworth	[redacted]	Sub-Option 1
Coventry Canal Fazeley		Discharge from Tame		Sub-Option 2a
River Tame Fazeley		Abstraction		Sub-Option 2b
Coventry Canal Atherstone		Discharge from Minworth		Sub-Option 3
Birmingham & Warwick Canal Junction Birmingham		Discharge from Minworth		Sub-Option 4
Grand Union Canal Copt Heath		Discharge from Minworth		Sub-Option 5
Grand Union Canal Leamington Trough Pound		Discharge from Minworth		Sub-Option 6

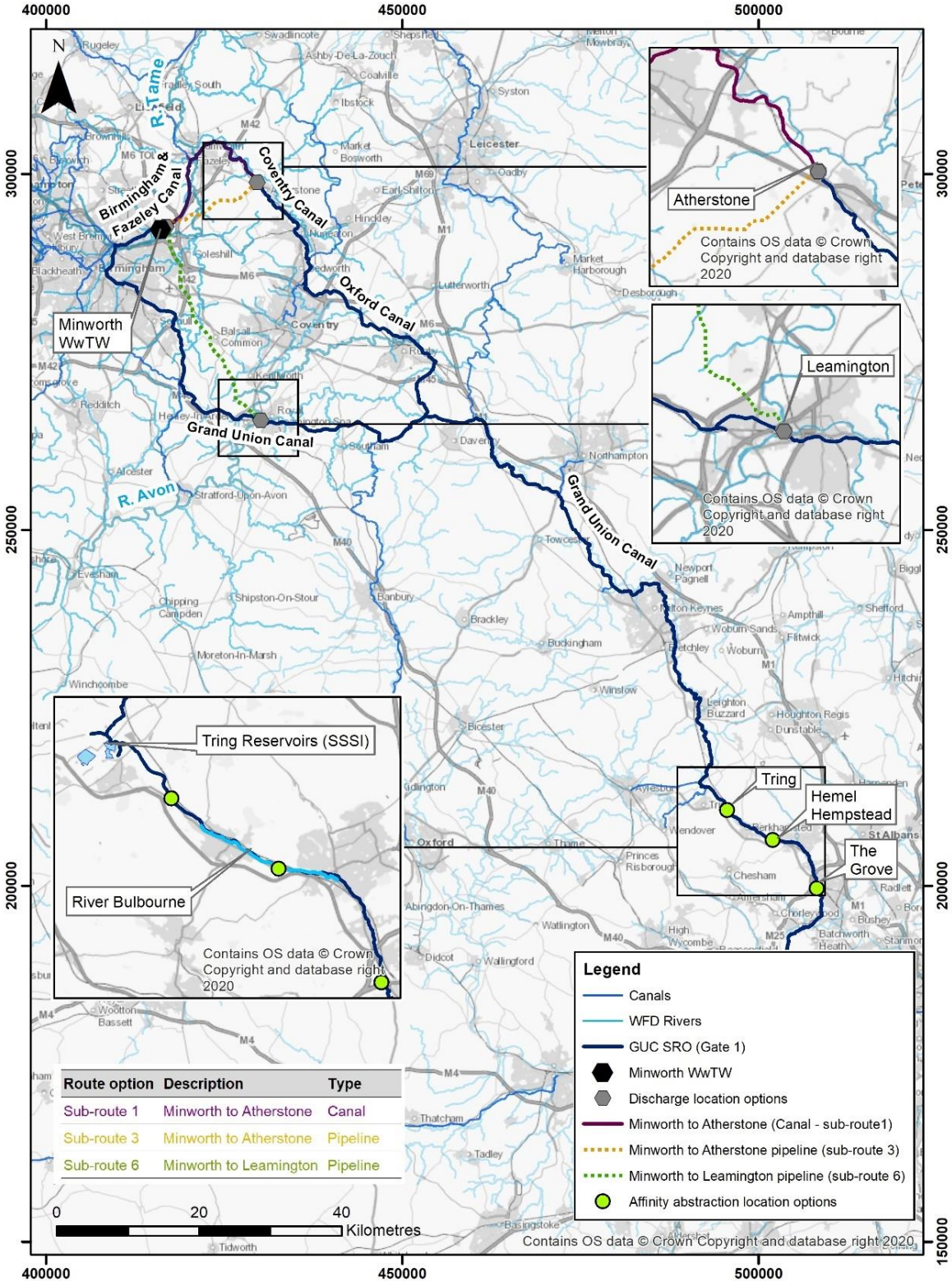

Figure 1. Map of GUC locations (courtesy of Stantec Ltd)

1.2 Objective

The objective of this project was as follows:

- To analyse the data from water quality samples collected as part of the GUC Water Quality Monitoring Phase 1 adjacent workstream within the SRO (Figure 2).
- To carry out an initial assessment of the potential for the transfer of a discharge from Minworth WwTW into the Midlands canal system to affect water quality of the GUC, in terms of its impact to the WFD status.
- To indicate to the GUC PMB the level of treatment which is likely to be needed at Minworth WwTW.

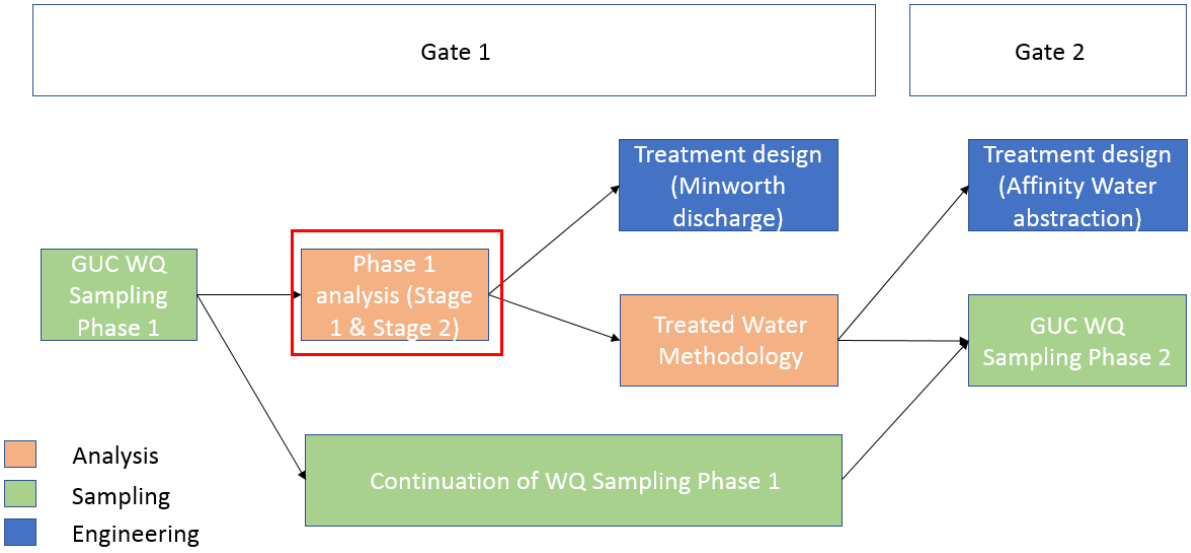

Figure 2. Workstreams of the GUC Transfer SRO project

1.3 This Report

The report covers two stages: Stage 1 has screened the substances being monitored to determine which ones were of concern and needed to be taken to Stage 2. Stage 2 involved water quality modelling using bespoke EA tools to assess whether discharging the Minworth WwTW final discharge into the canals would present a risk of exceeding WFD EQS.

The modelling tools used were RQP (the EA River Quality Planning v2.5) which was used for most substances and MPER (Metals Permitting) which was used for the assessment for bioavailable metals. The flow rates used in these models at the sampling sites were provided from models that are being generated as part of the GUC SRO project: Grand Union Canal Gate 1 Model, Draft Report March 2021 [redacted] GUC Modelling Report (issued as [redacted]).

Any EQS failures caused by the water transfer from Minworth WwTW at its current quality will be highlighted. This information will feed into the future additional treatment processes being

considered for Minworth WwTW, as upgrades in the treatment which will be required to support the GUC SRO scheme.

2. Methods

2.1 Stage 1: Screening

Note: the screening stage in Stage 1 related to whether the parameter continued to the next stage of analysis (Stage 2, RQP/MPER modelling). This does not relate to any decision on whether the parameter will continue to be sampled or if other parameters will be added.

At this stage there were 74 parameters being measured in the discharge and the water bodies. The parameters were selected for inclusion based on WFD monitoring requirements and in consultation with the EA, who requested some extra parameters to be assessed. The EQS for these 74 parameters were obtained from the WFD using 'The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015'.

For some of the parameters there are no WFD EQS and there is only a low level of certainty of the EQS to use (the EQS could be derived for some parameters from older, now repealed European Directives). These parameters are shown in Appendix 1, Table A.2. Advice from the EA was obtained on what EQS to use for Stage 2 (RQP/MPER modelling) or if any of the parameters could be screened out.

Note: site specific EQS have been calculated for some substances as required by the WFD. These type of EQS are based on the criteria for WFD assessments and use the data for a combination of dissolved organic carbon, pH, alkalinity and altitude. The EQS for these parameters are shown in Appendix 1, Table A.3.

The steps in this screening process were as follows:

1. Remove those parameters where the results at all sites (including Minworth WwTW) were all below the analytical limit of detection.
2. Remove those parameters where there is no EQS or if they are not included in WFD for freshwaters.
3. For those parameters detected above trace levels, determine the canal EQS for each parameter. This allowed for a sense check of the measured concentrations in the discharge against the EQS. This was another point at which parameters were screened out from further analysis, i.e. where the concentrations in the discharge levels were substantially below the EQS. We used 10% of the EQS value for this screening assessment. This screening method was carried out for each canal location, six in total as per Table 1.1.
4. Substances where the concentration at Minworth WwTW was lower than at any of the six canal locations were also screened out next because they were unlikely to cause any negative impact.

2.2 Stage 2: High-level assessment

Further analysis was carried out for the parameters which were screened in at Stage 1. Also, following the screening carried out in work package 'GUC WP1 – Optioneering (WSP 2021)

[redacted] WP1 Route Limitation Paper', only sub-options 1, 3 and 6 were selected for further analysis. Therefore, the Stage 2 assessment in this report was only carried out for three locations.

The analysis for Stage 2 involved carrying out a high level water quality modelling assessment for the screened in parameters. For this assessment we used two water quality modelling tools that were available from the EA:

- RQP (River Quality Planning v2.5). This allows the user to calculate the effect of a single discharge on the water quality of a river. It can also assess the discharge quality required to achieve a downstream water quality target if there is an EQS failure.
  The mixing of a discharge with a river is described by the Mass Balance Equation:

$$R = \frac{F \times C + f \times c}{F + f}$$

  where:
  • F is the river flow upstream of the discharge
  • C is the concentration of pollutant in the river upstream of the discharge
  • f is the flow of the discharge
  • c is the concentration of pollutant in the discharge
  • R is the concentration of pollutant downstream of the discharge.

- MPER (Metal Permitting) which is based on RQP and was designed as a result of new EQS for rivers for some dissolved metals (copper, zinc, manganese, nickel and lead). The standards aim to pinpoint a fraction of the dissolved metal that causes real damage: the part which is "bioavailable". MPER calculates the bioavailable fraction of the dissolved metals to assess the impact of the discharge on the EQS. This is used to determine what discharge quality is required to achieve a downstream water quality target.

The aim of this stage of the assessment was to determine whether discharging the Minworth WwTW discharge would present a risk of deterioration in water quality for WFD parameters. This work was carried out to support assessments by the STWL GUC engineering workstream on what additional treatment at Minworth WwTW might be required at each of the discharge sub options.

3. Results

The screening assessment in Stage 1 was carried out to determine whether the parameters continued to the next stage of analysis in Stage 2. The modelling in Stage 2 was as an initial assessment of the potential for the current discharge from Minworth WwTW to affect water quality in the GUC and to consider WFD effects of discharge. The findings from this assessment will feed the Minworth WwTW SRO design. In this section we have presented the results from Stage 1 and results from the Stage 2 high-level assessment.

3.1 Stage 1: Screening

Out of the original 74 parameters, 44 parameters were initially screened out based on the criteria stated previously: 17 parameters because all the samples at all locations were below

the LOD (Table 3.1); 2 parameters because there is no EQS (Table 3.2); and 25 parameters because they are not included in the WFD (Table 3.3). The relative concentration of Minworth WwTW in comparison to each of the three sites is also shown in Table 3.3. Although there is no EQS for these substances, it is apparent that the concentration in the discharge from Minworth WwTW is significantly higher than at any of the sites for Dissolved Organic Carbon, Nitrogen (Total Oxidised as N) and Phosphorus (total as P).

Table 3.1 List of parameters screened out at Stage 1 because all samples at all locations were below LOD

Parameter	Units	AA	MAC EQS	Analytical limit of detection
4-n-Nonylphenol	µg/l	0.3	2	0.01
4-n-Nonylphenol (Tech)	µg/l	0.3	2	0.01
BDE 100	µg/l	-	0.14	0.00003
BDE 153	µg/l	-	0.14	0.00008
BDE 154	µg/l	-	0.14	0.00008
BDE 28	µg/l	-	0.14	0.00003
Chloroform (trichloromethane)	µg/l	2.5	-	1
Diethylhexylphthalate	µg/l	1.3	-	0.2
NP diethoxylate (NPEO2)	µg/l	1	10	0.1
NP ethoxylates (Sum NPEO 1-3)	µg/l	1	10	0.3
NP monoethoxylate (NPEO1)	µg/l	1	10	0.1
NP triethoxylate (NPEO3)	µg/l	1	10	0.1
Octylphenol	µg/l	0.1	-	0.01
OP diethoxylate (OPEO2)	µg/l	0.1	-	0.02
OP ethoxylates (Sum OPEO 1-3)	µg/l	0.1	-	0.05
OP monoethoxylate (OPEO1)	µg/l	0.1	-	0.02
OP triethoxylate (OPEO3)	µg/l	0.1	-	0.02

Table 3.2 List of parameters screened out from the study because there is no EQS

Parameters	Units	AA	MAC EQS	Analytical limit of detection
Conductivity, Electrical 25°C	uS/cm	-	-	-
Field Temperature	Deg C	-	-	-

Table 3.3 List of parameters screened out from the study because they are not included in the WFD for freshwaters or for other reasons

Values show the concentration in the discharge from Minworth WwTW as a percentage of that in each of the three sites. Percentages below 100% indicate that the concentration at Minworth WwTW is lower than at the site.

Parameters	Units	Bham & Fazeley Canal Minworth	Coventry Canal Atherstone	Leamington Trough Pound	Comments
Alkalinity	mg/l	55%	65%	48%	No EQS, but data will be used for further modelling (Stage 2)
Aluminium, Dissolved as Al	µg/l	Below LOD	20%	Below LOD	No EQS, but another form of this substance will be used for modelling (Stage 2)
Aluminium, Total as Al	µg/l	15%	4%	4%	No EQS, but another form of this substance will be used for modelling (Stage 2)
Antimony, total as Sb (ug/l)	µg/l	72%	Below LOD	Below LOD	No EQS for freshwater, only for drinking water
Cadmium, Total as Cd	µg/l	20%	8%	93%	No EQS, but another form of this substance will be used for modelling (Stage 2)
Calcium, total as Ca	mg/l	68%	35%	88%	No EQS, but data will be used for further modelling (Stage 2)
Chlorophyll a COLD	µg/l	8%	19%	24%	Nutrients will be modelled in Stage 2 to check eutrophication.
Chromium, Total as Cr	µg/l	54%	118%	187%	No EQS, but another form of this substance will be used for modelling (Stage 2)
COD (Total)	mg/l	145%	103%	177%	No EQS, but data will be used for further modelling (Stage 2)
Copper, Total as Cu	µg/l	6%	44%	47%	No EQS, but another form of this substance will be used for modelling (Stage 2)
Dissolved Organic Carbon, as C	mg/l	240%	206%	191%	No EQS, but data will be used for further modelling (Stage 2)
Dissolved Oxygen (Saturation)	%	69%	84%	88%	Dissolved oxygen requires a detailed modelling approach so it has therefore been screened out.
Dissolved Oxygen, Fixed	mg/l	63%	79%	89%	Dissolved oxygen requires a detailed modelling approach so it has therefore been screened out.
Dissolved Oxygen, Unfixed	mg/l	98%	99%	100%	Dissolved oxygen requires a detailed modelling approach so it has therefore been screened out.
gamma-HBCDD	µg/l	389%	249%	Below LOD	No EQS, but another form of this substance will be used for modelling (Stage 2)
Iron, Total as Fe	µg/l	51%	16%	22%	No EQS, but another form of this substance will be used for modelling (Stage 2)
Lead, Total as Pb	µg/l	3%	8%	11%	No EQS, but another form of this substance will be used for modelling (Stage 2)

Parameters	Units	Bham & Fazeley Canal Minworth	Coventry Canal Atherstone	Leamington Trough Pound	Comments
Mercury, Total as Hg	µg/l	28%	36%	41%	No EQS, but another form of this substance will be used for modelling (Stage 2)
Nickel, Total as Ni	µg/l	68%	35%	401%	No EQS, but another form of this substance will be used for modelling (Stage 2)
Nitrogen, Total Oxidised as N	mg/l	1430%	1416%	725%	No EQS, but another form of this substance will be used for modelling (Stage 2) i.e. nitrate.
Phosphorus, total as P	mg/l	376%	299%	378%	No EQS, but another form of this substance will be used for modelling (Stage 2) i.e. SRP.
PFOA, in Surface Water	µg/l	97%	100%	188%	PFOA has been screened out because it is not included in the WFD. However, it is related to perfluorooctane sulfonate (PFOS), which has not been screened out.
pH	-	88%	92%	88%	All the results were within the range (6 to 9) so this parameter will be screened out.
Phaeophytin	µg/l	12%	29%	37%	No EQS, nutrients will be modelled in Stage 2 to check eutrophication.
Zinc, Total as Zn	µg/l	46%	94%	358%	No EQS, but another form of this substance will be used for modelling (Stage 2)

For those parameters that were provisionally screened in, the concentrations at the GUC sites were compared to the concentrations at Minworth WwTW. Minworth WwTW had the highest concentrations for 15 parameters (

Table 3.4). All these parameters were carried forward to Stage 2 for RQP/MPER modelling at all the GUC locations.

The Minworth WwTW concentrations were higher compared to some of the GUC sites for a further 8 parameters (Table **3.5**). These parameters were carried forward into Stage 2, but the modelling was only to be undertaken for those locations where the concentration was higher at Minworth WwTW.

In some instances, modelling was carried out for some substances and sites from Table 3.5 where it was initially believed not to be necessary. Dissolved nickel at GUC Coventry Canal Atherstone is an example of this. Even though Minworth STW doesn't pose a direct risk because the concentration at the site was higher than at Minworth STW, the GUC site was already failing the EQS. Because of this, we carried out the modelling to determine what load standstill limit would be required to not cause any further deterioration.

The concentrations for 7 parameters were lower at Minworth WwTW compared to all the GUC sites. These parameters are screened out from Stage 2 RQP modelling WwTW (Table **3.6**).

In summary, modelling in Stage 2 was carried out only for 23 substances, 15 of them at all the locations (

Table 3.4), and 8 at selected locations (Table 3.5).

Table 3.4 Parameters screened in for Stage 2 modelling because the concentration at Minworth WwTW was the highest value compared to GUC monitoring locations

Modelling is required for these parameters to assess impact at all locations (shading is used to indicate the highest values for every parameter).

Parameter	Units	Minworth WwTW	Other sites						
			Bham & Warwick Canal Jct	GUC Copt Heath	GUC Leamington Trough Pound	Coventry Canal Fazeley	River Tame Fazeley	Coventry Canal Atherstone	Bham & Fazeley Canal Minworth
alpha-HBCDD	µg/l	0.0009	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	0.0001	Below LOD
Ammoniacal Nitrogen, as N LL	mg/l	0.58	0.29	0.45	0.24	0.24	0.25	0.24	0.24
BDE 47	µg/l	0.00016	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	0.000069	Below LOD
BDE 99	µg/l	0.000157	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	0.000072	Below LOD
beta-HBCDD	µg/l	0.0003	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	0.0001	Below LOD
BOD + ATU (5 day)	mg/l	5.1	3.9	4.03	2.95	1.62	1.62	3.23	4.34
Chromium, Dissolved as Cr VI	µg/l	2.21	0.5	Below LOD	Below LOD	0.51	Below LOD	0.71	Below LOD
Cypermethrin	µg/l	0.0002	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD
HBCDD (Total WFD)	µg/l	0.0016	Below LOD	Below LOD	Below LOD	0.0002	0.0002	0.0003	Below LOD
Nitrate as N	mg/l	16.24	3.02	1.71	2.32	0.71	0.73	1.19	1.18
PBDEs (Total WFD)	µg/l	0.0005	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD
Soluble Reactive Phosphate LL	mg/l	0.29	0.02	0.04	0.09	0.01	0.01	Below LOD	0.02
Total Organic Carbon, as C	mg/l	10.5	4.97	5.6	5.8	5.34	4.67	5.01	4.59
Triclosan	µg/l	0.0193	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD
Zinc, Dissolved as Zn	µg/l	42.9	39.4	1.85	3.3	22.2	16.8	25.3	35.1

Table 3.5 Parameters screened in for Stage 2 modelling because the concentration at Minworth WwTW was higher than the value at some GUC locations

Modelling is required to assess impact only at some locations (highlighted in green).

Parameter	Units	Minworth WWTW	Other sites						
			Bham & Warwick Canal Jct	GUC Copt Heath	GUC Leamington Trough Pound	Coventry Canal Fazeley	River Tame Fazeley	Coventry Canal Atherstone	Bham & Fazeley Canal Minworth
Arsenic, total as As (ug/l)	µg/l	1.07	3.17	1.28	2.74	1.14	1.01	1.32	2.67
Cadmium, Dissolved as Cd	µg/l	0.02	0.07	Below LOD	Below LOD	Below LOD	Below LOD	0.07	Below LOD
Copper, Dissolved as Cu	µg/l	1.35	7.71	0.79	2.3	1.81	1.48	1.94	4.83
Iron, Dissolved as Fe	µg/l	63	32	54.71	Below LOD	98.86	Below LOD	165.7	29.57
Lead, Dissolved as Pb	µg/l	0.167	0.84	0.22	0.12	0.45	0.11	0.5929	0.72
Mercury, Dissolved as Hg	µg/l	0.00157	0.0014	0.0014	0.0013	Below LOD	0.00229	0.0013	0.0011
Nickel, Dissolved as Ni	µg/l	15.75	18.09	4.33	2.66	6.31	5.84	39.68	18
PFOS, In Surface Water	ug/l	0.0262	0.0319	0.0245	0.0084	0.0141	0.0134	0.0128	0.0341

Table 3.6 Parameters screened out for Stage 2 modelling because the concentration at Minworth WwTW was the lowest value compared to the GUC locations

Modelling will not be required to assess impacts at any of these locations

Parameter	Units	Minworth WWTW	Other sites						
			Bham & Warwick Canal Jct	GUC Copt Heath	GUC Leamington Trough Pound	Coventry Canal Fazeley	River Tame Fazeley	Coventry Canal Atherstone	Bham & Fazeley Canal Minworth
Aluminium, Reactive as Al	µg/l	6.81	12.9	7.96	11.74	8.89	8.21	19.3	12.21
Benzo(a)pyrene	µg/l	0.0006	0.007	0.016	0.019	0.022	0.016	0.024	0.007
Fluoranthene	µg/l	0.0018	0.03	0.02	0.03	0.03	0.03	0.04	0.01
Sulphide as S	mg/l	Below LOD	Below LOD	Below LOD	0.02	Below LOD	0.02	0.02	Below LOD
Total Suspended Solids	mg/l	4.86	9	13.1	28.4	31.9	28.6	48.4	18.7
Tributyltin	µg/l	0.00003	0.00008	0.0001	0.0002	0.0002	0.0002	0.0002	0.0001
Trichloroethene	µg/l	Below LOD	1.25	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD	Below LOD

3.2 Stage 2: High-level assessment

The flow data is required for the RQP and MPER modelling. It is worth noting that given this is a canal and not a river the flow will be variable and dependent upon boat traffic, and seasonality. The information used comes from an historic data series and is not as a result of the transfer. The transfer may increase the flow rate during times of operation.

Flow data was obtained from the Aquator water resources modelled flows (for the Coventry Canal Atherstone sampling point, Sub-Option 3) and the Canal & River Trust observed flows at Curdworth Locks (closest to Bham & Fazeley Canal Minworth sampling point, Sub-Option 1) and Hatton Flight (closest to GUC Leamington Trough Pound sampling point, Sub-Option 6) (Table 3.7). We used two different flows at Minworth WwTW, a maximum mean flow of 100 Ml/d and a minimum mean flow of 50 Ml/d, to replicate the discharge range being considered by the SRO. The 95th percentile for the discharges was calculated as one third of the mean, which is common practice for these assessments.

Modelled flow data was available at Curdworth and Leamington pounds, which are both trough pounds. Observed data had a lot of 'data noise' (high variability), this was likely to be due to sensor set up, boat movements, lock operation etc.

Table 3.7 Mean and Q95 flow values at Minworth WwTW and the locations used for RQP and MPER modelling

Location	Mean flow (Ml/d)	95%ile low flow (Ml/d)
Minworth WWTW Max flow	100.000	33.000
Minworth WWTW Min flow	50.000	16.667
Bham & Fazeley Canal Minworth	4.982	3.911
GUC Leamington Trough Pound	4.205	2.090
Coventry Canal Atherstone	2.902	0.158

We used RQP (for modelling most substances) and MPER (for modelling bioavailable metals), to assess the impact of the discharge from Minworth WwTW on the canal sites (Table 3.8)**Error! Reference source not found.**. If the discharge was predicted to cause an EQS failure, the permit limits that would be needed to achieve Good Ecological Potential (GEP) were calculated. Furthermore, if the site is already failing the standard, the load standstill limit required at Minworth WwTW was calculated so the water quality at the GUC site remains unchanged.

The main concern from discharging wastewater to a water course is the mass of each pollutant that is released into the environment. The mass of pollutant released is equal to flow released in a defined time, multiplied by its concentration during that time period. To ensure that the transfer does not cause deterioration in water quality over time, the mass of each pollutant should at least remain unchanged with any flow increase to the works (load standstill). This is described by the equation below:

$$Flow_1 \times Concentration_1 = Flow_2 \times Concentration_2 = Constant$$

Load standstill limits were also calculated for those locations where it was required to maintain current High Ecological Potential. Where a permit limit was not calculated then Minworth WwTW should maintain the current quality to avoid causing a deterioration and this is also indicated in Table 3.8.

Permit limits calculated in this report are only for information as a proxy for recommended maximum discharge value (RMDV). Their objective is to give an indication of the level of treatment which is likely to be needed at Minworth WwTW. They are not intended to be used as the final permit limits. Further monitoring is being carried out and further modelling/assessments will be carried out as the scheme progresses.

RMDV were required only for one of the bioavailable metals: dissolved nickel. GEP RMDV and load standstill RMDV are provided in Table 3.9 and Table 3.10. The equations which calculate the bioavailable portion of these dissolved metals are very complex and there is a certain amount of uncertainty around them. Because of this, the software returns upper, mean and lower confidence limits for the results.

For this work, two sets of RMDV, based on mean and upper confidence limits values, are presented. These RMDV can be significantly different, which at this stage is most likely to be due to the small number of samples and the variability in the data this causes.

The upper confidence limits are presented in this report because the EA tends to set the permit limits for bioavailable metals based on the modelling results for the upper confidence limits. This is in order to give the benefit of the doubt to the discharger.

The objective of this report is not to come up with firm permit limits, but is to show all the outcomes and come up with potential standards. This will inform the treatment process design at Minworth WwTW to support the GUC transfer SRO. Nevertheless, we recommend that the engineering solutions are initially based on the upper confidence limit figures that are provided.

Table 3.8 Effect on the indicative WFD status of the discharge from Minworth WwTW at several monitoring locations for the substances screened in at Stage 1

RMDV required at Minworth WwTW to achieve good ecological potential (GEP) or load standstill were calculated only when there is an EQS failure or high status needs to be protected. Results for two different flow rates (50 and 100 Ml/d) at Minworth WwTW are shown.

		Bham & Fazeley Canal Minworth - 50Ml/d				Bham & Fazeley Canal Minworth - 100Ml/d			
Parameter	Units	Site status	Discharge Impact	GEP RMDV (Mean/95%ile)	Load standstill RMDV (Mean/95%ile)	Site status	Discharge Impact	GEP RMDV (Mean/95%ile)	Load standstill RMDV (Mean/95%ile)
alpha-HBCDD	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Ammoniacal Nitrogen, as N LL	mg/l	Pass	Pass	No	0.10/0.30	Pass	Fail	0.14/0.43	0.09/0.28
Arsenic, total as As (ug/l)	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
BDE 47	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
BDE 99	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
beta-HBCDD	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
BOD + ATU (5 day)	mg/l	Fail	Fail	2.32/5.15	2.55/5.67	Fail	Fail	2.27/5.05	2.50/5.56
Cadmium, Dissolved as Cd	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Chromium, Dissolved as Cr VI	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Copper, Dissolved as Cu	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
Cypermethrin	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
HBCDD (Total WFD)	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Iron, Dissolved as Fe	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Lead, Dissolved as Pb	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
Mercury, Dissolved as Hg	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Nickel, Dissolved as Ni	µg/l	Fail	Fail	See Table 3.9	See Table 3.10	Fail	Fail	See Table 3.9	See Table 3.10
Nitrate as N	mg/l	Pass	Fail	7.56/12.34	N/A	Pass	Pass	7.26/11.85	N/A
PBDEs (Total WFD)	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
PFOS, In Surface Water	µg/l	Fail	Fail	Not Possible	0.034/0.050	Fail	Fail	Not possible	0.03413/0.4987
Soluble Reactive Phosphate LL	mg/l	Pass	Fail	0.07/0.19	0.04/0.10	Pass	Fail	0.07/0.19	0.03/0.10
Total Organic Carbon, as C	mg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Triclosan	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Zinc, Dissolved as Zn	µg/l	Fail	Pass	No	Maintain Q	Fail	Pass	No	Maintain Q

		GUC Leamington Trough Pound - 50Ml/d				GUC Leamington Trough Pound - 100Ml/d			
Parameter	Units	Site status	Discharge Impact	GEP RMDV (Mean/95%ile)	Load standstill RMDV (Mean/95%ile)	Site status	Discharge Impact	GEP RMDV (Mean/95%ile)	Load standstill RMDV (Mean/95%ile)
alpha-HBCDD	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Ammoniacal Nitrogen, as N LL	mg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Arsenic, total as As (ug/l)	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
BDE 47	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
BDE 99	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
beta-HBCDD	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
BOD + ATU (5 day)	mg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Cadmium, Dissolved as Cd	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Chromium, Dissolved as Cr VI	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Copper, Dissolved as Cu	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
Cypermethrin	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
HBCDD (Total WFD)	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Iron, Dissolved as Fe	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
Lead, Dissolved as Pb	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Mercury, Dissolved as Hg	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Nickel, Dissolved as Ni	µg/l	Pass	Fail	See Table 3.9	N/A	Pass	Fail	See Table 3.9	N/A
Nitrate as N	mg/l	Pass	Fail	7.31/11.93	N/A	Pass	Fail	7.09/11.58	N/A
PBDEs (Total WFD)	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
PFOS, In Surface Water	µg/l	Fail	Fail	Not Possible	0.00019/0.00029	Fail	Fail	0.00032/0.00046	0.00836/0.01221
Soluble Reactive Phosphate LL	mg/l	Fail	Fail	0.07/0.21	0.09/0.25	Fail	Fail	0.07/0.21	0.09/0.24
Total Organic Carbon, as C	mg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Triclosan	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Zinc, Dissolved as Zn	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q

		Coventry Canal Atherstone - 50Ml/d				Coventry Canal Atherstone - 100Ml/d			
Parameter	Units	Site status	Discharge Impact	GEP RMDV (Mean/95%ile)	Load standstill RMDV (Mean/95%ile)	Site status	Discharge Impact	GEP RMDV (Mean/95%ile)	Load standstill RMDV (Mean/95%ile)
alpha-HBCDD	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Ammoniacal Nitrogen, as N LL	mg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Arsenic, total as As (ug/l)	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
BDE 47	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
BDE 99	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
beta-HBCDD	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
BOD + ATU (5 day)	mg/l	Pass	Pass	No	2.28/5.08	Pass	Fail	2.77/6.17	2.22/4.94
Cadmium, Dissolved as Cd	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
Chromium, Dissolved as Cr VI	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Copper, Dissolved as Cu	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
Cypermethrin	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
HBCDD (Total WFD)	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Iron, Dissolved as Fe	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
Lead, Dissolved as Pb	µg/l	Pass	Maintain Q	Maintain Q	Maintain Q	Pass	Maintain Q	Maintain Q	Maintain Q
Mercury, Dissolved as Hg	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Nickel, Dissolved as Ni	µg/l	Fail	Fail	See Table 3.9	See Table 3.10	Fail	Fail	See Table 3.9	See Table 3.10
Nitrate as N	mg/l	Pass	Fail	7.07/11.55	N/A	Pass	Fail	6.96/11.37	N/A
PBDEs (Total WFD)	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
PFOS, In Surface Water	µg/l	Fail	Fail	0.00008/0.00012	0.0128/0.0187	Fail	Fail	0.00035/0.00052	0.01279/0.01868
Soluble Reactive Phosphate LL	mg/l	Pass	Fail	0.06/0.18	0.03/0.09	Pass	Fail	0.06/0.18	0.03/0.09
Total Organic Carbon, as C	mg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Triclosan	µg/l	Pass	Pass	No	Maintain Q	Pass	Pass	No	Maintain Q
Zinc, Dissolved as Zn	mg/l	Pass	Fail	See Table 3.9	N/A	Pass	Fail	See Table 3.9	N/A

Table 3.9 RMDV (calculated as 95th percentile and Upper Tier) required at Minworth WwTW to achieve indicative good ecological potential (GEP) for dissolved nickel and dissolved zinc (in µg/l)

Mean and upper confidence limits of the permits and results for two different flow rates (50 and 100 Ml/d) at Minworth WwTW are shown.

	GUC Bham & Fazeley Canal Minworth – 50 Ml/d				GUC Bham & Fazeley Canal Minworth - 100Ml/d			
	Face Value		Upper confidence		Face Value		Upper confidence	
	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier
Nickel, Dissolved as Ni	21	58	57	264	22	60	57	258
	GUC Leamington Trough Pound – 50Ml/d				GUC Leamington Trough Pound - 100Ml/d			
	Face Value		Upper confidence		Face Value		Upper confidence	
	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier
Nickel, Dissolved as Ni	20	57	69	372	20	55	67	362
	GUC Coventry Canal Atherstone – 50Ml/d				GUC Coventry Canal Atherstone - 100Ml/d			
	Face Value		Upper confidence		Face Value		Upper confidence	
	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier
Nickel, Dissolved as Ni	7	20	44	354	8	23	41	290
Zinc, Dissolved as Zn	84	276	222	1128	84	276	221	1126

Table 3.10 RMDV (calculated as 95th percentile and Upper Tier) required at Minworth WwTW to achieve indicative load standstill for dissolved nickel (in µg/l)

Mean and upper confidence limits of the permits and results for two different flow rates (50 and 100 Ml/d) at Minworth WwTW are shown.

	GUC Bham & Fazeley Canal Minworth – 50 Ml/d				GUC Bham & Fazeley Canal Minworth - 100Ml/d			
	Face Value		Upper confidence		Face Value		Upper confidence	
	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier
Nickel, Dissolved as Ni	47	131	122	552	47	131	120	538
	GUC Coventry Canal Atherstone – 50Ml/d				GUC Coventry Canal Atherstone - 100Ml/d			
	Face Value		Upper confidence		Face Value		Upper confidence	
	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier	95%ile	Upper Tier
Nickel, Dissolved as Ni	79	220	334	2100	79	220	330	2068

4. Conclusions

4.1 Stage 1: Screening

In Stage 1 of the GUC SRO water quality assessment project, the parameters which should be screened in for modelling in Stage 2 were identified, along with the relevant EQS to use from the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015. These parameters are shown in Appendix 1 (Table A.1). All the EQS were agreed with the EA, Appendix 1 ((Table A.1 and Table A.2)**.** In consultation with the EA, 51 substances were screened out at this point:

- 17 parameters have been screened out because all the results at all locations were below the LOD (Table 3.1)
- 2 parameters were screened out because there is no EQS in the WFD (Table 3.2)
- 25 parameters were screened out because they are not in the WFD (Table 3.3).
- 7 parameters were screened out because the concentration at Minworth WwTW is lower than the concentration at any of the GUC sites (Table 3.6)

In agreement with EA's Water Quality specialists from the Integrated Environment Planning teams in the Lincolnshire and Northamptonshire, Thames, East Midlands, West Midlands, and East Anglia areas, 23 parameters were screened in to be modelled in Stage 2:

- 15 substances were modelled at all the locations because the concentration at Minworth WwTW is higher than the concentration at any of the GUC sites (

- Table 3.4).
- 8 substances were modelled at selected locations only because the concentration at Minworth WwTW is higher than the concentration at some of the GUC sites (Table 3.5).

4.2 Stage 2: High-level assessment

In Stage 2 of the GUC SRO water quality assessment project the effect of the current discharge from Minworth WwTW on the water quality at several GUC locations was determined. This will determine what additional level of treatment is required at Minworth WwTW, in order to tackle any possible deterioration in water quality due to this scheme. We focused the assessment in Stage 2 on those substances previously agreed with the EA in the Stage 1.

Modelled or measured flow data (Table 3.7) were used for the RQP and MPER modelling work. Several indicative permit limits or recommended maximum discharge values (RMDV) were calculated. These standards were set to achieve Good Ecological Potential. The modelling was carried out if the discharge was likely to cause a failure of the WFD status, or where load standstill limits were required when the site is already failing (because it is necessary to maintain current water quality or to maintain current high WFD status) (Table 3.8).

Bespoke RMDV were calculated for dissolved nickel and dissolved zinc for Good Ecological Potential (Table 3.9) and load standstill purposes (Table 3.10).

RMDV were required for seven substances across the three locations. Some of the parameters: nitrate, soluble reactive phosphate, dissolved nickel and PFOS; need RMDV for all of the sites. RMDV for BOD are required for two locations and the remaining substances (ammoniacal nitrogen and dissolved zinc) only needed RMDV at one site (Table 4.1).

Overall, the RMDV required for the scenario where Minworth WwTW transfers the minimum flow (50Ml/d) are not significantly different to when it transfers the maximum flow (100Ml/d). This means that the RMDV on Table 4.1 would be able to protect the environment under any transfer flow rate.

The main substances of concern are soluble reactive phosphate, nitrate and dissolved nickel as they fail at all the locations under both minimum and maximum Minworth WwTW flow. PFOS also fails at all the locations, but this is due to its ubiquitous nature which makes it a widespread EQS failure across the whole country.

The modelling assessment shows that the GUC Leamington Trough Pound (sub-option 6) requires the lowest number of substances to be permitted (four). The Coventry Canal Atherstone (sub-option 3) and the Bham & Fazeley Canal Minworth (sub-option 1) require both the highest level of permit limits for six substances.

The indicative WFD status at all six locations included in this study, based on the collected data, is shown in Table 4.2. This shows that water quality is less than Good Ecological Potential at all sites for benzo(a)pyrene, dissolved oxygen and PFOS. Most of the sites also fail the standards for dissolved nickel. However, this indicative WFD classification is based on

a small number of samples (between 4 to 7) and we recommend monitoring continues in order to develop a more robust dataset.

Table 4.1 Summary of the RMDV required at Minworth WwTW to achieve good ecological potential (GEP) or maintain load standstill
Current quality of the discharge at Minworth WwTW and results for two different flow rates (50 and 100 Ml/d) at Minworth WwTW are shown.

		Bham & Fazeley Canal Minworth		Discharge Flow 50 Ml/d			Discharge Flow 100 Ml/d		
Parameter	**Units**	**Indicative Site status**	**Minworth discharge Q (Mean/95%ile)**	**Minworth Impact**	**RMDV GEP (Mean/95%ile)**	**Load standstill RMDV (Mean/95%ile)**	**Minworth Impact**	**GEP RMDV (Mean/95%ile)**	**Load standstill RMDV (Mean/95%ile)**
Ammoniacal Nitrogen, as N LL	mg/l	High	0.27/0.80	Good	No	0.10/0.30	Moderate	0.14/0.43	0.09/0.28
BOD + ATU (5 day)	mg/l	Moderate	2.27/5.67	Moderate	2.32/5.15	2.55/5.67	Moderate	2.27/5.05	2.50/5.56
Nickel, Dissolved as Ni	µg/l	Fail	16/25	Fail	See Table 3.9	See Table 3.10	Fail	See Table 3.9	See Table 3.10
Nitrate as N	mg/l	Good	16/26	Fail	7.56/12.34	N/A	Fail	7.26/11.85	N/A
PFOS, In Surface Water	µg/l	Fail	0.026/0.037	Fail	Not Possible	0.034/0.050	Fail	Not possible	0.034/0.50
Soluble Reactive Phosphate LL	mg/l	High	0.29/0.79	Poor	0.07/0.19	0.04/0.10	Poor	0.07/0.19	0.03/0.10
		GUC Leamington Trough Pound		**Discharge Flow 50 Ml/d**			**Discharge Flow 100 Ml/d**		
Parameter	**Units**	**Indicative Site status**	**Minworth discharge Q (Mean/95%ile)**	**Minworth Impact**	**RMDV GEP (Mean/95%ile)**	**Load standstill RMDV (Mean/95%ile)**	**Minworth Impact**	**GEP RMDV (Mean/95%ile)**	**Load standstill RMDV (Mean/95%ile)**
Nickel, Dissolved as Ni	µg/l	Good	16/25	Fail	See Table 3.9	N/A	Fail	See Table 3.9	N/A
Nitrate as N	mg/l	Good	16/26	Fail	7.31/11.93	N/A	Fail	7.09/11.58	N/A
PFOS, In Surface Water	µg/l	Fail	0.026/0.037	Fail	Not Possible	0.00019/0.00029	Fail	0.00032/0.00046	0.008/0.012
Soluble Reactive Phosphate LL	mg/l	Moderate	0.29/0.79	Poor	0.07/0.21	0.09/0.25	Poor	0.07/0.21	0.09/0.24
		Coventry Canal Atherstone		**Discharge Flow 50 Ml/d**			**Discharge Flow 100 Ml/d**		
Parameter	**Units**	**Indicative Site status**	**Minworth discharge Q (Mean/95%ile)**	**Minworth Impact**	**RMDV GEP (Mean/95%ile)**	**Load standstill RMDV (Mean/95%ile)**	**Minworth Impact**	**GEP RMDV (Mean/95%ile)**	**Load standstill RMDV (Mean/95%ile)**
BOD + ATU (5 day)	mg/l	High	2.27/5.67	Good	No	2.28/5.08	Moderate	2.77/6.17	2.22/4.94
Nickel, Dissolved as Ni	µg/l	Fail	16/25	Fail	See Table 3.9	See Table 3.10	Fail	See Table 3.9	See Table 3.10
Nitrate as N	mg/l	Good	16/26	Fail	7.07/11.55	N/A	Fail	6.96/11.37	N/A
PFOS, In Surface Water	µg/l	Fail	0.026/0.037	Fail	0.00008/0.00012	0.013/0.019	Fail	0.00035/0.00052	0.013/0.019
Soluble Reactive Phosphate LL	mg/l	High	0.29/0.79	Poor	0.06/0.18	0.03/0.09	Poor	0.06/0.18	0.03/0.09
Zinc, Dissolved as Zn	mg/l	Good	43/89	Fail	See Table 3.9	N/A	Fail	See Table 3.9	N/A

Table 4.2 Indicative current WFD status at all sites (see Table A.1 for EQS details)

Parametes	Bham & Warwick Canal Jct	GUC Copt Heath	GUC Leamington Trough Pound	Coventry Canal Fazeley	River Tame Fazeley	Coventry Canal Atherstone	Bham & Fazeley Canal Minworth
4-Nonylphenol	Good	Good	Good	Good	Good	Good	Good
alpha-HBCDD	Good	Good	Good	Good	Good	Good	Good
Ammoniacal Nitrogen, as N	High	Moderate	High	High	High	High	High
BDE 47	Good	Good	Good	Good	Good	Good	Good
BDE 99	Good	Good	Good	Good	Good	Good	Good
Benzo(a)pyrene	Fail	Fail	Fail	Fail	Fail	Fail	Fail
BOD + ATU (5 day)	Good	Good	High	High	High	High	Moderate
Cadmium, Dissolved as Cd	Good	Good	Good	Good	Good	Good	Good
Chromium, Dissolved as Cr VI	Good	Good	Good	Good	Good	Good	Good
Copper, Dissolved as Cu	Good	Good	Good	Good	Good	Good	Good
Cypermethrin	Good	Good	Good	Good	Good	Good	Good
Dissolved Oxygen (Saturation)	Bad	Bad	Poor	Bad	Bad	Bad	Poor
HBCDD (Total WFD)	Good	Good	Good	Good	Good	Good	Good
Iron, Dissolved as Fe	Good	Good	Good	Good	Good	Good	Good
Lead, Dissolved as Pb	Good	Good	Good	Good	Good	Good	Good
Mercury, Dissolved as Hg	Good	Good	Good	Good	Good	Good	Good
Nickel, Dissolved as Ni	Fail	Good	Good	Fail	Good	Fail	Fail
Nitrate as N	Good	Good	Good	Good	Good	Good	Good
PBDEs (Total WFD)	Good	Good	Good	Good	Good	Good	Good
PFOS, In Surface Water	Fail	Fail	Fail	Fail	Fail	Fail	Fail
pH	Good	Good	Good	Good	Good	Good	Good
Soluble Reactive Phosphorus	High	Good	Moderate	High	High	High	High
Total Suspended Solids	Good	Good	Fail	Fail	Fail	Fail	Good
Tributyltin	Good	Good	Good	Good	Good	Good	Good
Trichloroethene	Good	Good	Good	Good	Good	Good	Good
Triclosan	Good	Good	Good	Good	Good	Good	Good
Zinc, dissolved as Zn	Fail	Good	Good	Good	Good	Good	Fail

Appendix 1

Table A.1 List of parameters and EQS (annual average and maximum allowable concentration) where the EQS is known and has been taken from the WFD (high confidence)

Parameters	Units	EQS AA	EQS MAC
4-Nonylphenol	µg/l	0.3	2
alpha-HBCDD	µg/l	0.0016	0.5
Ammoniacal Nitrogen, as N*	mg/l	See Table A.3	
BDE 47	µg/l	-	0.14
BDE 99	µg/l	-	0.14
Benzo(a)pyrene	µg/l	0.00017	0.27
BOD + ATU (5 day)*	mg/l	See Table A.3	
Cadmium, Dissolved as Cd**	µg/l	0.15	0.9
Chromium, Dissolved as Cr VI	µg/l	3.4	-
Copper, Dissolved as Cu***	µg/l	1	-
Cypermethrin	µg/l	0.00008	0.0006
Dissolved Oxygen (Saturation)*	%	Table A.3	
HBCDD (Total WFD)	µg/l	0.0016	0.5
Iron, Dissolved as Fe	µg/l	1000	-
Lead, Dissolved as Pb***	µg/l	1.2	14
Mercury, Dissolved as Hg	µg/l	-	0.07
Nickel, Dissolved as Ni***	µg/l	4	34
Nitrate as N	mg/l	-	11.3 (95%ile)
PBDEs (Total WFD)	µg/l	0.049	0.14
PFOS, In Surface Water	ug/l	0.00065	36
pH	pH	-	6-9 (95%ile)
Soluble Reactive Phosphorus*	mg/l	See Table A.3	
Total Suspended Solids	mg/l	25	-
Tributyltin	µg/l	0.0002	0.0015
Trichloroethene	µg/l	10	-
Triclosan	µg/l	0.1	0.28 (95%ile)
Zinc, dissolved as Zn***	µg/l	10.9	-

* The EQS is site specific based on alkalinity and altitude.
** Both AA and MAC EQS are hardness dependent.
*** The EQS AA is expressed as the bioavailable fraction of the dissolved metal. This is site specific and dependant on DOC, $CaCO_3$ and pH data. Background concentration needs to be added to the AA EQS for Zinc (1.4 µg/l).

Table A.2 List of parameters and EQS (annual average and maximum allowable concentration) where there is low confidence because there is no EQS in WFD freshwaters. EA to advise on what EQS to use

Parameters	Units	EQS AA	EQS MAC
Alkalinity to pH 4.5 as CaCO3	mg/l	-	-
Aluminium, Dissolved as Al	µg/l	-	-
Aluminium, Reactive as Al	µg/l	0.05	0.25
Aluminium, Total as Al	µg/l	-	-
Antimony, total as Sb (ug/l)	µg/l	5	-
Arsenic, total as As (ug/l)	µg/l	50	-
beta-HBCDD	µg/l	0.0016	0.5
Cadmium, Total as Cd	µg/l	-	-
Calcium, total as Ca	mg/l	-	-
Chlorophyll a COLD	µg/l	-	-
Chromium, Total as Cr	µg/l	-	-
COD (Total)	mg/l	-	-
Conductivity, Electrical 25C	uS/cm	-	-
Copper, Total as Cu	µg/l	-	-
Dissolved Organic Carbon, as C	mg/l	-	-
Dissolved Oxygen, Fixed	mg/l	-	-
Dissolved Oxygen, Unfixed	mg/l	-	-
Field Temperature	Deg C	-	-
Fluoranthene	µg/l	0.0063	0.12
gamma-HBCDD	µg/l	0.0016	0.5
Iron, Total as Fe	µg/l	-	-
Lead, Total as Pb	µg/l	-	-
Mercury, Total as Hg	µg/l	-	-
Nickel, Total as Ni	µg/l	-	-
Nitrogen, Total Oxidised as N	mg/l	-	-
PFOA, in Surface Water	µg/l	-	-
Phaeophytin	µg/l	-	-
Phosphorus, total as P	mg/l	0.05	-
Sulphide as S	mg/l	0.05	-
Total Organic Carbon, as C	mg/l	-	-
Zinc, Total as Zn	µg/l	-	-

Table A.3 List of site specific environmental quality standards for Good Ecological Potential for physico-chemical parameters and phosphorus

Sites	Parameters			
	Total ammonia (90%ile, mg/l)	BOD (90%ile, mg/l)	Soluble Reactive Phosphorus (AA, mg/l)	Dissolved oxygen (10%ile, %)
Bham & Warwick Canal Jct	0.3	4	0.063	75
GUC Copt Heath	0.3	4	0.051	75
GUC Leamington Trough Pound	0.6	5	0.074	60
Coventry Canal Fazeley	0.6	5	0.062	60
River Tame Fazeley	0.6	5	0.063	60
Coventry Canal Atherstone	0.6	5	0.062	60
Bham & Fazeley Canal Minworth	0.3	4	0.064	75