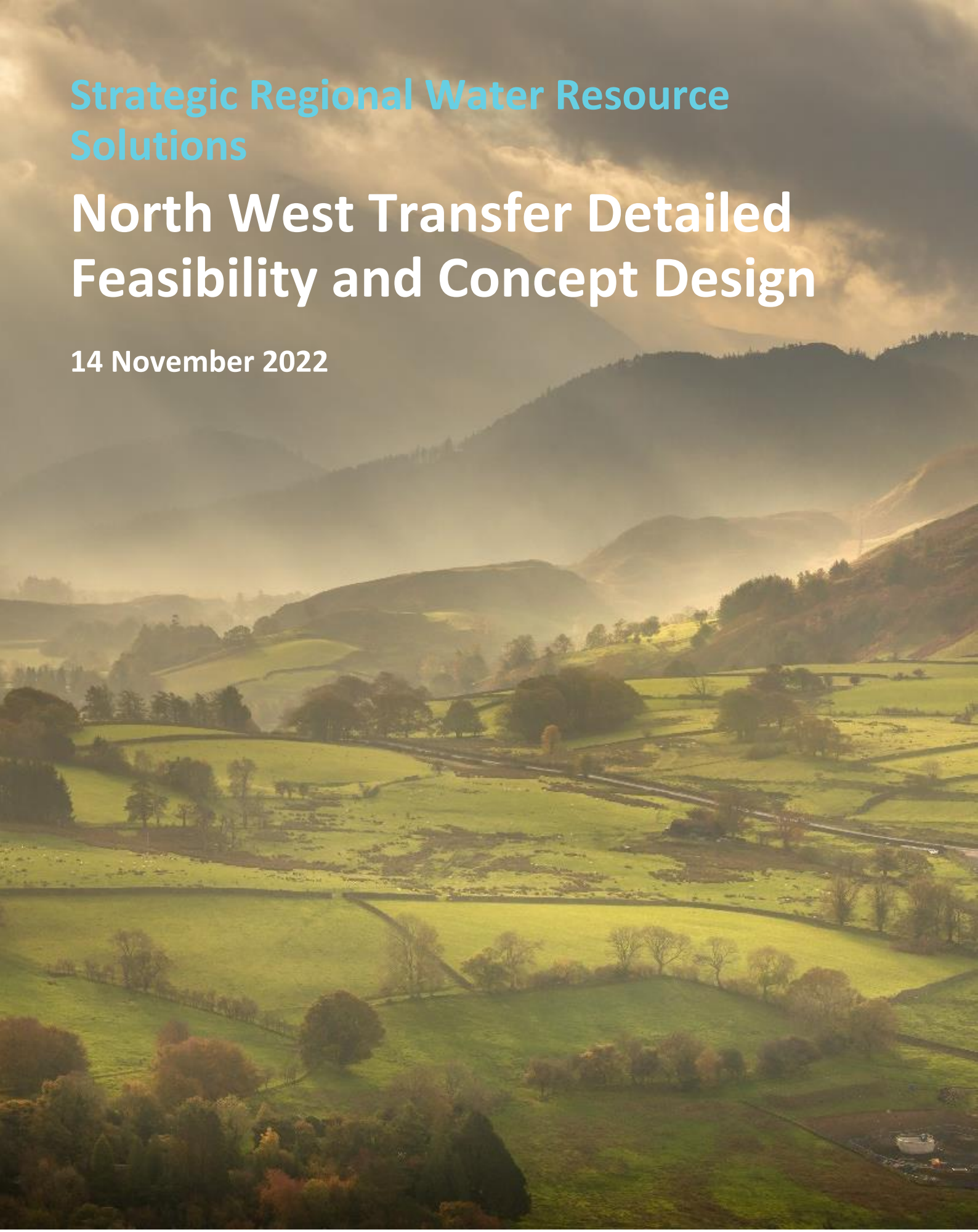


Strategic Regional Water Resource Solutions

North West Transfer Detailed Feasibility and Concept Design

14 November 2022

United Utilities

Water for the North West

Contents

Table of changes as per March 2023

1. Executive Summary

1.1.1 The North West Transfer Strategic Resource Option (NWT SRO) is one of a number of schemes promoted by Ofwat in the PR19 Final Determination (PR19 FD) to identify new strategic water resources to meet projected supply deficits as a consequence of population growth and climate change. The NWT SRO was formed at Gate 1 by the merging of the previous United Utilities (UU) Sources and Vyrnwy Aqueduct SROs to provide a holistic approach to delivering a transfer solution from the North West of England. The project scope and funding allocation was unchanged by this event.

1.1.2 The objective of the NWT SRO is to provide increased water supply resilience both within the Water Resources West (WRW) region and the Water Resources South East (WRSE) region via the proposed Severn to Thames Transfer (STT) SRO. This report illustrates that the NWT SRO has the potential to provide a scalable transfer of up to 205 Ml/d through development of new water sources in the North West and enabling works to the Vyrnwy Aqueduct distribution system, defined as the "Full Solution". This is subject to further assessment in future gates.

1.1.3 This report contains a summary of the activities and associated outcomes for the period between Gate 1 (July 2021) and Gate 2 (November 2022). These activities have been informed by both the recommended actions arising from our Gate 1 assessments and the Regulators' Alliance for Progressing Infrastructure Development (RAPID) guidance for Gate 2. The content is consistent with information previously shared with the RAPID through Quarterly Dashboard Reports.

1.1.4 The project has been delivered to programme and within the funding allowance for Gate 2.

Table 1 - Key facts and conclusions

Description	Comments
Key Assumptions	• Environmental and water quality impacts which may emerge through further detailed assessments in Gate 3 can be mitigated. • The NWT SRO would be required to support a transfer of up to 205 Ml/d for up to 15% of the time over a long-term average (maximum continuous transfer duration of approximately 250 days). • The Kielder Reservoir Sub-option (WR812 WIT_THIRD PARTY_22) will be progressed as a separate SRO. • Stakeholder concerns can be addressed prior to planning being submitted. • The STT SRO interconnector will be delivered to enable transfers to the South East of England. • Initial water transfers are not required until 2031.
Key Risks	• Evolving environmental guidance and/or legislation which may impact the volume of water UU can abstract to support transfers. • The volumes and timings of transfers are subject to change through the Regional Planning and WRMP processes which has a consequential impact on the scale of the requirement for the NWT SRO and pace of delivery. • Customer acceptability impacts as a consequence of changing water sources to facilitate transfers.
Key Conclusions and Recommendations	• We recommend that the NWT SRO is progressed to Gate 3. • There is the potential to offer a scalable transfer solution up to 205 Ml/d supported by a number of Sub-options. • The submission has been externally assured and a supporting UU Board Statement has been provided. • We expect to maintain supply to customers fed directly from the Vyrnwy Aqueduct during a transfer period of up to 250 days. • No additional abstraction from Lake Vyrnwy above currently permitted levels is required and we do not anticipate any construction activity in Wales. • We have identified an opportunity to drive efficiencies in scheme delivery through co-ordination with the current Vyrnwy Aqueduct Modernisation Programme (VAMP). • We are recommending that 4 Sub-options (equivalent to a trade of 75 Ml/d) are delivered to Severn Trent Water (STW) in 2031 in line with the November 2022 Draft WRMP. • The Town and Country Planning Act 1990 (TCPA) is the current recommended planning route for all elements of the NWT SRO. • Our initial assessment is that 2 Sub-options in our 'Full Solution' (WR076 SWN_RIVER BOLLIN and WR015 SWN_RIVER IRWELL) would be 'somewhat suitable' for a Direct Procurement for Customers (DPC) approach against the current PR19 criteria. • We are proposing a Mid-Gate 3 Checkpoint in December 2023 following the outcome of the WRMP and Regional Planning process to confirm the requirement for the NWT SRO and associated pace of delivery. • The earliest delivery date for the NWT SRO Full Solution of 205 Ml/d is 2033. • We are working in conjunction with Northumbrian Water (NWL) to assess whether the Kielder Reservoir Sub-option should be proposed as a separate SRO.

1.1.5 During Gate 2 we have engaged with both RAPID and Northumbrian Water regarding the progression of the Kielder Reservoir Sub-option (WR812 WIT_THIRD PARTY_22). Due to the scale, complexity and strategic nature of

Kielder we are considering whether there is merit in promoting a new independent SRO to be delivered in conjunction with NWL. The Sub-option is referenced within this document however it is assumed that it will not be progressed as part of the NWT SRO going forward.

1.1.6 In summary, based on our Gate 2 preliminary feasibility study we believe that we can contribute to the national framework for improving resilience to extreme droughts by offering an option that is cost effective, scalable and resilient while minimising disruption for customers in the North West or adverse effects to the environment. The NWT SRO has also been selected in the draft Water Resources West (WRW) and Water Resources South East (WRSE) regional plans. We therefore recommend that the NWT SRO is progressed to Gate 3.

2. Background and Objectives

Background

2.1.1 The Water Resources Long-term Planning Framework 2016, set out by Water UK, highlighted the "significant and growing risk of severe drought impacts arising from climate change, population growth and environmental drivers" in England. The report recommended that a portfolio of strategic supply side resources and transfers were required by 2065.

2.1.2 This work was developed by the National Infrastructure Commission (NIC) and reported in its publication "Preparing for a drier future England's water infrastructure needs" 2018. This report includes an action to "improve infrastructure through a national transfer network in England and new infrastructure, such as reservoirs and water re-use systems".

2.1.3 In 2020 the EA published its findings with the report "Meeting our future needs: a national framework for water resources". This report delved deeper into the regional supply demand balance and noted in particular that the Water Resources West and Water Resources North (WReN) "should explore the potential for transfers to neighbouring regions" as part of the national agenda on water resilience.

2.1.4 The NWT SRO is one of several projects currently being considered under the RAPID gated process. The NWT SRO was formed at Gate 1 following the merger of the previous UU Sources and Vyrnwy Aqueduct SROs due to their interdependency. The scope and funding remained unchanged.

2.1.5 The scheme is under consideration, as part of a portfolio of solutions, to ensure that a reliable and resilient water supply is provided to water stressed areas, including the Midlands and the South East of England. The project also takes a step towards the national transfer network first noted in the NIC report in 2018 by transferring water from an area of surplus to areas of deficit.

2.1.6 Figure 1 below illustrates how the NWT SRO interfaces with the STT SRO to enable water to be transferred to the Midlands and the South East.

Objectives

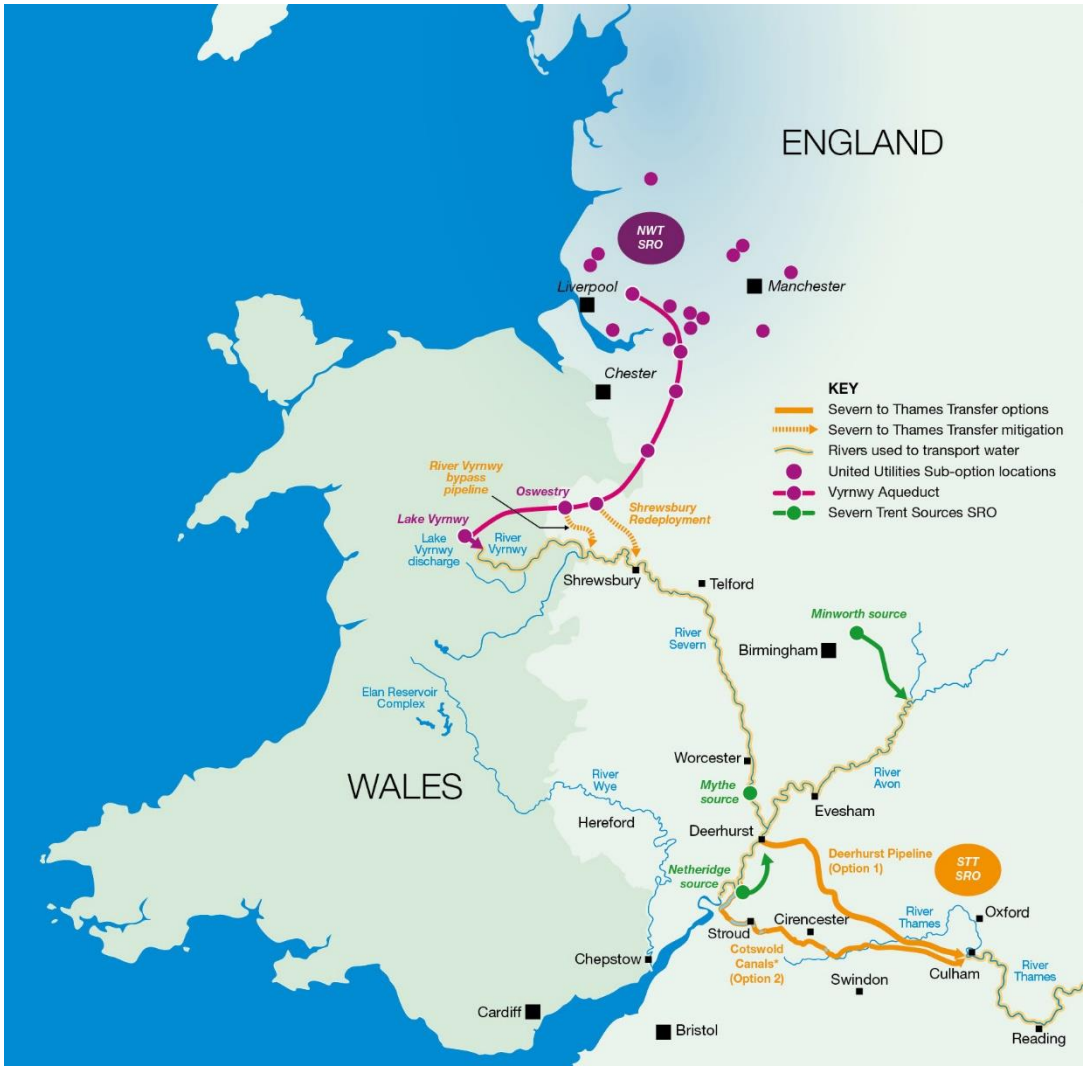
2.1.7 The objective of this project is to investigate the potential for a solution which facilitates the transfer of water from the North West without detriment to either the levels of service to customers in the UU operating region or the environment.

2.1.8 In support of this objective we have established a number of water trading principles which need to be achieved in order for UU to participate in trading (Table 2).

Table 2 - UU Water Trading Principles

Principle	Criteria
Drinking Water Quality	UU customers will receive drinking water that is fully compliant with all regulatory standards.
Customer Acceptability	Customers must continue to have confidence in their water supply and acceptance in terms of taste, odour, appearance (discolouration) and pressure.
Resilience	The transfer must not have a net detrimental impact – and should ideally improve – the resilience of the water resource and assets used to provide service to customers.
Environmental	The projects must not have a significant adverse effect on the environment, must be approved through regulatory oversight and must support, or at least not have a detrimental impact on the company's overall environmental performance.
Customer Bills	The scheme should provide demonstrable value for money for customers in the North West, as reflected in customer bills and customers in the region must receive a fair proportion of the national benefits, which arise from the scheme.

Figure 1 - NWT and STT System Overview



2.1.9 To assess whether the solution is likely to be consistent with these principles, along with the Gate 2 requirements defined by RAPID, we have continued to assess the potential benefits, risks and opportunities associated with the project. This has been achieved by engineering and environmental investigation coupled with associated planning and procurement considerations.

2.1.10 The NWT SRO is included in the UU draft WRMP to meet multiple needs. Elements of the scheme are selected by Severn Trent Water in the 2030's and then more is selected by South East water companies in the longer term. One of the trading principles is resilience and the inclusion of the NWT SRO as selected in the UU draft WRMP not only protects resilience during transfers but also helps to enable 1-in-40 year Temporary Usage Ban (TUB) resilience to meet customer preferences and align with other companies in the WRW region. It is proposed that these Sub-options would transition from supporting UU resilience in the short term to enabling water trading in the medium to long term as Per Capita Consumption (PCC) and leakage reductions mitigate UUs demand. We believe this provides a best value approach for customers in both the North West and the regions we would be trading with as costs would be shared based upon utilisation.

2.1.11 The outputs of our Gate 2 feasibility work have been shared with WRW and WRSE to inform regional planning. The national water transfer needs from NWT SRO from the reconciled regional transfer plan is shown in Table 3 below. The cumulative need shown is less than the total capacity of the NWT SRO Full Solution, however there are several alternative plans that would require the Full Solution to be delivered. For the purposes of this report we have focussed on the NWT SRO Full Solution (205 Ml/d), the phasing of delivery will be determined once the need has been finalised.

2.1.12 Peckforton and Kinsall are both potable water transfers from the Vyrnwy Aqueduct into STWs supply area and therefore do not have a UU sub-option reference. These connections were not previously considered at Gate 1, however they are similar to the Shrewsbury Redeployment and therefore we need to take account of their selection in regional reconciliation. As they source water from Lake Vyrnwy, and use some of the same assets as

the NWT SRO, they form part of the 205 Ml/d limit, i.e. the maximum we can trade via the NWT SRO is 205 Ml/d minus the volumes transferred via Peckforton and Kinsall. Our Bearstone (WR125) export option was also selected by STW, however this is not linked to the NWT SRO and does not affect the limit.

Table 3 - National water transfer needs as set out in the regional reconciliation (the reconciled transfer plan)

Recipient	Year of selection	Capacity (Ml/d)	Cumulative (Ml/d)	Description
Severn Trent Water	2031, ending in 2060	75	75	Vyrnwy
Severn Trent Water	2041	25	100	Shrewsbury Redeployment (Shelton)
Severn Trent Water	2051	7.5[1]	107.5	Vyrnwy (Peckforton and Bearstone)
Water Resources South East (WRSE)	2060	135	167.5	Vyrnwy
Severn Trent Water	2061	1	168.5	Vyrnwy (Kinsall)

2.1.13 RAPID made recommendations and actions to be undertaken following the Gate 1 submission. These have been addressed in this Gate 2 report, as summarised in Table 4 and Table 5.

Table 4 - Actions from Gate 1

	Actions to be addressed in Gate 2	Responses
1	Refine the list of source options down to a preferred suite early in the Gate 2 process, combining in portfolios as necessary for supply capacities. A manageable suite will allow for a full and detailed assessment to be completed during Gate 2. Progress and decisions on this action, including manageable numbers of preferred supply options, should be shared with regulators during checkpoint meetings.	*We have reduced the number of source options from 27 to 14 (plus 1 option for the Vyrnwy Aqueduct Enabling Works). Throughout this process we have engaged with the regulators to seek feedback and ensure full transparency. The process we have followed and the associated outcomes are outlined in Section 3.*
2	Ensure that further detailed utilisation calculations are undertaken early in Gate 2 in order to feed into the Environmental Impact Assessment (EIA).	*We have undertaken extensive water resource modelling to determine utilisation patterns and this data has been used to inform our environmental assessments. More information can be found in Section 4.*
3	Ensure Welsh stakeholders and customers are included in solution specific engagement.	*The scope of our Gate 2 solution does not directly impact Wales, however we have continued to engage extensively with Welsh stakeholders, including Natural Resources Wales (NRW). Details of this engagement can be viewed in Section 9.*
4	Further work required on elements of the solution which impact on Welsh ecosystem resilience. This will achieve sustainable management of natural resources and help achieve goals of the Wellbeing of future Generations Act. Any proposal which has implications for Wales must meet the requirements of this Act and the Environment (Wales) Act. This is in addition to natural capital and biodiversity net gain requirements for England.	*The scope of our Gate 2 solution does not directly impact Wales, with no additional abstraction of water being proposed from Lake Vyrnwy. Details of our proposed solution are addressed in Section 3.* *Natural capital and biodiversity net gain requirements are addressed in Section 6.*
5	Priority modelling and investigations should be carried out in relation to the 10 source options that concern Water Industry National Environment Programme (WINEP) studies and those source options with an impact on the River Dee SAC.	*The impact of WINEP has been a key consideration in our selection of Sub-options, with a number of sources being discontinued due to future environmental constraints. Additionally, we are not progressing any sources which impact the River Dee SAC. More information can be found in Sections 3 and 6.*
6	Provide further detailed evidence to support programme plans and identify key milestones	*We have developed a detailed Gate 2 programme plan illustrating key deliverables, owners, dependencies and timescales. The plan has factored in the Gate 2 requirements outlined in the PR19 Final Determination, the Accelerated Gate 2 template and these actions identified in the Gate 1 assessment. It also aligns with external programmes including regional planning and WRMP24. The programme plan can be viewed in Section 7.*
7	Continue to develop assessment of Direct Procurement for Customers (DPC), including detailed assessment of suitability against technical criteria. More clearly evidence the suitability and impact of the solution on DPC assessment.	*We have undertaken a detailed assessment of all Sub-options against DPC criteria, both independently and collectively (i.e. 'bundled' delivery). The outcome of these assessments can be viewed in Section 7.*
8	Identify the specific environmental risks of preferred supply options. Ensure issues and mitigation measures are well understood.	*We have assessed the environmental risks of all Sub-options, identified associated issues and proposed mitigation measures. Details can be found in Section 6.*

[1] Note: 1 Ml/d of trade selected in 2051 is not connected to the North West Transfer, but still requires 'back-fill' options.

Table 5 - Recommendations

Recommendations to be addressed in Gate 2		Responses
1	Stakeholder engagement at Gate 2 should further explore customer acceptability into change of supply source	*We have undertaken extensive customer acceptability research during Gate 2 through a series of 'Hall Tests', and this has been used to inform the development of our Sub-options. Details of this research can be viewed in Section 9.*
2	Studies should update all source option yields and model Deployable Output values from these yields, using WRMP19 figures. This work should be completed prior to the conclusion of the best value portfolios of source options. This work should be completed, as planned, during Gate 2.	*Both yields and DO values have been updated during Gate 2 and these figures have informed selection of Sub-options. Further information can be found in Section 4.*
3	Investigate source option-specific wider resilience opportunities at Gate 2. This will form part of the environmental resilience work planned for Gate 2.	*We have explored the wider resilience benefits at both the Full Solution and individual Sub-option levels. These are discussed in Section 4.*
4	Include how interaction with other strategic solutions (particularly the River Severn to River Thames transfer) will be managed in the programme plan, including any key check-ins and alignment and sharing of key investigation outcomes.	*We have continued to actively engage with SROs directly impacted by the NWT SRO, including the Severn Trent Sources SRO and STT SRO. This has ensured that dependencies have been identified and programmes aligned. The programme plan can be viewed in Section 7.*
5	The main submission document needs to be clear on the methodologies and/or frameworks used to calculate, manage and mitigate GHG emissions. Clearly state how approach to carbon management is helping to deliver on WaterUK 2030 net zero route map and is aligned with the sector's ambition on carbon.	*We have applied industry best practice to assess carbon impact and identified how our solution supports Water UKs 2030 net zero commitment. This is detailed in Section 6.*
6	Develop and align utilisation with other strategic resource solutions (especially River Severn to River Thames transfer options) and with Water Resources South East modelling outputs.	*Our water resource modelling has been informed by - and aligned with - regional groups (WRW and WRSE) and relevant SROs (STT). The outcome of this utilisation modelling can be viewed in Section 4.*
7	For the Gate 2 stakeholder plan, ensure those that live around Lake Vyrnwy are included in the engagement process.	*We have actively engaged with stakeholders who have an interest in Lake Vyrnwy and its environs. However, it should be noted that our solution does not propose a change in the volumes of water abstracted from the reservoir or any change to the assets in the area. Details of our engagement in Wales can be viewed in Section 9.*
8	Develop the best value assessment between solutions' sub-options, and link into discussions of best value of this and other enabling solutions for dependant solutions (particularly Severn Thames Transfer).	*We have undertaken a best value assessment in alignment with the WRW Regional Plan and UU WRMP methodologies. We have also worked in coordination with the STT SRO to optimise the 'STT System' to deliver a best value solution to WRSE. This is addressed in Section 4.*
9	Develop the programme plan to demonstrate management of interactions with other solutions (particularly River Severn to River Thames transfer options)	*We have continued to actively engage with SROs directly impacted by the NWT SRO, including the Severn Trent Sources SRO and STT SRO. This has ensured that dependencies have been identified and programmes aligned. The programme plan can be viewed in Section 7.*

3. Solution Design, Options and Sub-options

3.1 Solution Description

3.1.1 The objective of the NWT SRO is to maintain supply resilience in the North West while facilitating transfers both within the WRW region, and to the WRSE region via the proposed STT SRO.

3.1.2 Figure 1 illustrates the geographical locations of the UU Sources and Vyrnwy Aqueduct (VA) Enabling Works in relation to the STT SRO. The NWT SRO is the combination of the UU Sources Sub-options set out in Section 3.2 and the VA Enabling Works set out in Section 3.3. Together these allow for the transfer of up to 205 Ml/d out of the North West. The scope of works required for the onward transfer of water to other regions is contained within the STT SRO Gate 2 report.

3.1.3 Some important changes to the NWT SRO solution have been made since Gate 1 which are summarised in Table 6.

Table 6 – Key solution changes since Gate 1

Element	Detail
Solution Capacity	Increased from 180 Ml/d to 205 Ml/d following the first round of regional planning which revealed a potential need for higher transfer volumes.
UU Sources Capacity Requirement	Increased from 112 Ml/d to 167Ml/d in order to meet the increase in overall solution capacity and UU's resilience requirements. This assumes the transfer is not interrupted during short term supply network outages, however transfer flows could be impacted in order to safeguard supplies to UU customers in the event of a protracted emergency outage. Section 4 summarises the water resources modelling work used to calculate this.

Element	Detail
Solution Phasing	Previously we developed separate enabling works designs for 5 separate phases of transfer. Due to the uncertainty of exact water needs and to avoid unnecessary complexity at this stage for Gate 2 we have focussed on developing the design for the Full Solution of 205 Ml/d transfer.

3.1.4 The NWT SRO solution is likely to be required to support a transfer of up to 205 Ml/d from the Vyrnwy system for up to 15% of the time over a long-term average (maximum continuous trade duration of approximately 250 days). More information on utilisation is provided in Section 4.

3.1.5 The agreed maximum transfer volume comprises a maximum 180 Ml/d raw water release from Lake Vyrnwy, via the River Severn, and 25 Ml/d via a potable connection to Shrewsbury. The transfer of treated water to Shrewsbury, known as the Shrewsbury Redeployment, will enable STW to reduce its abstraction from the River Severn by a corresponding amount, taking the combined transfer via the River Severn to 205 Ml/d.

3.2 United Utilities Sources (Sub-options)

3.2.1 Lake Vyrnwy provides a resilient, high quality and cost-effective supply to customers in the North West, as part of a large conjunctive supply system. This system enables us to offset water exported, by utilising other existing sources. However, this would place additional pressure on the other sources, such that our risk of needing to impose customer restrictions, and impacting the environment, would increase. Additional water sources will be required to maintain resilience in our conjunctive supply network and so facilitate this form of transfer. No water from these sources will be transferred out of our area.

3.2.2 United Utilities Sources (UUS) comprises a portfolio of individual source Sub-options to maintain appropriate additional Water Treatment Works (WTW) output capacity to offset water exported. At Gate 1, we selected 27 Sub-options to support prospective water transfer volumes of 50, 75, 135, 150 and 180 Ml/d. These water sources were put forward for further assessment in Gate 2. Of the 27 longlisted Sub-options, three were out of region, namely Kielder and Cow Green Impounding Reservoirs, operated by NWL, and Shropshire Union Canal (Llangollen Branch), operated by Canal and River Trust (CRT). One third-party in-region source option, Killington Impounding Reservoir, operated by CRT, was also longlisted.

3.2.3 During Gate 2, we considered an additional transfer increment, which would increase the total NWT SRO transfer volume to 205 Ml/d. This scenario would entail the transfer of an additional 25 Ml/d of potable water to supply STW customers via an existing emergency import route. The Sub-options were checked and aligned with other major programme areas such as WRMP24, WINEP and UU Capital Delivery programmes to ensure dependencies and opportunities were identified early and that only cost effective solutions that meet our trading principles (Table 2) were promoted.

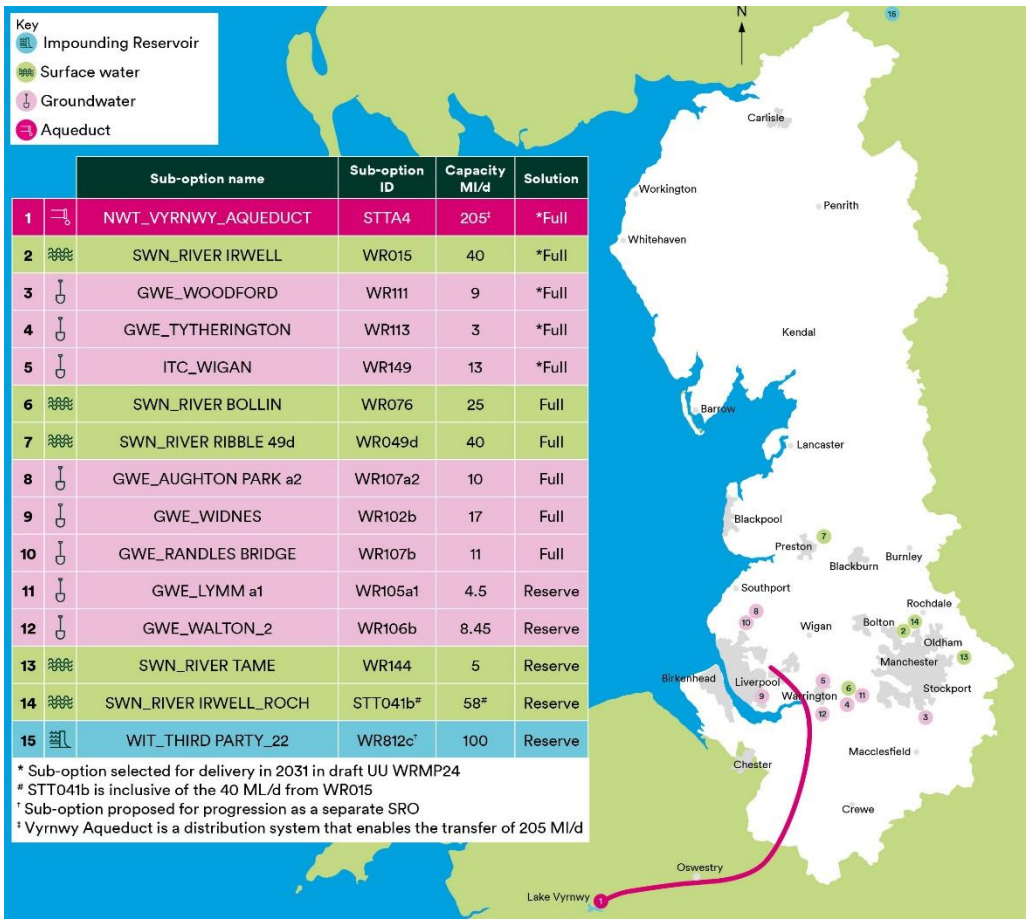
3.2.4 Whilst the Sub-options are required to support trading, there are times when they can also be used to provide resilience in the North West. A lack of correlation between drought conditions in the North West and South East is particularly helpful, and means that trading is unlikely to be requested in support of STT SRO during approximately half of droughts affecting the North West.

3.2.5 The UU Sources Sub-options are spread across a wide geographical area, however each one provides benefits to the wider system. Allowing this indirect type of trading support helped us to reduce the cumulative capacity of Sub-options required for trading to well below the total trading amount (167 Ml/d versus 205 Ml/d). Accordingly, the portfolio of Sub-options is required to meet or exceed the threshold value of 167 Ml/d.

3.2.6 The Full Solution comprises nine water resource Sub-options, consisting of three surface water sources and six groundwater sources, which together provide sufficient cumulative yield to provide the 167 Ml/d backfill requirement. The Full Solution portfolio will be developed through further surveys and stakeholder engagement to be undertaken in Gate 3. Should any of the current preferred Sub-options be discounted during this process, they will be replaced by one or more of five alternative Sub-options (two surface water sources, two groundwater sources and Kielder Sub-option) that have been developed and held in reserve. As noted in Section 1, Kielder Reservoir may be recommended for development as a separate SRO in collaboration with NWL.

3.2.7 Concept designs have been developed for all thirteen Sub-options (excluding the Kielder Sub-option). The designs incorporate new assets to abstract and transport raw water to the point of treatment, and either new WTW, or modifications to existing WTW, to provide the required increase in treatment capacity. Consideration has been given to water softening treatments where the change in hardness of raw water is likely to be a concern to customers. Network enhancements have also been considered to deploy additional water to customers where required. Figure 2 shows the locations of all Full Solution Sub-options and reserve sources.

Figure 2 - Proposed Sub-options

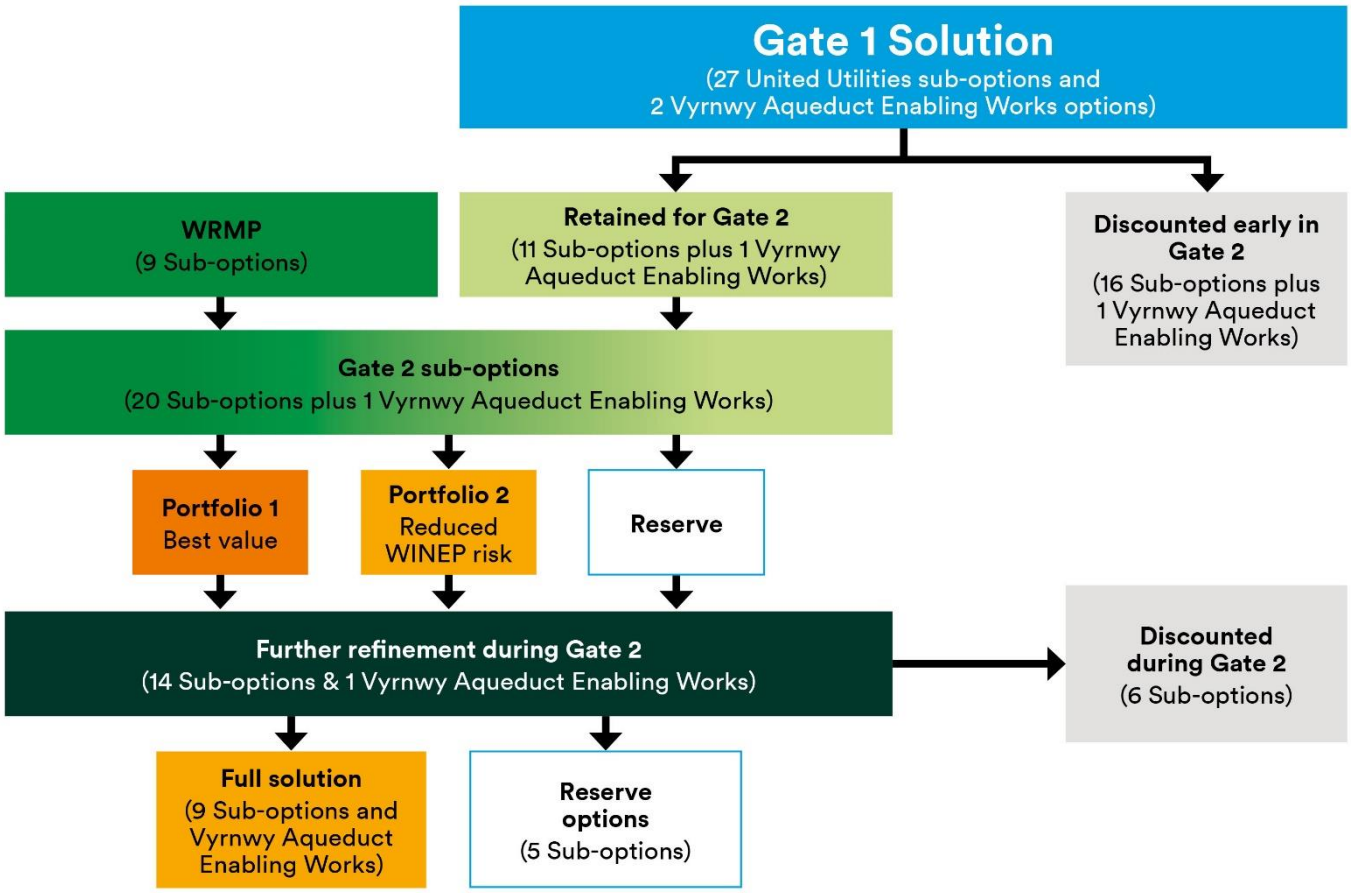


		Sub-option name	Sub-option ID	Capacity Ml/d	Solution
1		NWT_VYRNWY_AQUEDUCT	STTA4	205‡	*Full
2		SWN_RIVER IRWELL	WR015	40	*Full
3		GWE_WOODFORD	WR111	9	*Full
4		GWE_TYTHERINGTON	WR113	3	*Full
5		ITC_WIGAN	WR149	13	*Full
6		SWN_RIVER BOLLIN	WR076	25	Full
7		SWN_RIVER RIBBLE 49d	WR049d	40	Full
8		GWE_AUGHTON PARK a2	WR107a2	10	Full
9		GWE_WIDNES	WR102b	17	Full
10		GWE_RANDLES BRIDGE	WR107b	11	Full
11		GWE_LYMM a1	WR105a1	4.5	Reserve
12		GWE_WALTON_2	WR106b	8.45	Reserve
13		SWN_RIVER TAME	WR144	5	Reserve
14		SWN_RIVER IRWELL_ROCH	STT041b#	58#	Reserve
15		WIT_THIRD PARTY_22	WR812c†	100	Reserve

* Sub-option selected for delivery in 2031 in draft UU WRMP24
# STT041b is inclusive of the 40 ML/d from WR015
† Sub-option proposed for progression as a separate SRO
‡ Vyrnwy Aqueduct is a distribution system that enables the transfer of 205 Ml/d

3.2.8 Figure 3 illustrates the process through which potential UU Sources Sub-options were assessed, culminating in selection of the Full Solution portfolio. Details of the Sub-options assessment can be found in Section 13, NWT-G02-003-001.

Figure 3 - Sub-Option Selection Process



Notes:

- All Sub-options are subject to further assessment during Gate 3.
- WRMP recommends early delivery of 4 Sub-options and the Vyrnwy Aqueduct Enabling Works. See footnote in Figure 2.
- Kielder Reservoir is currently included as a reserve Sub-option but may be recommended for development as a separate SRO in collaboration with NWL.

3.3 Vyrnwy Aqueduct Enabling Works

3.3.1 The NWT SRO combines with the STT SRO, which allows water to be transferred to the South East, using water sourced from Lake Vyrnwy. Under this option, Lake Vyrnwy water is released into the River Vyrnwy / Severn, then abstracted and transferred via new infrastructure to the River Thames.

3.3.2 The NWT SRO relies upon the River Vyrnwy bypass pipeline and upgraded Shrewsbury Redeployment connection to deliver water to the River Severn and Shrewsbury Demand Management Zone (DMZ) respectively. These construction works are promoted under the STT SRO and are not discussed further in this report.

3.3.3 As well as offsetting water exported during transfer, we also need to maintain supply to customers who are connected directly to the Vyrnwy Aqueduct system.

3.3.4 At Gate 1, we identified two Vyrnwy Aqueduct options to enable transfers of up to 180 Ml/d in up to five incremental flow scenarios. The transfer flow scenarios were derived from the following assumed boundary conditions:

- A sustainable yield of 180 Ml/d from Lake Vyrnwy.
- A discharge of up to 75 Ml/d from Lake Vyrnwy into the head of the River Vyrnwy would be permitted.
- A minimum throughput of 110 Ml/d at Oswestry WTW, to ensure the treatment works can return to normal operation following a transfer period.

3.3.5 During Gate 2, UU considered a sixth phase of transfer, for flows up to 205 Ml/d, in which an additional 25 Ml/d of potable water would be transferred to supply STW customers via an existing emergency import route to Shrewsbury.

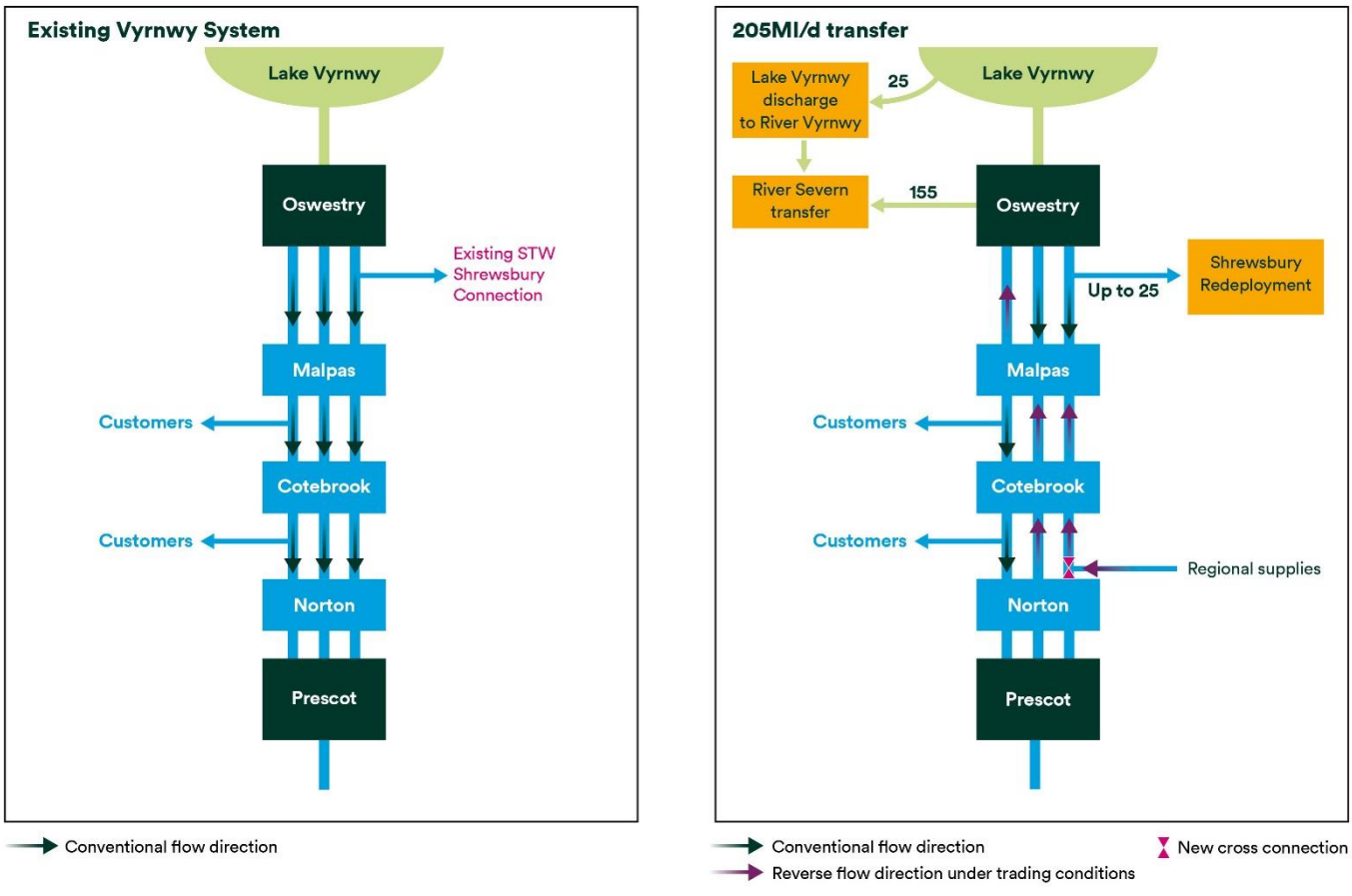
3.3.6 In June 2022, the Environment Agency (EA) and Natural Resources Wales (NRW) advised that the discharge to River Vyrnwy should be limited to 25 Ml/d pending the completion of flow trials and summer surveys as part of the STT SRO, which won't be fully evidenced until Gate 3.

3.3.7 During Gate 2, we refined the configuration of Vyrnwy Aqueduct Enabling Works based on the following revised boundary conditions:

- A sustainable yield of 180 Ml/d from Lake Vyrnwy.
- A maximum discharge of 25 Ml/d from Lake Vyrnwy into the head of the River Vyrnwy is permitted.
- A minimum throughput of 105 Ml/d is required at Oswestry WTW, to ensure the treatment works can quickly return to normal operation following a transfer period.
- A minimum 10 Ml/d of treated water from Oswestry will continue to be fed into Vyrnwy Aqueduct to maintain supply to customers between Oswestry and Malpas.
- A minimum flow of 135 Ml/d in the Vyrnwy Raw Water Aqueduct is required to maintain current operational performance.

3.3.8 Gate 2 has focused on the Full Solution of providing 205Ml/d as the maximum transfer volume. Lower volumes can be facilitated and the Full Solution can be scaled up incrementally to meet the requirements identified through the regional planning process which we expect to be confirmed during Gate 3.

Figure 4 - Vyrnwy System Schematic



3.3.9 As shown in Figure 4 above, in the revised solution for Vyrnwy Aqueduct Enabling Works, Oswestry WTW will continue to solely treat Lake Vyrnwy water. 25 Ml/d of raw water will be discharged directly into the head of the River Vyrnwy. Of circa 155 Ml/d raw water received at Oswestry WTW via the raw water aqueduct, 105 Ml/d will pass through the full treatment process, and 50 Ml/d will be taken off prior to disinfection on to the second stage filters.

3.3.10 10 Ml/d of treated water will be fed into Lines 1 and 2 of the Vyrnwy Aqueduct to maintain water supply to customers between Oswestry WTW and Malpas. This will also provide a sweetening flow for water quality purposes. New infrastructure at Oswestry WTW is needed to divert 95 Ml/d of treated water for de-chlorination

and blending with Vyrnwy raw water before being released to the River Severn via the proposed River Vyrnwy bypass pipeline, taking the transfer volume to 170 Ml/d.

3.3.11 The River Vyrnwy bypass pipeline forms part of the STT SRO and is discussed in more detail in the STT Gate 2 submission.

3.3.12 A new cross-connection between the Dee and Vyrnwy Aqueducts will be formed, near to Norton Tower, and new pumping stations, located on the siphons between Norton, Cotebrook and Malpas, will enable customers located between Malpas and Norton Tower to be supplied with treated water sourced from the River Dee.

3.3.13 The Vyrnwy and Dee Aqueducts currently supply water to Prescot WTW and the Liverpool conurbation. The drop in supply resulting from trading will be replenished within the conjunctive supply network using new water sources from the UUS Full Solution portfolio.

3.3.14 Further engineering works would be required to support transfers of between 170 and 205 Ml/d. These include the structural lining of Line 3 of the Vyrnwy Aqueduct, along the Oswestry to Malpas siphon, and construction of a further pumping station to enable treated River Dee water to be pumped upstream to Oswestry WTW. Up to 35 Ml/d of River Dee water would be blended with Vyrnwy raw water and de-chlorinated before being released to the River Severn via the proposed River Vyrnwy bypass pipeline.

3.3.15 This will take the river bypass transfer to 155 Ml/d and enable a further 25 Ml/d of treated water from Oswestry WTW to be directed to Shrewsbury. This water could be support the STT SRO or alternatively utilised by STW to address their in-region deficits.

3.3.16 UU are undertaking the Vyrnwy Aqueduct Modernisation Project (VAMP) in AMP7 and AMP8 to slip line the existing Vyrnwy treated water aqueduct system. The VAMP and NWT SRO project teams have been actively collaborating to look for opportunities to support the potential long term needs of water trading as well as delivering the short term requirements of the VAMP project. This has resulted in the following two main opportunities that are being activity progressed:

- Replacement of approximately 2x 35km of cast iron pipeline with new PE pipework of a suitable rating to accommodate potential reverse pumping required during transfers. The cost of this work is covered within the scope of the VAMP project.
- Replacement of cross-connections on the Vyrnwy Aqueduct during construction of the VAMP project. The proposal is to make use of the same excavations, access and contractors on site to carry out additional scope items required for future transfers. This scope is not included in the VAMP project and costs would need to be met through water trading. The approach will avoid significant future disruption of customers, stakeholders and the environment and is clear evidence of long term planning. We are engaging with RAPID to determine how best to fund these early transfer enabling works which could start construction in Spring 2023.

3.3.17 Below is highlighted the high level scope of works at Oswestry WTW (Table 7) and to the Vyrnwy Aqueduct Enabling Works (Table 8) to achieve the Full Solution trade of 205Ml/d. Consideration has also been given to the monitoring and controls infrastructure required to operate the assets in line with the UU Systems Thinking strategy:

Table 7 - Proposed Scope of Works at Oswestry WTW

	Pipework	Break Pressure Tank	De-chlorination Plant
Oswestry WTW	1430m @ 600 - 1200mm diameter Ductile Iron	Volume – 1100m3 Including Static Mixers and Magflo meters	Footprint of site area – 150m x 100m

Table 8 - Proposed Scope of Vyrnwy Aqueduct Enabling Works

	Section A - Oswestry to Malpas	Section B – Malpas to Cotebrook	Section C – Cotebrook to Norton Tower
Slip Lining	3.5km @ 1000mm diameter	n/a	n/a
Pump Station	(PS3) at Drenewydd Duty / Assist / Stand-by Pumps Flow – 30 Ml/d - Line 3 only	(PS2) at Cottenham Farm Duty / Assist / Stand-by Pumps Flow – 60 Ml/d – Lines 1 and 2 only	(PS1) at Roddy Lane Duty / Assist / Stand-by Pumps Flow – 90 Ml/d – Lines 1 and 2 only
Break Pressure Tank	n/a	Malpas – New Flow Control Valves on Lines 1 and 2 including Kiosks	n/a
Existing Valve Houses	n/a	2 x No.– Replace Line 1 & 2 Pipework over 50m length	1 x No.– Replace Line 1 & 2 Pipework over 50m length

	Section A - Oswestry to Malpas	Section B – Malpas to Cotebrook	Section C – Cotebrook to Norton Tower
Existing Valve Chambers	n/a	3 x No. – Replace Line 1 & 2 Pipework over 50m length	3 x No.– Replace Line 1 & 2 Pipework over 50m length
Bulk Supply points	3 x No. connections to 2 x No. VA pipework	8 x No. connections to 2 x No. VA pipework	6 x No. connections to 2 x No. VA pipework
Concessionary Connections	5 x No. connections to 2 x No. VA pipework	5 x No. connections to 2 x No. VA pipework	4 x No. connections to 2 x No. VA pipework
Miscellaneous	n/a	n/a	Dee Aqueduct to Vyrnwy Aqueduct Cross Connection, and New Flow Control Valves (3 x No.) on Norton Tower Outlet

4. Water Resource Assessment

4.1 Utilisation

Key Messages

- Based on utilisation patterns received from prospective transfer recipients, we have undertaken sophisticated water resources modelling to predict the future utilisation of the NWT SRO Sub-options.
- The modelling has indicated uncertainty in the level of utilisation of the Sub-options due to factors including weather and climate. Drier conditions lead to higher levels of utilisation. For Gate 3 we will explore other uncertainties such as different trade volumes and patterns of utilisation, as well as climate change and demand.
- There are differences between the overall utilisation of Sub-options based on their cost, availability and network location. However, as conditions start to become dry, in years with limited rainfall, utilisation ramps up quickly and in extreme droughts (1 in 500 year return period) all Sub-options are fully utilised.
- The levels of utilisation predicted demonstrate that the Sub-options will be effectively deployed and will not sit idle waiting for a 1 in 500 year drought to occur. This is because we were able to size the scheme below the overall transfer amount (167 Ml/d versus 205 Ml/d), which not only supports trading but also has a benefit of increasing TUBs resilience in the North West to create parity with other companies in the WRW region.

Introduction

4.1.1 Utilisation is a key consideration for the NWT SRO, both in terms of the pattern of transfer need, which was provided by prospective recipients, and utilisation of our Sub-options to mitigate Lake Vyrnwy releases. Using a water resources model we simulated the utilisation of Sub-options to inform scheme design, cost and trading prices. It was also a key input into our environmental assessments (Section 6).

4.1.2 Estimated utilisation patterns were provided by prospective recipients. These ranged from a full 19,200 year stochastic utilisation sequence provided by WRSE, with a headline support utilisation of 7%, to high-level assumptions provided by STW of 15% and 100%. We also calculated a theoretical maximum utilisation of Vyrnwy support releases, based on the River Severn stochastic flow dataset and the proposed STT SRO Deerhurst hands-off-flow condition, the result was 30%.

4.1.3 Despite the high level of attention given to overall utilisation percentages, the underlying pattern of utilisation really drives the selection of Sub-options. The length of continuous transfer periods is particularly important and our Full Solution was demonstrated to be effective with durations up to around 250 days. However, the level of alignment between the transfer period and testing conditions in the North West (i.e. dry weather and elevated demand) is equally important. This aspect was accounted for in the water resource model by simulating transfer from the Strategic Resource Zone with forecast demand, reservoirs inflows, climate change perturbations etc. All the modelling described below was undertaken using the WRSE utilisation sequence, and based on this we are relatively confident the design can provide 15% overall utilisation, assuming the length of support does not exceed 250 days.

4.1.4 However, we cannot be sure our solution will work for other parties without properly assessing their utilisation patterns. Unfortunately, this information is not yet available for STW and will need to be modelled by them in the near future. Therefore, as noted above, for Gate 2 we assumed their pattern of use will reflect that of WRSE. There should be a fairly high degree of correlation given that flow levels in the River Severn will drive both STW's need for transfer and WRSE's need for supported versus unsupported transfer. For the Gate 3 water resources assessment we will obtain STW's utilisation data and refine the Sub-option requirements if necessary. For 100% utilisation transfers, i.e. full use of the transfer amount every day, there was insufficient time to undertake further

modelling between regional planning reconciliation and the Gate 2 submission. We anticipate a higher Sub-option requirement for the 100% utilisation transfers, which account for around 30 Ml/d of the total 205 Ml/d trade amount, and will confirm the corresponding solution for Gate 3. A summary of the transfers selected in regional planning reconciliation is provided in Section 2.

4.1.5 Ultimately, the use of transfers will be governed by contractual agreements yet to be formulated. The modelling described here will help to provide the basis for these agreements. It could be that conditions considered for inclusion in the contracts lead to the need for further modelling, which in turns leads to further refinement of the Sub-option requirements. We have already assessed a hypothetical contract condition in our restrictive use scenario (Section 4.2.27). For Gate 3 we plan to progress heads of terms agreements with prospective trading partners and test the sensitivity of our solution to different potential contract conditions (Section 4.2.30).

4.1.6 Calculating utilisation for the NWT SRO components was challenging due to the nature of the scheme and the role of the Sub-options. Water from these Sub-options does not leave our supply area, but is used to mitigate the loss of water transferred from Lake Vyrnwy or the River Dee (Shrewsbury option). The Sub-options become an integrated part of our Strategic Resource Zone (SRZ), one of the largest conjunctive supply systems in Europe. They rely heavily on our current network to move water to where it's needed, and work alongside our existing sources to meet customer demand.

4.1.7 Whilst all of the Sub-options are required to support transfers there are times when they can also be used to support resilience in the North West. A lack of correlation between drought conditions in the North West and South East means that in approximately half of droughts affecting the North West trading will not be required. The role of the Sub-options can therefore be broken down into three elements

- Meeting supply needs during transfer periods, i.e. as a direct response to trading.
- Use for transfer but outside of specific trading periods, either preparing the system for trading or helping the system to recover from trading. In some years we may prepare the system for trading but a transfer request may not materialise. Allowing this indirect type of trading support helped us to reduce the capacity of options required for trading well below the total transfer amount (167 Ml/d versus 205 Ml/d).
- Utilising the options for our own needs, when they are not required to support transfers.
- All of the results presented here correspond to all three types of use combined. In Gate 3 we plan to attempt to isolate each type of use.

Approach

4.1.8 As introduced in the previous section, calculating utilisation for the NWT SRO is complex. Different Sub-options will be used at different rates depending on their characteristics and the conditions occurring. Our approach was developed to meet three objectives:

- To provide the information required as set out in the RAPID Gate 2 guidance.
- To inform the NWT SRO environmental assessments.
- To inform the development of solution costs.

4.1.9 We used our Pywr water resources model to simulate the utilisation of Sub-options. As described in Section 4.2, we used the model to select the Sub-options, and the utilisation modelling was essentially an extension of that exercise. We simulated the full 19,200 hydrological stochastic dataset (Section 4.2.5) in order to maximise the level of confidence in our statistical analysis. The model assumptions were consistent with the central scenario used for Sub-option selection (Section 4.2.26):

- 2035 planned supply network
- WRSE stochastic trading utilisation (also used for STW)
- Forecast 2035 demand
- 2035 climate change (RCP 6.0)
- Most likely predicted abstraction licence changes

4.1.10 The Pywr model has a daily allocation procedure to determine which sources to abstract from to meet demand. This is based on the cost and availability of water, with cost being the dominant factor during wet and normal conditions, and availability taking over once conditions become dry. Proximity to demands, water trading, resilience needs and the surrounding network, are also key factors controlling utilisation. The Sub-options were built into the model as if they were existing assets with information on operational costs based on the engineering estimates described in Section 8, and availability taken from the hydrological assessment outlined in Section 4.2.

4.1.11 The results were processed to provide annual and monthly statistics, as presented in the tables below. We also separated out different severities of weather conditions / drought events by ranking each stochastic year according to total minimum reservoir storage reached. For 1 in 500 year drought utilisation we selected all years between 1 in 475 and 1 in 525 severity to prevent the results from being specific to only one drought event. We calculated utilisation both in terms of: (i) the number of days with any abstraction; and (ii) total Ml abstraction versus total available Ml abstraction. All the results presented here relate to the latter.

4.1.12 As this stage we have only simulated the utilisation of Sub-options in the Full Solution of 205 Ml/d. However, for Gate 3 we plan to simulate smaller trade volumes, as selected in regional planning reconciliation, phased over the planning period. We will simulate utilisation sequences from other prospective recipients such as STW, once provided. As noted in Section 4.1.4, the STW utilisation pattern for the Vyrnwy option is anticipated to be relatively similar to WRSE. We also plan to switch to the new STT SRO Pywr model which provides a more accurate representation of Vyrnwy and the STT SRO scheme.

4.1.13 During Gate 3 we will ascertain any “sweetening flow” requirements which will be particularly salient for groundwater Sub-options. A sweetening flow is small continuous flow which ensures the source remains online and ready for operation to support water trading. Once we have this information we will repeat the modelling to update the results. Whilst utilisation in terms of number of days will obviously become 100%, there may be limited difference in terms of the total Ml utilisation presented here.

4.1.14 The NWT SRO is designed to provide water to multiple users in parallel. As described in Section 4.2, for Gate 3 we will consider if we can design operational rules to take advantage of any differences in the proposed utilisation patterns of different users, with the aim of further enhancing the overall benefits and efficiency of the NWT SRO. We will also further review the potential to accommodate other Third Party users. All of this being said, the high levels of Sub-option utilisation presented here demonstrate that the solution is already at a high level of maturity in terms of effectiveness and efficiency. However, due to the flexibility and scalability of the scheme (Section 4.3), it would be straightforward to implement additional Sub-options.

4.1.15 Whilst the Kielder Sub-option does not form part of our Full Solution we have undertaken modelling in collaboration with NWL that has demonstrated it is available almost 100% of the time. We plan to set up a new separate SRO for the Kielder transfer.

4.1.16 Table 9 to Table 12 show the results of the assessment. The overall headline utilisation of the Sub-options is provided in the “Annual Average” column of Table 9. Sub-options with higher utilisation are preferred by the model due to a combination of their cost, availability and network location. Overall simulated utilisation of Sub-options across all years ranges from 18-64%. However, in dry years all Sub-options are fully utilised through Summer months.

4.1.17 A key takeaway point from this section of the submission is that the NWT SRO has been designed to be utilised and not left on stand-by, waiting for a 1 in 500 year drought to occur. The level of utilisation of Sub-options is higher than the transfer demand because we have designed a scheme which is smaller than the total required trade volume (167 versus 205 Ml/d) and can also be used to benefit the North West.

Table 9 – Simulated utilisation across all years

			All years												
			% utilisation (Ml)												
Option	**Option Name**	**Capacity (Ml/d)**	**Annual Average**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
WR111	GWE_ WOODFORD	9	64	32	45	55	51	72	100	100	89	79	62	50	29
WR102b	GWE_WIDNES	17	57	29	35	42	51	69	88	93	83	74	49	39	26
WR076	SWN_RIVER BOLLIN	25	40	12	13	22	30	43	75	86	72	59	30	19	16
WR015	SWN_ RIVER IRWELL	40	38	12	13	21	29	41	74	85	69	57	29	19	14
WR107b	GWE_RANDLES BRIDGE	12	37	10	12	19	25	38	73	82	66	56	32	21	11
WR149	ITC_WIGAN	13.8	37	12	12	20	27	37	70	79	64	56	32	22	15
WR113	GWE_ TYTHERINGTON	3	46	16	21	33	34	37	65	75	77	73	59	43	21
WR049d	SWN_RIVER RIBBLE 49d	40	30	8	12	17	24	34	53	65	52	49	25	15	8
WR107a2	GWE_ AUGHTON PARK a2	10	18	2	1	2	4	7	25	52	50	42	20	8	2

Table 10 - Simulated utilisation in "normal years"

			Normal year (bin 1:1 to 1:20 events)												
			% utilisation (Ml)												
Option	Option Name	Capacity (Ml/d)	Annual Average	J	F	M	A	M	J	J	A	S	O	N	D
WR111	GWE_WOODFORD	9	63	32	46	54	50	71	100	100	88	78	60	48	27
WR102b	GWE_WIDNES	17	56	29	36	42	51	68	87	92	82	73	47	37	25
WR076	SWN_RIVER BOLLIN	25	39	12	13	21	29	41	74	86	70	57	27	18	15
WR015	SWN_RIVER IRWELL	40	37	12	13	21	28	39	73	85	68	54	26	17	14
WR107b	GWE_RANDLES BRIDGE	12	36	10	12	19	24	36	72	81	64	54	29	19	10
WR149	ITC_WIGAN	13.8	36	11	12	20	26	35	69	78	62	54	30	20	14
WR113	GWE_TYTHERINGTON	3	45	15	21	33	33	35	63	74	75	71	57	41	19
WR049d	SWN_RIVER RIBBLE 49d	40	29	8	12	17	24	32	51	63	49	47	23	13	7
WR107a2	GWE_AUGHTON PARK a2	10	16	1	1	2	3	5	22	49	48	39	17	7	2

Table 11 - Simulated utilisation in "dry years"

			Dry year (bin 1:20 to 1:100 events)												
			% utilisation (Ml)												
Option	Option Name	Capacity (Ml/d)	Annual Average	J	F	M	A	M	J	J	A	S	O	N	D
WR111	GWE_WOODFORD	9	78	36	42	55	66	88	100	100	100	100	98	88	66
WR102b	GWE_WIDNES	17	72	32	31	41	62	85	97	100	100	100	91	71	49
WR076	SWN_RIVER BOLLIN	25	59	15	13	21	40	72	95	100	100	99	81	44	30
WR015	SWN_RIVER IRWELL	40	58	14	13	21	39	70	95	100	100	99	80	43	29
WR107b	GWE_RANDLES BRIDGE	12	60	13	12	20	37	69	95	100	100	99	85	58	32
WR149	ITC_WIGAN	13.8	59	15	13	21	38	68	92	96	96	96	82	57	33
WR113	GWE_TYTHERINGTON	3	70	26	26	38	50	65	92	99	100	100	97	86	62
WR049d	SWN_RIVER RIBBLE 49d	40	52	10	12	18	36	60	74	90	94	97	69	36	22
WR107a2	GWE_AUGHTON PARK a2	10	43	5	3	5	10	25	74	98	99	98	65	28	11

Table 12 - Simulated utilisation in "extreme drought"

			1 in 500 year droughts (bin, for e.g., 1:475 to 1:525 events)												
			% utilisation (Ml)												
Option	Option Name	Capacity (Ml/d)	Annual Average	J	F	M	A	M	J	J	A	S	O	N	D
WR111	GWE_WOODFORD	9	88	41	45	73	91	99	100	100	100	100	100	100	100
WR102b	GWE_WIDNES	17	80	37	33	58	90	100	100	100	100	100	100	92	49
WR076	SWN_RIVER BOLLIN	25	70	6	13	38	81	100	100	100	100	100	100	83	26
WR015	SWN_RIVER IRWELL	40	70	6	13	38	80	100	100	100	100	100	100	83	26
WR107b	GWE_RANDLES BRIDGE	12	72	6	13	38	77	100	100	100	100	100	100	90	35
WR149	ITC_WIGAN	13.8	70	9	15	37	77	97	97	97	97	97	97	87	34
WR113	GWE_TYTHERINGTON	3	84	35	31	59	81	96	100	100	100	100	100	100	100
WR049d	SWN_RIVER RIBBLE 49d	40	67	4	11	39	76	90	93	97	99	100	98	68	24
WR107a2	GWE_AUGHTON PARK a2	10	59	0	0	19	43	74	98	100	100	100	98	53	17

Future uncertainty

4.1.18 There are many factors which could affect future utilisation of the Sub-options. The most influential of these is the weather and climate change, which affects the extent and timing of trading requests and the opportunity to support resilience in the North West. The results presented in the previous section show how utilisation varies across different severity dry weather / drought events. Table 13 presents further analysis of uncertainty in the same underlying dataset, based on calculating the lower quartile (LQ) and Upper quartile (UQ) utilisation, i.e. the level of utilisation exceeded in 75% and 25% of years respectively. As can be seen, simulated utilisation of the Sub-options again varies across different conditions. Summer use is consistently high but at other times of year utilisation can fall away for some Sub-options.

4.1.19 For Gate 3 we plan to explore how other uncertainties such as transfer volumes, climate change and demand affect utilisation.

Table 13 - Uncertainty in simulated utilisation

Option	Option Name	Capacity (Ml/d)	Utilisation uncertainty (all years)												
			% utilisation (Ml)												
			Statistic*	Annual Average	J	F	M	A	M	J	J	A	S	O	N	D
WR111	Woodford Borehole	9	UQ	82	44	64	76	75	88	100	100	100	100	100	86	49
			Mean	64	32	45	55	51	72	100	100	89	79	62	50	30
			LQ	46	13	26	34	27	57	100	100	84	65	29	13	3
WR102b	Widnes BHs to Liverpool and Warrington	17	UQ	76	50	55	64	72	85	99	100	100	100	80	65	46
			Mean	57	29	36	42	51	69	88	93	83	74	49	39	26
			LQ	46	13	26	34	27	57	100	100	84	65	29	13	3
WR076	River Bollin	25	UQ	57	10	14	35	50	71	97	100	100	97	52	33	26
			Mean	40	12	13	22	30	43	75	86	72	59	30	19	16
			LQ	37	2	13	19	30	54	80	89	72	57	18	7	0
WR015	River Irwell to Heaton Park WTW	40	UQ	56	10	14	35	47	68	97	100	100	93	49	30	21
			Mean	39	12	13	21	29	41	74	85	69	57	29	19	14
			LQ	19	0	0	0	3	13	60	77	48	30	0	0	0
WR107b	Randles Bridge Knowsley Primrose Hill	12	UQ	55	6	14	30	43	64	97	100	100	97	61	37	11
			Mean	37	10	12	19	25	38	73	82	66	56	32	21	11
			LQ	18	0	0	0	0	10	57	74	45	25	0	0	0
WR149	ITC Wigan	14	UQ	55	9	14	32	45	62	93	97	95	93	59	39	22
			Mean	37	12	12	20	27	37	70	79	64	56	32	22	15
			LQ	16	0	0	0	0	6	57	71	39	20	0	0	0
WR113	Tytherington Boreholes	3	UQ	68	16	32	52	53	56	90	100	100	100	100	80	32
			Mean	46	16	21	33	34	37	65	75	77	73	59	43	21
			LQ	16	0	0	0	0	6	55	67	37	23	0	0	0
WR049d	Ribble to Rivington WTW	40	UQ	43	4	15	28	42	56	67	78	73	80	42	21	8
			Mean	30	8	12	18	24	34	53	65	52	49	25	15	8
			LQ	24	0	0	10	10	13	47	61	61	53	23	3	0
WR107a2	Aughton Park Moss End Boreholes	10	UQ	28	0	0	0	0	0	47	94	87	80	29	3	0
			Mean	18	2	2	2	4	7	25	52	51	42	20	8	2
			LQ	13	0	0	0	0	7	40	53	30	19	0	0	0

*The upper and lower quartiles represent the utilisation that is exceeded in 25% and 75% of years respectively. Typically these lie above and below the mean, but this is not always the case.

4.2 Water Resource Benefit

Key messages

- The deployable output (DO) benefits of the STT SRO and NWT SRO were calculated by transfer recipients. We supported their assessments, but the benefits relate to their supply systems and supply-demand balances.
- The current maximum transfer from the NWT SRO is 205 Ml/d, either to support the STT SRO or as direct transfers to other parties. This includes 180 Ml/d from Lake Vyrnwy, based on its source-level DO.
- Sub-options are required to mitigate the impacts of trading in our area. We used a sophisticated “system simulation” approach to properly understand the water resource benefits of the Sub-options, and to develop our “best value” solution. We worked closely with WRW to define best value and the approach was also aligned to our company trading principles.
- The NWT SRO has a large degree of inherent flexibility. The water resources benefits can be scaled, phased and readily incorporated into adaptive plans.
- The solution can provide benefits to a range of different parties. Crucially, it contributes to recipients’ 1 in 500 year resilience without constructing low utilisation assets.

Introduction

4.2.1 As a constituent part of the STT SRO, the NWT SRO’s water resources benefits were determined on several levels:

- **DO benefits of the STT SRO** – WRSE undertook DO modelling of the scheme as a whole. This involved testing different levels of support (i.e. augmentation of flow in the River Severn), including from the NWT SRO. These DO benefits are reported separately in the STT SRO Gate 2 submission but summarised below in Table 14.
- **DO benefit of NWT SRO transfers to other parties** – other regional groups and water companies, including West Country Water Resources, Severn Trent Water (STW) and South Staffs Water, undertook DO modelling to determine the benefits of transfers from the NWT SRO. These benefits are reported separately in their

respective regional plans and WRMPs. Of these, STW was the only company outside WRSE to include NWT SRO options in its draft WRMP preferred plan.

- **NWT SRO support to the STT SRO** – the STT SRO team collated the support available from each element of the scheme to feed into WRSE's assessment.
- **UU Sub-options –** we selected Sub-options to mitigate the impacts of these transfers. Understanding how these Sub-options work within our supply network to provide this benefit formed the bulk of our water resources assessment as shown in Section 3.1.

Recipient deployable output benefit

4.2.2 A summary of the benefits determined by NWT SRO recipients is provided in Table 14. In terms of the WRSE options, this is consistent with information collated by the STT SRO team to support high-level assessment of regional water resource benefit. More information about how the benefits were derived can be found in the STT Gate 2 submission document and STW's draft WRMP24. Note that the DO figures quoted account for river bed losses where applicable.

Table 14 - NWT SRO transfer recipient DO benefits

Recipient	Option	1 in 500 year deployable output (Ml/d)	Maximum deployable output for Dry Year Critical Period (DYCP) scenario (Ml/d)
WRSE	50 Ml/d Vyrnwy release	28.7	40.8
	75 Ml/d Vyrnwy release	43.1	61.2
	100 Ml/d Vyrnwy release	57.4	81.6
	135 Ml/d Vyrnwy release	77.6	110.2
	155 Ml/d Vyrnwy release	86.2	122.4
	180 Ml/d Vyrnwy release	103.4	146.9
	25 M/d Vyrnwy Mitigation – Shrewsbury Redeployment	13.5	19.0
Severn Trent Water	75 Ml/d Vyrnwy release	68	68
	25 Ml/d Shelton	25	25
	6.5 Ml/d Peckforton	6.5	6.5
	1 Ml/d Kinsall	1	1

NWT SRO maximum transfer amount

4.2.3 The maximum NWT SRO available transfer is 205 Ml/d. This consists of 180 Ml/d of raw water from Vyrnwy and a 25 Ml/d potable supply from Oswestry WTW to Shrewsbury. This 25 Ml/d could be sourced either from Lake Vyrnwy or the River Dee, but the total amount that can be transferred from Lake Vyrnwy is limited to 180 Ml/d.

4.2.4 The 180 Ml/d Vyrnwy transfer amount is a longstanding value reaching back to our 2015 WRMP. It relates to the source-level deployable output of the reservoir, taking into account inflows, compensation releases, River Severn regulation releases from the EA water bank, the water bank itself, and flood drawdown. It assumes that Lake Vyrnwy will be fully utilised by UU outside of transfer periods, as will be the case.

4.2.5 Previously, the DO of Lake Vyrnwy was calculated based on the maximum abstraction that could be maintained through the worst drought on record without breaching emergency storage (i.e. "English and Welsh" DO method). For Gate 2 we updated this assessment to reflect two key WRMP24 revisions:

- We moved to a 1 in 500 year assessment (i.e. "system response" DO method) using our 19,200 year stochastic hydrological dataset, and a failure point at dead water (i.e. the point at which we would implement emergency drought orders, such as standpipes).
- We used a new hydrological inflow sequence for Lake Vyrnwy, jointly developed with STW for the WRW regional plan.

4.2.6 The DO result from the updated assessment was 187 Ml/d. However, due to the additional uncertainty introduced by the use of the stochastic dataset, which contains synthetically generated weather events, we opted to retain the value of 180 Ml/d. The additional 25 Ml/d required to take the total amount to 205 Ml/d would likely be sourced from the River Dee when trading 180 Ml/d from Lake Vyrnwy. This sits within the existing abstraction licence and Dee General Directions (DGD) constraints.

4.2.7 Due to the inherent flexibility of the NWT SRO we can transfer any increment of the 205 Ml/d maximum, albeit there are some steps changes in engineering need for the Vyrnwy Aqueduct Enabling Works. The increments tested by WRSE are shown in Table 14.

Water resources assessment of UU Sub-options

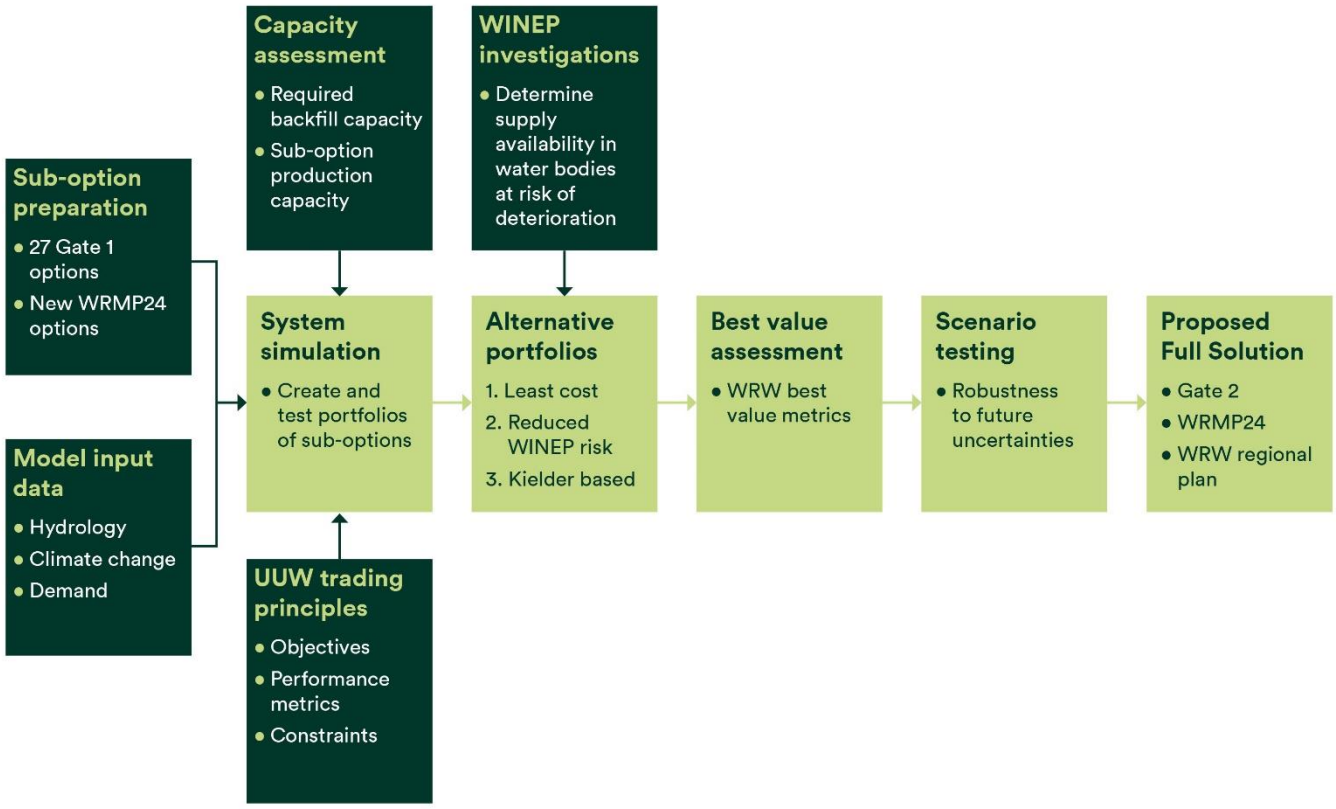
4.2.8 The NWT SRO involves large-scale trading from Lake Vyrnwy which, without mitigation, would significantly adversely affect our supply area. “Back-fill” Sub-options are therefore required to enhance our network to facilitate this form of trading. Note that no water from these Sub-options is actually transferred out of our area.

4.2.9 This aspect of our water resources assessment extends beyond the traditional supply-demand balance type approach. Using a supply-demand balance would grossly oversimplify the effects of large-scale water transfers on our system, and make it impossible to design a solution which would both function effectively and properly protect customers and the environment. A “system simulation” approach, where Sub-options were selected directly within a water resources model, was therefore implemented to:

- Help meet several of our high-level water trading principles, particularly around resilience.
- Take into account the huge complexity of the Strategic Resource Zone, and properly understand the Sub-options’ water resources benefits within this context.
- Reflect the scale of the NWT SRO, both in terms of its size, at over 205 Ml/d, and level of integration of Vyrnwy and the backfill Sub-options within our network.
- Ensure that the proposed configuration of Sub-options is operable (noting that for Gate 3 water resources modelling will be supported by other forms of more detailed modelling to ensure full operability), and properly protects customers and the environment.

4.2.10 We used this approach in WRMP19 and refreshed it for Gate 1. For Gate 2 we fully updated the objectives, data and tools. Figure 5 provides an overview of the steps in the Sub-option water resources assessment and the following sections explain each aspect.

Figure 5 - Overview of Assessment Steps



Sub-option preparation

4.2.11 The work completed for Gate 2 was a continuation of the Gate 1 assessment, and therefore the initial Sub-option pool remained largely consistent. However, with work also underway on WRMP24 we gave newly identified Sub-options an opportunity to enter the NWT SRO pool to ensure the best value Sub-options were captured. At various

stages of the water resources assessment average incremental cost (AIC) ranking was used to help ensure that we reached the most cost effective solution. At this early stage we took the top 40 Sub-options Gate 1 / WRMP24 options into the modelling assessment based on AIC.

Model input data

4.2.12 We collated the data required for modelling, for example: asset capacities; operational costs; operational and environmental constrictions; constraints from other users; hydrology; climate change perturbations; forecast demand; and WRSE utilisation of the STT SRO. Whist the modelling exercise was specific to the NWT SRO Gate 2 assessment, the model itself and many of the input data were carried across from WRMP24. This included the WRW regional stochastic hydrological dataset, which contains a large number of plausible drought events, and the demand forecast. In all cases we used the best data available at the time of the assessment.

4.2.13 Full details on the progression or otherwise of Sub-options through the Gate 2 selection process are provided in the UU Sources Conceptual Design Report (CDR) in Section 13, NWT-G02-003-001.

UU trading principles

4.2.14 Our company trading principles are presented in Table 2 and our system simulation water resources modelling approach was specifically designed to help deliver the resilience and environment principles as illustrated in Table 15.

Table 15 - UU trading principles relating to the water resources assessment

Principle	Criteria	Proof Point
Resilience	The transfer must not have a net detrimental impact – and should ideally improve – the resilience of the water resource and assets used to provide services to our customers.	No deterioration in predicted level of service for: • Temporary Use Bans (TUBs) • Drought permits • Non-Essential Use Bans (NEUBs) • Emergency Droughts Orders (EDO), e.g. standpipes No deterioration to supply demand balance (Baseline to be established through initial WR modelling)
		No short term loss in production capacity
		No reduction in resilience to high impact, short term events such as: • Unplanned outage/asset failure • freeze thaw
		Solutions include for system thinking capabilities.
Environment	The projects must not have a significant adverse effect on the environment, must be approved through regulatory oversight and must support, or at least not have a detrimental impact on the company's overall environmental performance.	Alignment with EA environmental destination and WINEP plans Alignment with UU Net Zero carbon target
Customers	The scheme should provide demonstrable value for money for customers in the North West, as reflected in customer bills and customers in the region must receive a fair proportion of the national benefits which arise from the scheme.	Solution costs include for all cost elements potentially incurred by UU to enable full recovery through trading agreements.
		High certainty that North West customer bill impact over the life of the project is positive, with robust protections against unacceptable bill increases in the short term.

4.2.15 These principles were translated into the specific performance metrics shown in Table 16. Also derived from these principles were the two key constraints applied in the assessment:

- All metric scores, for example predicted customer levels of service, must be either equalled or improved due to trading.
- System cost must not increase relative to the baseline, or alternately any increase must be captured and recovered within the trading price. Note that costs related to utilisation of the Sub-options for the benefit of the North West were excluded from the trading price (Section 4.1).

4.2.16 The water resources benefits derived are summarised in the right hand column of the table.

Table 16 - Water resources modelling performance metrics

Theme	Aspect	Performance metric	Water resources benefits provided
Resilience	Customer restrictions	Annual chance of implementing TUBs	Customers' forecast levels of service are maintained or improved.
		Annual chance of implementing NEUBs	
		Annual chance of implementing EDOs	
	Production capacity	Total Strategic RZ production capacity	Our ability to manage short-term outage is not impaired.
	Supply-demand balance	Resource zone 1 in 500 year deployable output	Whilst not used to select Sub-options for trading, it is crucial to understand and protect our supply-demand position.
Environment	Drought permits	Annual chance of implementing drought permits	Ensure the likelihood of drought permits does not increase.
	Water Framework Directive (WFD) no deterioration	Utilisation of sources under the spotlight (base on AMP7 WINEP investigations)	Impacts of water trading on our current sources is less apparent and so can be highlighted and prevented / managed by the water resources assessment.
Cost	Solution cost	NPV whole life TOTEX of solution (calculated outside of the model)	Ensure that a cost effective solution is selected.
	System cost	Average annual OPEX (Sub-options and BAU sources)	Ensure that any "hidden costs" of water trading are identified and accounted for.

Capacity assessment

4.2.17 At an individual Sub-option level the key water resources benefit for use in a system simulation approach is capacity, i.e. the volume of water that can be deployed in a specific network location. The capacity of each Sub-option was derived based on the physical capacity of assets, the anticipated licence conditions and the raw water availability. In accordance with the production capacity requirement (Table 16), Sub-options unable to provide additional production capacity (i.e. supply potable water), either through the inclusion of a WTW or an upgrade to existing WTW, were screened out.

4.2.18 In order to ensure the production capacity requirement was met it was also necessary to define an overall capacity target. The most simplistic approach would have been to set this to be equivalent to the overall transfer amount of 205 Ml/d. However, we identified a best value opportunity for all companies and customers involved to lower this to 167 Ml/d by allowing a short-term (i.e. 2-4 weeks) increase in abstraction from Lake Vyrnwy, above 180 Ml/d, utilising the daily licence volume of 250 Ml/d, plus 40 Ml/d spare capacity at Oswestry WTW during trading. Whilst abstraction over 180 Ml/d is unsustainable during dry weather, our water resources modelling showed that it was feasible for short periods of time, as long as the Lake Vyrnwy abstraction was then briefly reduced below 180 Ml/d subsequent to trading. This would in-turn be facilitated by utilisation of the Sub-options. In Gate 3 we will undertake further modelling to develop real-life operational rules to help govern this practice.

System simulation

4.2.19 System simulation essentially involves selecting options within a water resources model rather than a supply-demand balance-based investment model. In the UKWIR 2016 Decision Making Processes guidance these two approaches are referred to as "non-aggregated" and aggregated" respectively. The UU Pywr water resources model was used for the assessment and the following steps were undertaken to create alterative portfolios of Sub-options:

- Run the model to represent future conditions with no trading occurring. Capture the metric scores to form a baseline.
- Implement trading according to utilisation sequences provided by transfer recipients. Measure the drop in performance due to water trading without any Sub-options in place.
- Build groups of Sub-options into the model to recover the drop in performance, at the same time minimising overall solution cost (Totex 80-year NPV) by testing them in order of AIC.

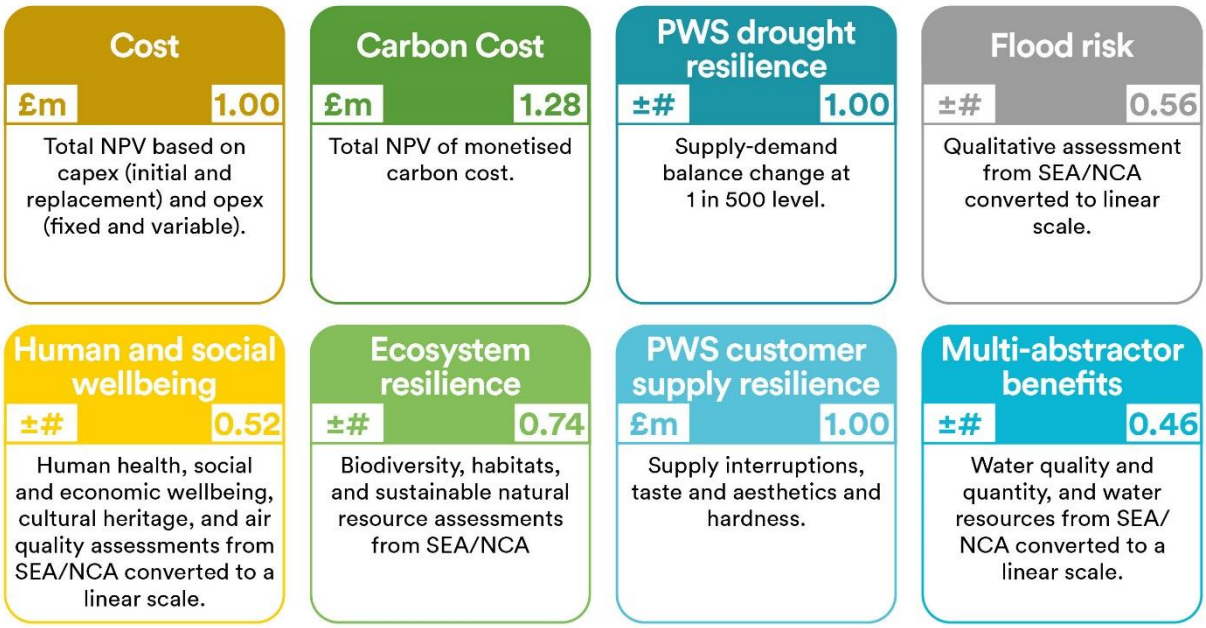
4.2.20 We also used these simulations to ensure that the transfer demand could be met with a maximum failure threshold of 1 in 500, i.e. that there was a very high degree of reliability in the water resources benefits for recipients.

Best value assessment - alternative portfolios

4.2.21 The performance metrics derived from the company trading principles (Table 2) allowed us to take a "best value" approach, i.e. to consider wider value beyond financial cost. We also incorporated our WRMP24 best value metrics, which were formulated in collaboration with our partner companies in WRW. These metrics are shown in Figure 6, along with weightings that were derived based on an innovative customer choice experiment which helped to ensure that our solution is aligned with customer preferences. All metrics were monetised to allow a

best value cost to be calculated; the lower the cost the higher the value. More information about this approach is provided in the WRW draft plan and UU draft WRMP24.

Figure 6 - Water Resources West best value metrics



4.2.22 The process worked as follows:

- Develop three alternative portfolios using system simulation and the UU trading principle metrics.
- Score the three portfolios based on the WRW metrics.
- Based on the outcome, and any other salient information, select the overall best value proposed solution.

4.2.23 The three alternative portfolios are shown in Table 17. At the time of the assessment, groundwater bodies containing several Sub-options were subject to investigation under the WINEP programme (i.e. linked to our current abstractions in these locations), with a corresponding risk to aquifer supply availability. Therefore, the first two portfolios followed the system simulation process to generate the most optimal solutions, but with and without the WINEP-affected options made available. The third portfolio explored the inclusion of the Kielder transfer from the WReN region. This is a large 100 Ml/d transfer that would provide significant benefits in terms of improving national drought resilience and utilising an underused asset. However, it is an expensive scheme (as shown in Table 17) with some environmental challenges to overcome related to the pipeline route.

Table 17~ - Alternative portfolios in best value assessment

Portfolio	A – Most optimal portfolio including WINEP Sub-options	B – Most optimal portfolio excluding WINEP Sub-options	C – Kielder-based Sub-options
Sub-options selected	WR107b GWE_RANDLES BRIDGE WR144 SWN_RIVER TAME WR015 SWN_RIVER IRWELL WR102b GWE_WIDNES WR153 GWE_SIMMONDS HILL WR107a2 GWE_AUGHTON PARK WR149 ITC_WIGAN WR049d SWN_RIVER RIBBLE WR154 GWE_SANDIFORD WR111 GWE_WOODFORD	WR107b GWE_RANDLES BRIDGE WR015 SWN_RIVER IRWELL WR102b GWE_WIDNES WR107a2 GWE_AUGHTON PARK WR113 GWE_TYTHERINGTON WR149 ITC_WIGAN WR076 SWN_RIVER BOLLIN WR111 GWE_WOODFORD WR049d SWN_RIVER RIBBLE	WR107a2 GWE_AUGHTON PARK WR144 SWN_RIVER TAME STT041b SWN_RIVER IRWELL_ROCH WR113 GWE_TYTHERINGTON WR111 GWE_WOODFORD WR812c WIT_THIRD PARTY_22
80-year NPV financial cost**	£1002m	£1071m	£2317m
80-year NPV best value cost*, **	£1779m	£1883m	£3769m
Outcome	Discounted due to WINEP conclusions	Gate 2 proposed Full Solution	Retained as an alternative solution

*A lower best value cost denotes higher value (our optimisation minimises cost)

** The financial and best value NPV costs used in the best value assessment in June 2022 were refined during Gate 2 and the updated figures for Portfolio B are used elsewhere in this report and the Draft WRMP.

~Table notes updated 10/03/2023.

4.2.24 In addition to being the most optimal solution discovered by system simulation, Portfolio A also represented the "least cost" and "best value" solution according to the WRW metrics. However, Portfolio B, which removes the WINEP risk, was within 5% of Portfolio A in terms of financial cost and 6% in terms of best value. Portfolio C was significantly more expensive and lower best value (i.e. higher cost), hence would need to be promoted on the basis of factors not already explicitly included in our best value approach.

4.2.25 Subsequent to this assessment, the WINEP studies concluded that no further water would likely be available for the Simmonds Hill or Sandiford Sub-options, thereby rendering Portfolio A infeasible. Several other NWT SRO Sub-options were rejected for the same reason but had not been selected by system simulation. Portfolio B was progressed as the proposed Full Solution and Portfolio C retained as an alternative solution for future adaptive planning.

Scenario testing

4.2.26 The proposed Full Solution was mainly formulated using a "central" scenario representing predicted conditions in 2035, the approximate earliest year that large-scale STT SRO transfers could feasibly occur. It included the following assumptions:

- Central view of demand based on the WRMP24 2035 forecast.
- WRMP24 leakage and Per Capita Consumption (PCC) planned 2035 reductions assumed to be fully achieved.
- Median RCP6.0 UKCP18 2035 climate change impact on supply.
- Monthly demand profile based on 2018 conditions with a large summer spike in demand.

4.2.27 To ensure that the solution is robust to future uncertainties we tested it against a wide range of scenarios:

- Maximum stress - high forecast demand and a severe climate change projection.
- 2050 time-slice – projected demand and climate change in 2050.
- Alternative monthly demand profile, based on 1995-1996 historical drought.
- Restrictive use - simulating a contractual clause preventing transfer when Level 3 restrictions (non-essential use bans) are implemented in the UU supply area.
- High STT SRO / WRSE utilisation – all trading periods were doubled in length.

4.2.28 In all cases apart from the high utilisation scenario the preferred solution performed robustly and, whilst there was some variance in performance, all metrics were still either equalled or exceeded relative to the baseline with no trading. It is important to note that the baseline was also reset to the conditions reflected in the scenario. The transfer portfolio was designed to mitigate trading in the context of these conditions and not expected to also for example, mitigate the impact of severe climate change. The WRMP process fulfils this role.

4.2.29 The proposed solution was sensitive to STT SRO utilisation of the NWT SRO support. If the level of utilisation was increased this could lead to a greater requirement for back-fill Sub-options above 167 Ml/d. This again is a strength of the STT and NWT SRO schemes which can be flexible to future needs. Note that the specific pattern of utilisation, for example the maximum duration of trading periods, is more important than the headline percentage. We plan to further review recipient utilisation patterns for Gate 3.

4.2.30 The restrictive use scenario represents one simple hypothetical contractual clause, based on the implementation of Level 3 (NEUBs) restrictions. In reality there could be a range of contractual conditions that affect the utilisation of the NWT SRO, with potential implications for the Sub-options required and the associated cost. These conditions could be linked to customer restrictions, outages, environmental conditions etc. For Gate 3 we will work with our trading partners to formulate heads of terms agreements. Based on the outcomes of this process this we will assess the implications of any potential contractual clauses for the water resources assessment.

4.2.31 Whilst the restrictive use scenario provided information about the impact on the North West, this is only part of the story. Equally important is the impact on the DO benefit to the transfer recipient. At face value, ceasing the transfer at Level 3 would appear to be very detrimental to Level 4 (EDO) (i.e. 1 in 500 year) resilience. However, in the case of WRSE, the lack of drought correlation between the North West and the South East (Section 4.2.35), as well as the presence of storage in the London Resource Zone, would likely significantly lessen the impact. When we explore contractual clauses for Gate 3 this will need to incorporate corresponding recipient testing of DO benefits.

Smaller trades

4.2.32 All of the work described in the preceding sections was focussed on developing the Full Solution of 205 Ml/d transfer. However, the central plan output from the regional planning reconciliation process included a total of

167Ml/d transfer from the NWT SRO, phased over the period 2031-60. This is mirrored in the preferred plans of the WRSE and WRW regional plans and company draft WRMPs.

4.2.33 A number of scenarios were also tested in regional planning, which resulted in a multitude of different trade amounts and times. Unfortunately, it was infeasible to develop new solutions for each specific trade amount using system simulation. Therefore, our WRMP24 best value decision making tool ValueStream, developed in collaboration with the other companies in WRW, was used to optimise partial trading solutions. The key inputs to the tool were the Sub-options in the Full Solution and a time-series of transfer need. The tool then optimised and scheduled the Sub-options across the 2025-85 planning period to achieve best value. For the WRMP24 preferred plan we also used Pywr to test key stages in the planning period, i.e. years with incremental trading volume increases, to ensure that the UU trading principles were still met. As instructed by WRSE, the pattern of trading utilisation for these runs was retained irrespective of the trading volume.

Conjunctive use benefits

4.2.34 There are two mechanisms by which significant conjunctive use benefits can be provided by the NWT SRO. Firstly, we can trade with different parties at the same time, as long as we don't exceed the maximum 180 Ml/d release from Lake Vyrnwy. So, for example, we could concurrently trade 90 Ml/d with company A and 90 Ml/d with company B. We could potentially take this even further by accounting for differences in utilisation patterns, for example trading 180 Ml/d with company A and 180 Ml/d with company B at times when their transfer needs are not overlapping. However, this type of arrangement could be curtailed by the fact that transfer needs for Lake Vyrnwy releases are likely to correlate with River Severn flow, i.e. when flow is high enough in the river abstraction is already available. This an area we intend to explore further during Gate 3.

4.2.35 Secondly, there is a benefit to our Strategic Resource Zone. The Sub-options must be used in anticipation that a drought may occur in the future to ensure our system is in a position to enable the transfer, for example reducing the use of Lake Vyrnwy. The proposed solution reflects the best value portfolio of Sub-options to support water trading. If we removed any one of the Sub-options the solution would not meet the necessary requirements. However, due to the nature of water trading there are times when the Sub-options would not be required for water trading. The overall level of utilisation need for most of the NWT SRO transfer options selected in WRMP preferred plans is less than 15%; as explained above the need for Sub-options is driven by very high levels of utilisation during drought events. Furthermore, the correlation between drought events in the North West and South East is relatively low. If the North West is in drought there is approximately a 50% chance that the South East is in drought too.

4.2.36 This all means that the Sub-options can be used to increase drought resilience for customers and communities in the North West as well as help to deal with outages. Critically this means that we are not investing in new assets that will be underutilised in the future. The same benefits also apply in reverse; there will be times when our existing assets can be safely used to support water trading, for example when an NWT SRO Sub-option is affected by outage.

4.2.37 In addition, we believe that significant additional benefits can be realised by WRSE through conjunctive use. At present the NWT / STT SROs are focussed on Thames Water's London Resource Zone, however there are clear supply routes into their Swindon and Oxford (SWOX) Resource Zone, as well as to Southern Water and Affinity Water. Furthermore, we believe the full benefits of the NWT / STT SROs can only be fully realised by re-optimising operational rules within WRSE, for example the Lower Thames Control Diagram (LTCD). We hope to work further with WRSE to unlock these conjunctive benefits for Gate 3.

4.2.38 As previously explained, the NWT SRO is not a discrete option but an extension to the Strategic Resource Zone. The operation of most assets in the resource zone will be affected by water trading to some degree. We designed the NWT SRO solution within our Strategic Resource Zone water resources model and ran simulations to help understand the implications for our current assets, in terms of impacts on flows and operational costs. For Gate 3 we will conduct more in-depth investigations using our Miser production planning and Synergi network models. We will also use these models to help formulate the operational rules required to make water transfers work in practice, both at a company level within the Strategic Resource Zone, and at a macro level as part of the overall STT SRO scheme.

4.2.39 Working with our STT SRO partners we have developed a new Pywr water resources model representing the STT scheme. The model stretches from the north of the UU supply area, down through STW's supply area, to the point of discharge into the River Thames (a future aim is to link up the model with the WRSE Pywr regional simulator). The UU portion of the model is identical to the Strategic Resource Zone model used for the NWT SRO for Gate 2, with one important exception. River Severn regulation releases from Lake Vyrnwy can be simulated much more

accurately in the new model, due to the presence of downstream nodes representing the River Severn and STW's supply area. We plan to switch to the new STT model for all Gate 3 NWT SRO water resources modelling activities.

4.3 Long term opportunities and scalability

4.3.1 Maximising scalability and long-term opportunities was a central objective in designing the STT and NWT SROs. We envisage the STT scheme as the backbone of a future national supply network, with the capability to connect together all five regions. We have already developed specific NWT SRO export options to companies in WRSE, WRW and WCWR, as well as import options from WReN to support further transfer from the North West.

4.3.2 The NWT SRO provides a number of wider benefits plus opportunities to further enhance capacity, as outlined in the following sections.

Operational supply resilience

4.3.3 By increasing the overall production capacity in our supply network outside of trading periods, the NWT SRO will help to mitigate both planned and unplanned outages. Due to the lack of correlation between drought events in the North West and other regions, there will be times when the NWT SRO Sub-options can be safely used to provide additional drought resilience to the North West.

Climate change adaptation

4.3.4 The nature of the NWT SRO, which involves diverse source types situated right across the North West, means it has excellent capability to support climate change adaptation. Our latest assessments show that the Sub-options currently selected are resilient to climate change, but if these conclusions change in the future we can easily incorporate other Sub-options. We appreciate that the impact of climate change on potential transfer recipients is challenging for them to predict, and that this may lead to changes in the amount or timing of support required. The NWT SRO is designed with this type of future uncertainty in mind, and can be easily adapted according to recipients' changing needs.

Supporting the resilience of the natural environment

4.3.5 The NWT SRO has been designed in a way that protects the environment in the North West and Wales. Furthermore, we plan to implement environmental improvements through Biodiversity Net Gain (Section 6). Viewing the scheme holistically, the NWT SRO can provide significant protection and rehabilitation of other sensitive habitats around the country. One of the key drivers for water companies selecting the NWT SRO in their WRMP preferred plans is to support their Environmental Destination.

Flood resilience benefits

4.3.6 Assessment of potential flood risks has guided the initial site selection options for the Sub-options and all of the assets that form the NWT SRO have been carefully designed to ensure they are resilient to flooding.

4.3.7 There is limited potential for the overall NWT SRO to provide any flooding benefits as the volume of water abstracted from Lake Vyrnwy remains within current operational parameters. We continue to will work with regulators through the STT SRO to explore flood risk opportunities.

Water quality benefits

4.3.8 The NWT SRO has been carefully designed to minimise impacts on water quality. In our best value assessment used to select the Sub-options, we incorporated a customer supply resilience metric with three components: (i) supply interruptions; (ii) taste and aesthetics; and (iii) hardness. This helped to ensure that our solution will deliver tangible water quality benefits and mitigates the customer acceptability risk (further detailed in Section 9). As noted above, the presence of the NWT SRO Sub-options in the UU network will also help to manage outages caused by water quality issues during non-trading periods.

Enabling capacity increases in future

4.3.9 The current Full Solution can provide up to 205 Ml/d of transfers, shared between multiple recipients. This can be phased with increments specifically sized to meet recipients' developing needs. The overall capacity of NWT SRO could potentially be further upgraded. However, this could not be reliant on further increasing Lake Vyrnwy releases above 180 Ml/d, which is the limit. Therefore, we would need to export from other sources of water such as the River Dee, taking into account current abstraction controls, or newly developed sources. This could involve the use of the Vyrnwy Aqueduct Enabling Works to transfer water out of our area.

4.3.10 While we would prefer to retain Lake Vyrnwy predominantly as a UU source we could also adapt the 205 Ml/d solution to accommodate increased levels of utilisation. This would likely need to involve developing further Sub-options. There are also potential opportunities to increase benefits and efficiency by incorporating more integrated use of NWT SRO, i.e. taking advantage of misalignment between recipients' utilisation patterns.

4.3.11 We have already identified several reserve Sub-options that could be used to enable capacity increases in the future. Beyond these, we have several other feasible WRMP supply options. In the unlikely event that options in the North West become exhausted we have also been working with NWL to develop large scale transfer options of up to 100 Ml/d from the WReN regional. As such, we are in the process of proposing a new Kielder SRO with NWL.

4.3.12 We have focussed on the design of the Full Solution of 205 Ml/d, as described in Section 3, however the modular nature of both the UU sources and the Vyrnwy Aqueduct Enabling Works allow for phased delivery of infrastructure over time to meet progressive increases in transfer volume. Once the need through the WRMPs has been confirmed the detailed phasing of the project needs to be established balancing the benefits of spreading the investment versus the impact and practicalities of having several delivery phases.

5. Drinking Water Quality Considerations

5.1.1 The Strategic Water Quality Risk Assessment (SWQRA) provides a high-level risk assessment using the AWCG methodology, based on a Drinking Water Safety Plan (DWSP) approach, to identify limiting hazards and assess their risks across the water supply system for the NWT SRO. At each stage, from catchment to consumer (i.e. catchment, abstraction, conveyance, treatment, storage, distribution, and consumer), pre-mitigated risks are assessed using a 5x5 (likelihood x consequence) risk matrix, mitigation measures proposed, and resultant post-mitigated residual risks assessed. This section provides a summary of the outcome from the risk assessment framework approach for the NWT SRO at Gate 2.

5.1.2 The risks to our customers impacted by this SRO are assessed in this SWQRA. The risks to downstream consumers (i.e. potential trading partners) will be assessed as part of the relevant recipient SROs.

5.1.3 The following process was used in preparation of the SWQRA as outlined below :

- Review of new and updated information
- Limiting Hazards
- SWQRA risk scoring methodology
- Completion of the SWQRA
- Risk Assessment outcome

5.1.4 An independent assessment of the risks for each limiting hazard was carried out by using a methodology developed by Jacobs for the Gate 2 SQWRA. These scores were then compared with the risk scores, our existing DWSPs, and the highest risk score adopted as the Gate 2 risk score. This procedure allowed for consistency with UU DWSP risk scores while allowing for the scores to be increased (a conservative approach) where the independent assessment considered the risk to be higher.

5.1.5 The SWQRA was developed using desk based information in collaboration with the Water quality and public health team, Subject Matter Experts (SMEs) as well as the DWI and RAPID. It is envisaged this will be revisited, reviewed, and updated in light of new information as the project progresses through Gate 3 and beyond and will ultimately feed into the DWSPs for the sites.

Risk assessment Scenarios

5.1.6 The NWT SRO comprises schemes with river, borehole and reservoir sources and the Vyrnwy Aqueduct Enabling Works. The Sub-options were grouped into the following four categories and one risk assessment was carried out for each group as shown in the Table 18, these SWQRA's can be found in Section 13, NWT-G02-005-001 to 5:

Table 18 - Grouping of Risk Assessments

Group Risk Assessment	Constituent Parts
Rivers	WR015 SWN_RIVER IRWELL WR076 SWN_RIVER BOLLIN WR049d SWN_RIVER RIBBLE 49d WR144 SWN_RIVER TAME STT041b SWN_RIVER IRWELL_ROCH
Boreholes	WR111 GWE_WOODFORD

Group Risk Assessment	Constituent Parts
	WR113 GWE_TYTHERINGTON WR149 ITC_WIGAN WR107a2 GWE_AUGHTON PARK a2 WR102b GWE_WIDNES WR107b GWE_RANDLES BRIDGE WR105a1 GWE_LYMM a1 WR106b GWE_WALTON_2
Impounding Reservoirs	WR812 WIT_THIRD PARTY_22
Vyrnwy Aqueduct Enabling Works	STTA4 NWT_VYRNWY

Information used for Gate 2 SWQRA

5.1.7 Water quality risks for various sources were identified from the relevant DWSPs. From these a typical risk profile for each source type was derived and used to carry out the SWQRA.

Limiting Hazards at Gate 2

The limiting hazards at Gate 2 were as follows:

Table 19 - Limiting Hazards (see conclusion, 5.1.13, below for explanation of RAG status).

	E-Coli	Cryptospori	Iron	Manganese	Aluminium	Nitrates	Metaldehyd	Total	Corosivity	Change in	Change in	ECCs	PFAS	PAH	Benzo(a)pyr	Chloride	Chromium	Turbidity	Carbon	Algae	Geosmin/2-	Arsenic	Cyanide	Ammonium
River	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y			Y
Borehole	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y		Y			Y	Y	Y				Y	Y	
Reservoirs	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y		Y	Y	Y			Y
Vyrnwy Aqueduct	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y			Y	Y	Y	Y	Y	Y			Y
Residual risks																								

Regulators' Comments

5.1.8 We have engaged with RAPID and the DWI during Gate 2. A number of comments were made which are now being addressed. These included:

- Abstraction Licences for the borehole sources. We advised that three borehole Sub-options have been removed following WINEP investigations and the others are being progressed for further assessment.
- Water Quality data gathering. We advised that borehole schemes will have a minimum of 1 year of sampling and river schemes will have a minimum of 2 years of sampling data. The sampling programme is ongoing and will be completed as part of Gate 3.
- Consumer Engagement. We advised that research has taken place in areas where there may be changes in source to the consumers. Further customer engagement to be undertaken is detailed in Section 9.

5.1.9 PFAS (PFOA & PFOS) along with other Contaminants of Emerging Concern (CEC) have been considered particularly in catchments influenced by wastewater. Based on available water quality data it is considered that the current risk from these contaminants is low; however the risk scores assigned reflect uncertainty. It is expected that further water quality data, collected to support subsequent Gate stages, will reduce the associated risk assessment scores for these hazards. Should the hazard be identified in the raw water, suitable mitigation will be identified and installed. It is, however, recognised that global health advice continues to change with regards to CEC and will be addressed through the Gated process.

Drinking Water Protected Areas (DWPA) - Challenges for the Water Environment

5.1.10 The collaborative 'catchment to consumer' approach of the SWQRA process is also aligned with the objectives of the Drinking Water Protected Areas (DWPA). This is meeting the requirements of the Water Supply (Water Quality) Regulations 2016, protection of the supply by avoiding deterioration in water quality to reduce the level of purification treatment required and for groundwater, to meet good chemical status and reverse upward trends in pollution.

Other considerations

5.1.11 Compliance with drinking water quality regulation 31 is a requirement for materials in contact with drinking water. This will be considered early in the detailed design process and engaging with potential suppliers will ensure compliance. “Consideration of any applicable The Network & Information Systems (NIS) Regulations 2018 or security and emergency measures direction (SEMD)” will also be completed by UU.

Conclusions

5.1.12 Key conclusions from the Gate 2 assessment are:

- Pre-mitigated catchment risks for most of the limiting hazards are Red or Amber.
- The majority of the risks are reduced at the treatment stage.
- RAG status of residual risks (illustrated in Table 19) to the consumer are low (green) for several of the limiting hazards. For a number of limiting hazards the residual risks to consumer remain high (red) or medium (amber). These are hazards related to:
    - Consumer’s perception of water (source (red), hardness/alkalinity and corrosivity (amber)). The mitigation is early customer engagement, and this has been initiated and will continue as described in Section 9.
    - Limiting hazards related to CECs (including PFAS). The current risk from these is considered to be low, however this may increase in future. Assessed as amber risk due to limited data and changing regulatory landscape.
- Limiting hazards have been assessed as a red or amber residual risk based on information from existing DWSPs. In the company’s current water supply system these hazards are currently mitigated at the point they arise, or before they reach customers. However, maintaining the precautionary principle, we have held them as a raised risk at this stage in the development of the NWT SRO. These include:
    - Red Risk - Aluminium, Nitrates and Arsenic.
    - Amber Risks – Iron, Manganese, Turbidity, TOC, Ammonium, Geosmin/2MIB and Total Pesticide.

5.1.13 Further water quality data obtained from sampling results during Gate 3 will be used for refining the water quality risks and associated mitigation measures.

6. Environmental Feasibility Statement

6.1 Introduction

6.1.1 We are committed to ensuring that the NWT SRO supports, or at least does not have a detrimental impact on our overall environmental performance.

6.1.2 We have undertaken environmental feasibility assessments of the NWT SRO Sub-options and Full Solution following the principles of the Habitats Regulations and the Water Framework Directive, and completed Natural Capital, Biodiversity Net Gain, and Invasive Non-Native Species Assessments. Our assessments:

- Are aligned with the approaches adopted for the assessment of United Utilities’ (UU) 2024 Water Resource Management Plan (WRMP24) and the WRW Regional Plan;
- Have been informed by extensive regulatory engagement;
- Evaluate the environmental effects of the Sub-options individually, the cumulative effects of the Sub-options which comprise the NWT SRO Full Solution, and the in-combination effects of NWT with other plans and projects;
- Facilitate the identification of measures to mitigate potential adverse effects and deliver environmental benefits; and
- Provide the foundation for the more detailed environmental assessments which will be undertaken during Gate 3 and beyond.

The environmental feasibility statement presented here is supported by the following technical appendices:

- NWT-G02-006-001: Assessment of Sub-options Involving Groundwater Abstractions;
- NWT-G02-006-002: Assessment of Sub-options Involving Surface Water Abstractions;
- NWT-G02-006-003: Water Framework Directive (WFD) Compliance Assessment;
- NWT-G02-006-004: Informal Habitats Regulations Assessment (HRA);
- NWT-G02-006-005: Invasive Non-Native Species (INNS) Assessment;

- NWT-G02-006-006: Biodiversity Net Gain (BNG) and Natural Capital (NC) Assessment; and
- NWT-G02-006-007: Initial Environmental Appraisal (IEA).

6.2 Approach to Gate 2 environmental assessment

6.2.1 The key risks to the environment from the NWT SRO are associated with the long-term operational impacts of abstracting additional water from rivers and aquifers, and this is the main focus of the Gate 2 environmental assessments. Risks associated with construction and the operational presence of new infrastructure are considered, but at a higher level.

6.2.2 The environmental assessment undertaken during Gate 2 has built on the initial environmental assessment work undertaken at Gate 1 and has comprised:

- An initial evidence and assessment scoping exercise for each Sub-option, identifying which environmental topics should be the focus of the environmental assessments during Gate 2, the existing environmental data available for each option, and the gaps in data and understanding which needed to be addressed.
- The completion of an environmental assessment for each Sub-option. For the groundwater Sub-options this focussed on impacts on aquifer water balances and linkages to groundwater dependent surface water features. For the surface water Sub-options this focussed on impacts on river flows and water quality and establishing the sensitivity of ecology downstream ecology to those impacts.
- An INNS assessment to identify risks and mitigations to avoid the transfer of such species.
- Informal assessments of compliance with the Water Framework Directive and Habitats Regulations, intended to inform the formal compliance assessments that will be required as part of planning and permit applications.
- BNG assessments to ensure the implementation of the Sub-options provides at least the minimum required 10% increase in biodiversity, and to identify strategic opportunities for the implementation of this.
- A Natural Capital assessment to support identification of the best value solution and decision making.
- Preparation of the IEA Report, which pulls together the above assessments into a combined environmental appraisal for the NWT SRO Sub-options and Full Solution.

6.2.3 Our Gate 2 assessments have been undertaken following methodologies established in consultation with the NAU and NRW, and aligned with the assessment methodologies for WRMP24 and the WRW Regional Plan, as well as guidance developed by the ACWG.

6.2.4 Our assessments align with the requirements set out in RAPID's Guidance for Gate 2. The informal Water Framework Directive and Habitats Regulations Assessments are presented in Technical Appendices NWT-G02-006-003 and NWT-G02-006-004 respectively. A Strategic Environmental Assessment (SEA) has not been undertaken as part of the NWT SRO environmental assessments, but the SEA of UUs WRMP24 has been used to inform the Initial Environmental Appraisal (IEA) which is presented in Technical Appendix NWT-G02-006-007, and summarised in Sections 6.5 to 6.9 of this document. Our approach to Carbon assessment and reduction is described in Section 6.4.

6.3 Gate 2 Sub-options

6.3.1 The NWT SRO comprises 14 Sub-options (13 source Sub-options and one Vyrnwy Aqueduct enabling works Sub-option) as listed in Figure 2. Figure 2 also identifies the ten Sub-options which comprise the NWT Full Solution. See Section 3 for a more detailed description of each Sub-option and the selection of options for the Full Solution.

6.3.2 The 14 Sub-options included in Gate 2 are different from the 29 Sub-options (27 sources Sub-options and two Vyrnwy Aqueduct enabling works Sub-options) included at Gate 1. During Gate 2 we have refined the list of options, including introducing new Sub-options from the WRMP24 process to ensure the best available solution is developed.

6.3.3 During Gate 2 we have used the results of the environmental assessments to inform the selection of Sub-options and influence the design process. Examples include:

- Removal of a proposed increased reservoir abstraction as the yield would not have been environmentally sustainable.
- Changed a Sub-option from transfer of raw river water to a reservoir to transfer direct to a water treatment works to remove the risk of transfer of INNS between source and receiving waters.
- Inclusion of "hands off flow" assumptions for new river abstractions.
- Revised routes and locations of infrastructure to avoid designated sites such as Sites of Special Scientific Interest, ancient woodlands etc.

6.3.4 A number of Sub-options were also removed from Gate 2 as a result of completion of the AMP7 Water Industry National Environment Programme (WINEP) WFD no deterioration investigations in March 2022.

6.4 Carbon

6.4.1 Table 20 presents the estimated whole life carbon cost of the NWT SRO broken into embodied and operational greenhouse gas emissions, expressed as tCO2e, for each of the Sub-options and Full Solution. This emissions estimate is then scaled by a carbon value in £GBP per tCO2e to provide Carbon Costs NPV.

6.4.2 In the WRMP, the monetised cost of carbon was modelled using values taken from Data Table 3 (central profile) of the supplementary guidance to HM Treasury's Green Book. The tabulated values increase year-on-year up to 2100. UU has extrapolated, beyond the 2100, up to the 80 year asset life. The values increase by circa 1.5% each year.

Table 20 – Carbon Volumes and Costs

Option ID	Option Name	Implementation Related Carbon (Tonnes CO2e)	Operation Related Carbon excluding power (Fixed + Variable) (Tonnes CO2e/year)	Carbon Costs NPV (£m)
STTA4	NWT_VYRNWY	23,135.00	360.00	9
WR015	SWN_RIVER IRWELL	50,142.87	7,072.29	77
WR111	GWE_WOODFORD	2,834.40	1,394.72	14
WR113	GWE_TYTHERINGTON	3,807.23	523.86	6
WR149	ITC_WIGAN	8,856.76	2,057.83	21
WR076	SWN_RIVER BOLLIN	35,349.23	4,017.39	46
WR049d	SWN_RIVER RIBBLE 49d	58,768.74	14,905.03	152
WR107a2	GWE_AUGHTON PARK a2	5,480.80	2,387.08	23
WR102b	GWE_WIDNES	11,005.71	5,004.25	49
WR107b	GWE_RANDLES BRIDGE	18,637.25	742.29	11
Total	**Full Solution**	**218,017.99**	**38,464.74**	**408**
WR105a	GWE_LYMM a1	5,995.88	552.87	n/a
WR106b	GWE_WALTON_2	12,173.45	2,106.04	n/a
WR144	SWN_RIVER TAME	4,100.53	3,226.12	n/a
STT041b	SWN_RIVER IRWELL_ROCH	65,197.49	9,810.59	n/a

Note: Discounted Carbon Costs have not been calculated for the reserve Sub-options

6.4.3 Construction/embodied carbon for each Sub-option has been quantified using the UU carbon estimating tool. This tool was developed using the guidance in the UKWIR (2012) Framework for accounting for embodied carbon in water industry assets (12/CL/01/15) and the Bath University Inventory of Carbon & Energy v3.0. The tool contains a database of 'cradle to grave' emissions factors for commonly used construction materials (e.g. aggregates, different forms of cement, mortar and concrete, and materials such as glass steel and timber.) The quantity (volume, length or weight as appropriate) of each material element is multiplied by the emissions factor in the tool to give an estimate of greenhouse gas emissions from the use of that material in the construction of the Sub-option. Given that the SRO is at concept design stage, a number of assumptions have been used in the estimates of quantities, details of which can be found in the Concept Design Reports. The development of the option designs between Gate 1 and Gate 2 has reduced the level of uncertainty in the quantification of carbon, and this will continue to be reduced as we move from concept design to detailed design during Gate 3.

6.4.4 Whole life operational carbon was quantified from estimated emissions from annual operational activities for the whole life term. These include emissions from use of energy including in vehicles (scope 1 and 2) and chemicals (scope 3). Operational emissions can be categorised as fixed or variable. Fixed operational carbon relates to any emission that is independent of the volume of water delivered (e.g. daily impact of keeping a plant operational). Variable operational carbon relates to any carbon proportional to the volume of water delivered (e.g. pumping efforts or chemicals).

6.4.5 UU has a strong track record of playing our part to mitigate climate change and have reduced scope 1 and 2 emissions by over 70% since 2005/06, largely through substantial investment in renewable power generation and green energy procurement. Our ambition and commitments are based on international guidance and climate science and we were delighted in July 2021 that our four near-term science-based targets were verified by the Science Based Targets initiative (SBTi). In October 2021, the remainder of our purchased electricity switched to a

renewable tariff backed by Renewable Energy Guarantees of Origin certificates, meaning that in the future 100% of our purchased electricity will be from renewable sources enabling us to deliver on our carbon pledge and our SBT. The SBTi Net Zero Standard was launched in late 2021 and we have committed to validate our 2050 ambition to this standard when we revise and revalidate our near-term targets in advance of 2025.

6.4.6 As well as our company-specific science-based targets, we share the UK water sector ambition for a defined set of operational emissions to be net zero from 2030 as set out in the Water UK's Net Zero 2030 Routemap. Note that this target has a smaller scope than SBTi and allows use of purchased credits, using agreed offsetting principles consistent with the GHG Management Hierarchy[1]. Water UK's Net Zero 2030 Routemap is 20 years ahead of the UK Government's own legally binding target of 2050 and forms the world's first detailed plan to get an entire industry sector to net zero. We are also actively contributing to the ACWG Carbon Task & Finish Group which is aiming to develop a consistent carbon ambition across all SRO projects.

6.4.7 We have minimised the carbon impacts (and other environmental impact) of the NWT SRO by choosing, where possible, to use or modify existing infrastructure, rather than constructing new pipelines, abstraction boreholes, water treatments works etc. The most significant example of this is using the exiting Vyrnwy Aqueduct pipelines to move water southwards from the source Sub-options, rather than constructing additional pipelines.

6.4.8 There are two key points in the solution design where the carbon emissions resulting from the SRO can be influenced. Firstly during the choice of Full Solution by including the estimated construction and operational carbon emissions in the best value assessment of all of the Sub-options. This has been undertaken in Gate 2 and is described in Section 4.2.

6.4.9 Secondly, now that the Full Solution has been identified there are opportunities to reduce the impact of that solution for instance though the use of lower emission products/materials, efficient use and reuse of resources, and inclusion of opportunities to sequester carbon as part of, or alongside, the SRO (for instance linked to achieving biodiversity net gain). As the SRO moves from concept design to detailed design during Gate 3 these opportunities will be incorporated into the design of the SRO.

6.5 Sub-option environmental assessments

6.5.1 Table 21 summarises the results of the environmental assessments for each Sub-option, using a red, amber, green (RAG) rating to represent the level of risk to the environmental feasibility (and therefore compliance with permitting or regulatory requirements) of each Sub-option. The RAG rating is informed by the environmental assessments listed in Section 6.2, and defined as follows:

- Green: the Gate 2 environmental assessments have identified potential negligible, minor or moderate negative effects which are readily mitigated with standard best practice measures, and pose a minor or negligible risk to the future permitting of the Sub-option.
- Amber: the Gate 2 environmental assessments have identified potential moderate negative effects which may require non-standard bespoke mitigation, or further investigation is required to fully understand the potential impacts or provide sufficient evidence and confidence to meet permitting requirements.
- Red: the Gate 2 environmental assessments have identified potential major negative effects which would be difficult to mitigate or mean that permitting requirements are unlikely to be met.

6.5.2 For most appraisal topics we have identified only minor or negligible negative effects on the environment. For the land use, geology and soils, and the traffic and transport topics we have identified the potential for moderate negative effects due to temporary loss of high grade agricultural land during construction of Sub-options WR076 and WR105a1, and temporary increased traffic movements during construction of eight Sub-options. However these impacts will be readily mitigated through embedded design measures as the Sub-options progress to detailed design, and implementation standard best practice construction and operation methods. These are scored Green in Table 21.

6.5.3 The construction and operation of all the Sub-options will require substantial quantities of construction materials, chemicals, and energy use and the IEA identified a major negative effect on resource use for all but two Sub-options. Due to the nature of the SRO (i.e. construction of new infrastructure and treatment of abstracted water) the use of raw materials cannot be avoided or fully mitigated, but we will adopt measures to reduce raw material

[1] GHG Management Hierarchy, as detailed by the Institute of Environmental Management and Assessment (2020 version), is a framework organisations can use to guide the scoping and strategic planning of their energy and carbon management activities.

and energy use and select sustainable alternatives during detailed design, reducing in the impact where feasible. This topic is scored Green in Table 21.

6.5.4 We have identified that potential moderate effects on water and biodiversity from construction activities will be reduced to minor with the use of appropriate mitigation measures for all Sub-options. With the implementation of BNG, positive biodiversity effects are likely to occur associated with the creation and improvement of habitats. However, further evidence and assessment is required before the potential moderate impacts on water and biodiversity from the operation of the Sub-options can be discounted or appropriate mitigation measures devised, so all Sub-options other than STTA4 are scored Amber in Table 21 for water and biodiversity.

Table 21 - Summary of Sub-option environmental assessments

Ref	Sub-option ID	Name	Capacity (Ml/d)	Status	Population	Health	Biodiversity	Land use, geology, soils	Water	Flood risk	Noise & vibration	Air Quality	Climate Change	Traffic and transport	Resource use and waste	Historic environment	Landscape and visual	Notes
1	STTA4	NWT _ VYRNWY_AQUEDUCT	n/a	Full Solution & WRMP Preferred Plan														- HRA concludes that this Sub-option is unlikely to result in adverse effects on European designated sites. - WFDA concludes the Sub-option is compliant due to the negligible interaction of the enabling works with the water environment. - IEA identifies substantial use of raw materials during construction (building materials), and permanent loss of agricultural land at Oswestry WTW.
2	WR015	SWN _ RIVER IRWELL	40.00	Full Solution & WRMP Preferred Plan														- HRA concludes that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA concludes the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of fish populations. - IEA identifies potentially moderate temporary traffic impacts on the local road network during construction. - IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).
3	WR111	GWE _ WOODFORD	9.00	Full Solution & WRMP Preferred Plan														- HRA concludes that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA concludes the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of surface water bodies, GWDTEs, aquifer water balance and groundwater chemistry. - IEA identifies moderate use of raw materials during construction (building materials).
4	WR113	GWE _ TYTHERINGTON	3.00	Full Solution & WRMP Preferred Plan														- HRA concludes that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA concludes the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of surface water bodies, GWDTE, aquifer water balance and groundwater chemistry. - IEA identifies potentially moderate temporary traffic impacts on the local road network during construction. - IEA identifies moderate use of raw materials during construction (building materials).
5	WR149	ITC _ WIGAN	13.00	Full Solution & WRMP Preferred Plan														- HRA concludes that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA concludes the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of surface water bodies, saline intrusion, aquifer water balance and groundwater chemistry. - IEA identifies potentially moderate temporary traffic and rail impacts on the local networks during construction. '- IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).
6	WR076	SWN _ RIVER BOLLIN	25.00	Full Solution & WRMP Preferred Plan														- HRA concludes that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA concludes the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of fish populations. - IEA identifies loss of greenfield agricultural land. - IEA identifies potentially moderate temporary traffic impacts on the local road network during construction. - IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).

Ref	Sub-option ID	Name	Capacity (Ml/d)	Status	Population	Health	Biodiversity	Land use, geology, soils	Water	Flood risk	Noise & vibration	Air Quality	Climate Change	Traffic and transport	Resource use and waste	Historic environment	Landscape and visual	Notes
7	WR049d	SWN _ RIVER RIBBLE 49d	40.00	Full Solution & WRMP Preferred Plan														- HRA indicates that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - INNS assessment identifies a moderate risk of transfer of INNS (e.g. Zebra mussels) which will require stringent biosecurity measures to mitigate. - WFDA indicates the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of fish populations. - IEA identifies potentially moderate temporary traffic impacts on the local road network during construction. - IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).
8	WR107a2	GWE _ AUGHTON PARK a2	10.00	Full Solution & WRMP Preferred Plan														- HRA indicates that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA indicates the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of surface water bodies, saline intrusion, aquifer water balance and groundwater chemistry. - IEA identifies substantial use of raw materials during construction (building materials).
9	WR102b	GWE _ WIDNES	17.00	Full Solution														- HRA indicates that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA indicates the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of surface water bodies, saline intrusion, aquifer water balance and groundwater chemistry. - IEA identifies potentially moderate temporary traffic impacts on the local road network during construction. - IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).
10	WR107b	GWE _ RANDLES BRIDGE	12.00	Full Solution														- HRA indicates that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA indicates the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of surface water bodies, GWDTEs, and groundwater chemistry. - IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).
11	WR105a1	GWE _ LYMM a1	4.50	Reserve														- HRA indicates that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA indicates the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of GWDTEs, saline intrusion, aquifer water balance and groundwater chemistry. - IEA identifies loss of greenfield agricultural land. - IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).
12	WR106b	GWE _ WALTON _ 2	8.45	Reserve														- HRA indicates that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA indicates the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of surface water bodies, GWDTEs, saline intrusion, aquifer water balance and groundwater chemistry. - IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).

Ref	Sub-option ID	Name	Capacity (Ml/d)	Status	Population	Health	Biodiversity	Land use, geology, soils	Water	Flood risk	Noise & vibration	Air Quality	Climate Change	Traffic and transport	Resource use and waste	Historic environment	Landscape and visual	Notes
13	WR144	SWN _ RIVER TAME	5.00	Reserve														- HRA indicates that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations. - WFDA indicates the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of fish, macroinvertebrate and macrophyte populations. - IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).
14	STT041b**	SWN _ RIVER IRWELL _ ROCH	58.00	Reserve														- HRA indicates that this Sub-option is unlikely to result in adverse effects on European designated sites. Further evidence is required to confirm no detrimental effects of abstraction on riverine habitats and populations.- IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals). - WFDA indicates the Sub-option is potentially non-compliant as further evidence is needed to confirm no deterioration of fish, macroinvertebrate and macrophyte populations. - IEA identifies substantial use of raw materials during construction (building materials) and operation (water treatment chemicals).
	Full Solution	10 Sub-options of the Full Solution	167.00	Full Solution														

6.6 Full solution environmental assessment

6.6.1 We have undertaken a cumulative assessment of the ten Sub-options that comprise the NWT SRO Full Solution. We have considered if the individual environmental effects arising from the Sub-options could combine to create effects that are more significant when more than one Sub-option is constructed or operated at the same time. The Full Solution cumulative assessment uses the same RAG rating as the Sub-option assessments and is presented as the lowermost row in Table 21.

6.6.2 We have identified potential cumulative effects on biodiversity, water, flood risk, air quality, climate change and resource use and waste management, however the combined magnitude of the cumulative effects are not sufficient to increase the RAG scoring. For the other environmental topics, cumulative effects are not anticipated due to the geographic spread of the individual Sub-options.

6.7 In-combination environmental assessment

6.7.1 We have considered the likelihood of in-combination effects arising from the implementation of the NWT SRO Full Solution along with UU plans, other strategic plans, Nationally Significant Infrastructure Projects (NSIPs), and major planning applications. This screening level assessment has identified that significant in-combination effects are unlikely to occur, but this will be considered in more detail as part of the environmental assessments to support planning applications and abstraction licence applications.

6.8 Environmental assessment in Gate 3

6.8.1 We are implementing a programme of environmental surveys and assessments which will meet the requirements of and provide sufficient evidence to support planning applications and abstraction licence applications. These have begun in the late stages of Gate 2 and will continue throughout Gate 3 to gather further evidence to help us to understand the potential environmental impacts of the NWT SRO Sub-options, enable us to demonstrate with confidence that the Full Solution will not have a detrimental impact on the environment, and where necessary design mitigation measures.

6.8.2 The environmental assessment programme for late Gate 2 and Gate 3 comprises:

- The use of two EA Regional Groundwater Models. Regional groundwater models are the best available tool to investigate the impact of groundwater abstractions on aquifers and river flows. The NWT SRO groundwater Sub-options are in aquifers represented by the Lower Mersey Basin Model and the East Cheshire Models which have not been in active use since their development in the early 2000s. We have commissioned a study in Gate 2 to establish the scope of the update required and how the models should be used, which will be progressed in Gate 3, working in partnership with the EA.
- Modelling of river flows using a rainfall runoff model and river water quality models (SAGIS SIMCAT and ICM) to better understand the impacts of the Sub-options on the physical river environment. Calibrated SAGIS SIMCAT models are available from the EA and we are already using these models on other projects. We maintain our own ICM models. We are developing methodologies for the assessment of the NWT SRO Sub-options during late Gate 2 for agreement with the NAU, to progress the modelling early in Gate 3.
- A programme of environmental surveys including river flow, geomorphology, habitats, fish, invertebrate, macrophytes, diatom and phytobenthos surveys beginning in Autumn 2022. We may also undertake groundwater level monitoring and pumping tests of groundwater sources and site specific surveys of designated sites, depending on the outcome of the groundwater model scoping study described above, and the results of the early Gate 3 surveys and assessment work.
- Fully compliant HRA, WFD, NC & BNG and INNS assessments will be required to support applications for new abstraction licences and variations to existing licences, and to support planning applications for new infrastructure.
- We will subject Sub-options where abstraction rates are proposed to increase within existing licenced limits (so new or changed abstraction licences are not required) to the same level of environmental investigation and assessment as the new sources in order to demonstrate that increased abstraction will not cause environmental deterioration or non-compliance.
- Further details of the Gate 3 environmental surveys and assessment are presented in Section 6 and Appendix C of the IEA (NWT-G02-006-007).

6.9 Opportunities, risks and mitigation measures

Risks

6.9.1 A number of environmental risks remain associated with the NWT SRO. All options have been flagged as amber for biodiversity and water in Table 21 which reflects that further investigations and assessment are needed to demonstrate to a sufficient level that the implementation of the NWT SRO will not have detrimental impact on the environment. The Gate 2 HRA and WFD assessments have not identified any Sub-options that are confirmed to be non-compliant with these regulations, but we do not yet have the level of evidence required satisfy the requirements of the Habitats Regulations and the Water Framework Directive. A programme of environmental assessment is planned for Gate 3 (as set out in Section 6.8) which will address these risks.

6.9.2 The Gate 3 assessments (both the environment assessments and those of other workstreams) may indicate that some Sub-options currently selected for the Full Solution are not feasible. If this is the case, one or more of the reserve options will be brought into play so that the NWT SRO as a whole will provide sufficient resilience to customers in the North West when trading is in operation. The reserve options will be subject to the same level of environmental investigation during Gate 3 as the Full Solution Sub-options, allowing them to be transferred to the Full Solution easily should that be required.

6.9.3 Three groundwater Sub-options have been flagged as at risk of requiring licence reductions as part of Environmental Destination (WR111 WOODFORD, WR113 TYTHERINGTON, and WR105a1 GWE_LYMM). There is also the risk that other Sub-options may be identified to be at risk of causing environmental deterioration by the EA in the future. We are mitigating this risk by updating and using the regional groundwater models to establish the sustainability of all the groundwater options now and in the future.

Opportunities

6.9.4 This feasibility statement has necessarily focussed on the potential negative environmental impacts of the NWT SRO, as these are the main influence on the feasibility of the scheme, however there are a range of opportunities and potential benefits that will arise from the SRO.

6.9.5 The fundamental driver for the implementation of the NWT SRO is to improve the resilience of drinking water supply to customers, and to reduce the environmental impact of drinking water abstraction in the South East of England. The design of the NWT SRO will also bring benefits to customers in the North West of England, reducing the frequency of temporary use bans and thereby supporting economic and population growth, and resilience to climate change. In addition, construction of the Sub-options would involve significant capital expenditure which would have socio-economic benefits in terms of generating employment both directly and through the supply chain.

Mitigation measures

6.9.6 Some mitigation measures have already been implemented in the design of the NWT SRO (see Section 3), but as the design is still at the concept level we will incorporate further mitigation measures as required during Gate 3. Environment mitigation measures are set out in Section 4 of the IEA and may include timing of construction activities, designing in-river structures to avoid impacts on geomorphology and habitats, and implementation of nature based solutions to mitigate the impacts of abstraction in a way that is of business and environment benefit.

6.10 Conclusions

6.10.1 Through the Gate 2 environmental assessments we have identified that the key risks posed to the environment by the NWT SRO are associated with the long-term operational impacts of abstracting additional water from rivers and aquifers, and the assessments have focussed on investigating these risks. We have identified the existing data availability and gaps in understanding for each Sub-option, and made progress in filling those gaps through a desk based assessments of each Sub-option.

6.10.2 While some uncertainties and risks remain, our current assessment is that the NWT SRO is environmentally feasible. Further investigation and assessment is required to provide sufficient evidence to comply with the requirements of the Habitats Regulations, Water Framework Directive and other permitting requirements, and we have a programme of investigations in place for Gate 3 and beyond that will do this.

7. Programme and Planning

7.1 Project Plan

7.1.1 We have developed the NWT SRO Project Plan based on our current understanding of the requirements and timescales of the RAPID gated process and the wider WRMP and Regional Planning processes. The draft WRMP requirements have been integrated into our programme. We expect the WRMP requirements to be defined following the initial consultation and finalised on publication of the revised draft WRMP in September 2023. As a result, the programme is subject to change.

7.1.2 A flexible approach is therefore proposed with a Mid-Gate 3 Checkpoint in December 2023 to confirm and adjust the progression of the NWT SRO project, as appropriate, once the WRMP and Regional Plans are finalised.

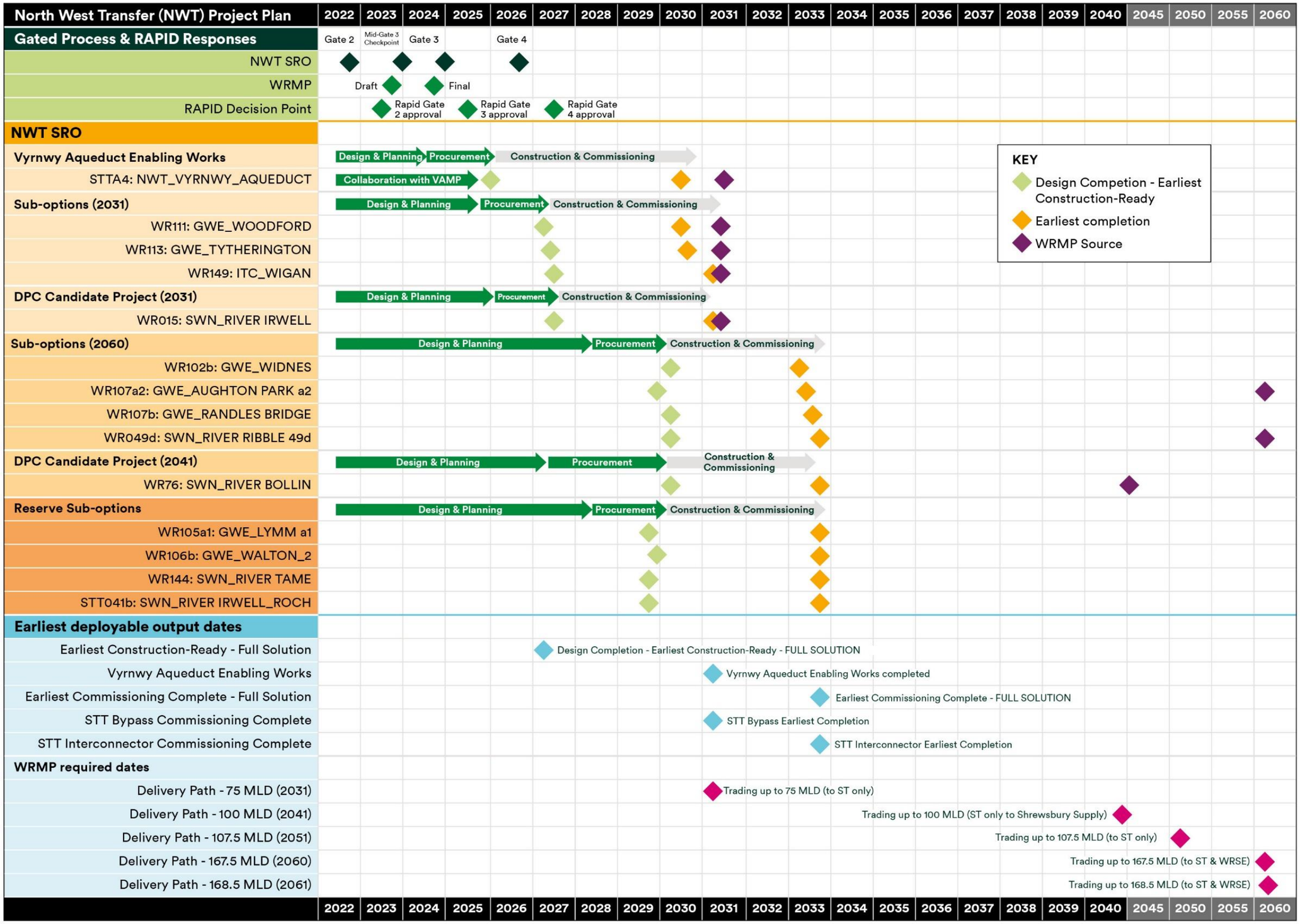
7.1.3 We have identified key milestones and activities associated with delivery of the NWT SRO programme post Gate 2 submission through to Gate 5. This also encompasses the pre-construction activities required to be 'construction ready' in AMP8. All Sub-options and the Vyrnwy Aqueduct Enabling Works have a construction start date within AMP8. The earliest deployable output dates for all Sub-options is shown in Table 19 along with the dates each Sub-option is required by the WRMP. The Full Solution delivery date is by the end of 2033 to align with the completion of the STT SRO Interconnector. However, 75 Ml/d required by the draft WRMP could be available in 2031. It should be noted that there is no quantified schedule risk allowance in this programme and this programme represents an 'earliest available water date'.

7.1.4 The programme below represents the trading required as per the draft WRMP outcome shown in Table 3. The programme also identifies earliest possible delivery dates for Sub-options currently implemented during the later phase works.

7.1.5 For all Sub-options, the main activities during the pre-construction stage will include the detailed design works, environmental and ecological assessments to satisfy the Town and Country Planning preparation needs. Design activities will include: engineering and environmental investigations; drinking water quality sampling; and initial stakeholder engagement. The planning activities will include: preparation and submission of planning applications and Environmental Impact Assessments (EIA) where required. As both of these elements progress through Gate 3 and beyond the associated programme for each Sub-option will be subject to change and this will be communicated to RAPID at regular intervals. Progress of subsequent activities will be monitored and tracked against the baseline schedule.

7.1.6 The construction durations have been provided by SMEs within the Engineering team and are based on high level concept design and are subject to change as the designs mature.

Figure 7 - Project Plan



Critical Activities to Completion

7.1.7 The key activities between Gates 3 and 5 are summarised in Table 22 below:

Table 22 - Activities on Critical Path

Workstream	Activity on Critical Path
Engineering	• Water Quality Sampling & Monitoring – Sampling and Jar Tests • Early Works Information (EWI) Production
Stakeholder Engagement	• Site Investigation / Land Access/ Communication Plan / Stakeholder Engagement Plan • Screening Opinion – Local Planning Authorities / Statutory Consultees • Pre-Planning Application Phase 1 – Stakeholder / Public Consultation Begins • Stakeholder / Public Consultation Feedback Review (Feed into Internal Design)
Environment	• Gate 3 Environmental Feasibility Statement • Abstraction Licence Application & Assessment • Planning Application Determination
Water Quality	• Testing of water quality (1 - 2 years)
Procurement	• RFP Preparation & UU Approvals • Tender Issue / Bid Return / Tender Review • Recommended Bidder / Negotiations / UU Approvals
Implementation (Post Contract Award)	• Ecological enabling works • Construction and Commissioning

7.1.8 The assumptions and dependencies within our programme are outlined in Table 23 and Table 24 below:

Table 23 – Key Assumptions

Assumptions	Description for each Workstream
Stakeholder Management	The stakeholder management plan will address stakeholder concerns to enable timely and successful delivery of planning consents.
Procurement and Implementation	Construction contracts will be awarded through UU frameworks although candidate projects will be subject to a DPC process (see Section 7.5 for outcome of DPC assessment) Two Sub-options (WR076 SWN_RIVER BOLLIN and WR015 SWN_RIVER IRWELL) would be delivered through a DPC procurement route. Construction and Commissioning duration assumed as 720 Days for Groundwater Sub-options and 960 Days for the Surface Water Sub-options.
Programme	Onward transmission of water provided by the NWT SRO is facilitated by other SROs, especially in relation to supplying water to the South East. NWT SRO is selected in both WRW and WRSE Regional Plans. The Full Solution satisfies the requirements of the UU Water Trading Principles.
Engineering	There are sufficient viable Sub-options to maintain supply resilience in the UU operating region. Available yields from groundwater and river Sub-options are based on the permitted abstraction limits set by the EA. However, confirmation of yields will be undertaken as part of the survey investigations and data gathering to be undertaken as part of the Engineering design works. The NWT solution would be required to support a transfer of up to 205 Ml/d from the Vyrnwy system for up to 15% of the time over a long-term average (maximum continuous trade duration of approximately 250 days).
Environmental & Planning	Environmental and water quality impacts which may emerge following on site assessments can be mitigated to enable support from environmental regulators and achievement of planning consents. Sub-options of the Full Solution would be consented under the Town and Country Planning regime. Abstraction Licence permits would be granted EIA activities are assumed to be 18 months in duration

Table 24 – Key Dependencies

Dependencies	Description
Trading Volumes for other regions	The NWT SRO will be delivered to enable out of region transfers. If the water is required in the South East, the NWT SRO has a dependency on the STT SRO.
WRMP	The NWT SRO needs to be selected in the relevant Regional Plans and WRMPs. Future water resource needs are dependent on numerous factors covered within the WRMP's including the delivery of leakage and demand management outcomes and accuracy of climate and population forecasts.
Regulatory decisions	Regulator decisions at Gates 2, 3 and 4 to obtain approval to continue with SRO. Legal, commercial and operational frameworks are sufficiently developed to support commitment to progress trading projects beyond Gate 3. Funding for AMP8 delivery requirements is provided through PR24 ahead of Gate 3. Environmental permitting is carried out in a timely manner.
STT SRO – Vyrnwy Bypass	Transfers greater than 25 Ml/d are dependent upon the proposed Vyrnwy bypass pipeline being operational (STT SRO scope).
VAMP	Current UU capital scheme to clean and line the Vyrnwy Aqueduct needs to be completed ahead of December 2028 to facilitate trading.

Dependencies	Description
UU Outages	All works to be integrated with the planned UU outages associated with the AMP8 capital programme.

7.2 Planning and Consenting Route Strategy

Summary

7.2.1 At Gate 1 our planning strategy identified the potential for the Cow Green and Kielder Reservoir options to be consented via the development consent order (DCO) route. If taken forward, Kielder (now referred to as the WR812c: Third Party 22 Sub-option) would be progressed by way of separate SRO and is not considered further. We consider that the most appropriate consenting strategy for the remaining Sub-options and the Vyrnwy Aqueduct Enabling Works would be pursuing consents under the Town and Country Planning Act 1990 (TCPA 1990), either under permitted development rights or express planning permissions or most likely a combination of the two. None are considered to be of such a scale or complexity to justify a s35 direction under the Planning Act 2008.

Work done to date to support the proposed land and planning process

7.2.2 For Gate 2, desktop planning assessments in Section 13, NWT-G02-007-001 to 14 have been undertaken for all the Sub–Options and the Vyrnwy Aqueduct Enabling Works. These have been produced using our internal constraints assessment layer on GIS supported by our site and locational knowledge and experience of developing projects of a similar nature. They have identified potential consent requirements, planning and environmental constraints, planning risks (including those around environmental impact assessment (EIA) requirements). Indicative timeframes have been built into the programmes for Gate 3 onwards. In addition discussions have been held with the planning lead of the STT SRO to ensure consistency with their approach to consenting.

Preferred planning route and key steps

7.2.3 The Gate 2 submission for the STT SRO confirms that the other SROs including the NWT SRO that make up the STT system are physically distinct and separate schemes and do not need to be consented by the proposed DCO for the interconnector.

7.2.4 None of the Sub–options, or the Vyrnwy Aqueduct Enabling Works, meet the threshold criteria for a NSIP and at this stage no proposals are considered to be of sufficient scale or complexity to qualify as nationally significant and therefore justify UU seeking a s35 direction under the Planning Act 2008. All Sub-options and the Vyrnwy Aqueduct Enabling Works are proposed at this stage to be consented via planning permissions under the TCPA 1990.

7.2.5 All proposals would need to be screened as to the requirement for EIA, with those requiring new Water Treatment Works and/or substantial lengths of long distance pipeline most likely to require EIA. Where EIA is required, those Sub-options would need to be consented by way of express planning permissions from the local planning authority. For those not requiring EIA some elements of the development would be covered by deemed planning permission, or 'permitted development rights' under the Town and Country Planning (General Permitted Development) (England) Order 2015. It is possible that the WR107b: Randles Bridge and WR107a2: Aughton Park and Moss End Sub-options would be viewed as one development for the purposes of the EIA regulations.

7.2.6 Stakeholder engagement with Local Planning Authorities and key consultees such as the EA and Natural England would further inform information and design requirements. Stakeholder engagement plans are to be developed for each individual Sub-option with required delivery timeframes critical to understanding the messaging and prioritisation for this.

7.2.7 It is likely that our existing planning and environmental framework contractors would be engaged to produce the planning and consenting deliverables including the EIA work. Resources would be procured when timeframes for the development of the Sub-options are understood.

Strategy for obtaining other regulatory consents

7.2.8 At this early stage of design the details of other regulatory consents for each Sub-option have not been finalised but for the purposes of Gate 2 the preliminary desktop planning assessments have identified other consents that are likely to be required. Timescales have been built into the preliminary programmes. Further design work will identify the detailed regulatory consent requirements many of which are related to the construction process.

7.2.9 The five new river source Sub-options and one new groundwater source Sub-option will require new abstraction licences. One groundwater Sub-option will require a variation of an existing abstraction licence, and six

groundwater Sub-options will operate within current conditions/limits on existing licences, further information can be found in Section 13, NWT-G02-006-001&2. Our Gate 2 environmental investigations (see Section 6) will form the basis of the more detailed Gate 3 investigations which will inform the abstraction licence application process, or the need to demonstrate that abstraction on existing licences can be increased without causing environmental deterioration. The Gate 2 environmental investigations have identified potential risks to the environment which require further investigation or mitigation during Gate 3.

The land lifecycle

7.2.10 The approach to land referencing, arranging access where required for surveys and landowner input into the design development will be incorporated into the wider stakeholder engagement plans to ensure consistency of message. Timeframes will vary from Sub-option to Sub-option dependent on delivery priorities. Land referencing is now underway via our framework contractors such that ecological surveys and site investigations can begin to support the early Gate 3 activities.

7.2.11 At this stage it is assumed that the acquisition of all interests in land would be agreed through negotiation, with access for survey work and laying pipelines secured through Water Industry Act powers where required.

Ensuring a good experience for customers

7.2.12 Securing planning approval relies on timely and effective customer consultation, to ensure that they are fully informed and are able to have their say in the development of schemes. A Stakeholder Manager has been assigned to the NWT SRO and will develop stakeholder engagement plans for the programme of works. Our approach will build on that successfully undertaken on previous capital projects such as West Cumbria Supplies and the Haweswater Aqueduct Resilience Programme (HARP). This will include for engagement with statutory agencies, highway authorities, local planning authorities, parish councils, community groups and customers, through meetings, public and virtual exhibitions and social media etc. (see Section 9).

Managing planning and land risks

7.2.13 There is confidence at this stage that each of the Sub-options and the Vyrnwy Aqueduct enabling works can be developed to secure land access, planning permission and all other required consents. Desk top assessment, supported by our own knowledge of sites, communities and stakeholders, have been carried out, although consultation with stakeholders and customers and discussions with landowners have yet to get underway. Key risks and mitigation are identified in Table 25 below.

Table 25 – Key Planning Risks & Mitigation

Key risk	Mitigation
Express planning permissions from the local planning authorities would be needed – this carries the risk of delays, inconsistency of handling, the risk of refusal and lack of appropriate resources.	Engage with the local planning authorities during pre-application including entering into, for example, Planning Performance Agreements (PPAs) (to ensure suitable and adequate resource can be deployed to deal with the applications). Enter into similar agreements with NE, EA, Highway Authorities to secure appropriate inputs. Applications need to be supported by suitable pre-application consultation and engagement with the public and key statutory stakeholders.
There will be multiple decision-makers across all Sub-options comprising the SRO.	Engage with the local planning authorities and other regulators and ensure consistency of approach in submissions. Where possible "join up" external stakeholders. This will help avoid any inconsistencies.
Refusal of planning application/Landowners unwilling to sell land.	Engagement with key stakeholders to ensure the planning application (including any necessary mitigation) is fully-formed, to limit scope of contentious matters and ensure objections limited as far as possible. Engagement with landowners and where practicable building their views into the designs. Consider use of CPO powers if needed.
Onerous conditions or requirements attached to a planning permission, which could limit development or impede implementation.	Engage with the local planning authorities and ensure submissions have sufficient detail of proposed mitigation articulated to provide for adaptive approaches.
Sub options on the reserve list if brought forward may impact on the consenting strategy leading to delays.	Keep reserve list under review and where practicable allow for flexibility in design to deal with any change.
Changes to planning policy or legislation e.g. through the Levelling Up and Regeneration Bill or through the local planning process	Identify any relevant changes, confirm impacts and build in any requirements to processes and programmes.
Changes to the Sub-options or thresholds within the Planning Act 2008 which would dictate that consent by DCO is required	Identify any relevant changes, confirm impacts and build in any requirements to processes and programmes.
Works trigger EIA thresholds, meaning permitted development rights may not be available for certain works and planning decisions will take longer.	Early consideration of EIA issues as part of scheme development. Engagement with local planning authorities and statutory environmental bodies to conclude optimal strategy – obtaining legal advice at key stages to

Key risk	Mitigation
	test robustness of approach and consideration and use of EIA screening as appropriate.
Legal challenges to consenting decisions.	Proactively obtain legal advice at all stages of the development, to ensure applications are robust.

7.3 Key risks and mitigations measures

7.3.1 We have developed and maintained a RAID (Risks, Actions, Issues, and Decisions) log from the inception of this project. All workstream leads assess their risks with the Risk Manager monthly and this is reviewed, monitored, and shared monthly to the NWT SRO Project Management Board. The review and governance process ensures proposed mitigation actions remain effective.

7.3.2 The risks and mitigation measures contained within this submission are consistent with those reported in the Quarterly Dashboards issued to RAPID as they are based on the same source data from our RAID log.

7.3.3 We have detailed the key risks and associated mitigation measures for the NWT SRO in Table 26.

Table 26 - Key Programme Risks and Mitigation Measures

Reference	Short description name / Trend	Pre-mitigation impact	Summary Description including plan to manage	Post-mitigation impact
R121	**Commodity Pricing Risk** Trend: Increasing	**Red**	**Risk:** The prices/costs quoted for the proposed solution may increase as a result of upward pressure on commodity prices which have not yet been reflected in the cost estimates. **Mitigation:** Working with the ACWG to ensure consistency for option comparison and submission of revised pricing in early 2023 for the Regional Reconciliation process.	**Amber**
R156	**Abstraction Licences** Trend: Steady	**Red**	**Risk:** There is a risk that the EA cap existing abstraction licences and/or do not approve new licences thereby restricting the available Sub-options for trading. **Mitigation:** Early engagement with EA and NAU. Utilisation of the pre-application process and timely submission of information. Continued development and introduction of reserve Sub-options.	**Amber**
R167	**Evolving Environmental Regulation** Trend: Steady	**Amber**	**Risk:** Environmental Regulatory requirements evolve during the lifecycle of the programme impacting the viability and selection of Sub-options to support the NWT SRO. **Mitigation:** Proactive liaison with Environmental Regulators and potential introduction of reserve Sub-options.	**Amber**
R193	**NWT Water Requirement** Trend: Decreasing	**Amber**	**Risk:** There is reduced or delayed requirement for NWT SRO in the November 2023 Draft WRMP or Regional Plans. This would require our current programme to be reviewed. **Mitigation**: Engagement with WRMP, Regional Planning processes and RAPID.	**Amber**
R102	**Vyrnwy Aqueduct Operational Impacts** Trend: Steady	**Amber**	**Risk:** There is a risk that the changing over of bulk supply points from a gravity to a pumped system during water trading, could generate changes in pressure and/or water quality impacts. **Mitigation:** Further modelling and design to mitigate the risks associated with switching between current and trading operations.	**Green**
R126	**Environmental Outputs Delayed** Trend: Steady	**Amber**	**Risk:** Due to seasonal and resourcing constraints we cannot capture the data required to achieve the outcomes required by the environmental regulators for Gate 3. **Mitigation:** Early engagement with Environmental Regulators to agree an environmental programme and timely procurement of services.	**Green**
R180	**Groundwater Modelling Results** Trend: Steady	**Amber**	**Risk:** Groundwater modelling identifies significant issues with some groundwater sources impacting the viability and selection of Sub-options to support the NWT SRO. **Mitigation:** Ground water balance calculations are taking place for the end of Gate 2 and further Ground water modelling during Gate 3.	**Green**
R183	**Trading Delay** Trend: Steady	**Amber**	**Risk:** The implementation of the current delivery programme for trading with STW in 2031 may be delayed due to readiness of the solution. **Mitigation:** Liaising with STW, Regulators and other stakeholders to manage any risks to the timescales ensuring the overall programme delivers options on time.	**Green**
R081	**Customer Acceptability** Trend: Steady	**Amber**	**Risk:** There is a risk that customer will not accept changes to their water source to facilitate trading. This could lead to increased customer contacts, resulting in regulatory penalties and reputational damage to UU. **Mitigation:** Further customer acceptability research, network modelling and process design to mitigate the impact of any changes in supply.	**Green**

7.3.4 The RAID Log is a live document which will continually evolve as the NWT SRO matures. During Gate 3 we will be able to provide an estimated Expected Monetary Value (EMV) based on the live data. This is based on the severity of the risk probability and impact, we will then apply a percentage of the CAPEX and indirect costs for the whole programme to show the EMV and the factored risk cost.

7.3.5 As the NWT SRO progresses and the cost model is refined we will have identified the Sub-options that will be selected by the WRMP, this will enable us to develop the costed risk picture and at that stage will be able to provide a Quantitative Costed Risk Assessment for the NWT SRO.

7.4 Proposed Gate 3 activities and outcomes

7.4.1 Advance works for Gate 3 have been endorsed by RAPID for the following activities:

- Groundwater modelling - Preparation for the update of two regional groundwater models (Lower Mersey Basin (LMB) and East Cheshire (EC) aquifers) during Gate 3. Includes scoping study to establish the technical scope, cost and programme of the groundwater modelling and a preliminary update of groundwater balance calculations to give us more confidence in the feasibility of the groundwater Sub-options prior to the completion of the Gate 3 groundwater modelling (anticipated to be summer 2023).
- MISER Modelling - Understand the future utilisation of existing and proposed new sources within UU's Integrated Regional Supply Zone and how water will blend within the system (potential impact on customer acceptability).
- Ecology Survey - Early commencement of environmental surveys, including hydrology and ecology surveys of river options to ensure we have sufficient length of data collection to inform the EIA for planning and abstraction licence applications which need to be ready by the end of Gate 3 (December 2024).
- Borehole Water Investigations - Surveys to investigate the integrity of borehole linings, sample water quality and confirm potential yields.
- Land referencing - Identification of land owners and tenants affected by the proposed works to enable commencement of surveys and sampling identified above.
- Vyrnwy Aqueduct Enabling Works detailed design - Confirmation of scope requirements for construction phase, validation of design parameters and reduction of risk profile.

7.4.2 Further to the above, during Gate 3 the following works will be progressed providing the outcomes identified below:

Table 27 - Proposed Gate 3 Activities and Outcomes

Workstream	Gate 3 Activities	Outcomes
Engineering	• Development of the solution • Water Quality Sampling & Monitoring • Borehole investigation • Civil, M&E & Process Design • Site investigation • Cost Estimating • Risk identification and estimation	• A single defined scalable solution • Confirmation the water quality is treatable • Confirmation of capacity and quality of water • Development of design for Planning • Confirmation of ground conditions • Greater cost certainty of the Solution • Developed QCRA • Design developed for Planning Application
UU System	• Modelling of UU distribution system	• Ensuring compatibility of Full Solution and individual Sub-options with existing UU distribution system
Water Resources	• STT Model development and integration • Review of NWT SRO Sub-options with field data and WRMP	• Improved understanding of the how the NWT SRO will interact with the STT SRO • Confirmation of the Sub-options to be progressed by the NWT SRO • Narrowed down solution to a firm single, potentially scalable, option included in final regional plans and WRMPs
Stakeholder Engagement	• Stakeholder engagement for those affected by the solution • Public Consultation	• De-risking the Planning application through early engagement

Workstream	Gate 3 Activities	Outcomes
		• Pre-planning application consultation progressed
Ecology	• Field surveys and assessments	• Informing the Environmental workstream • Informing the Engineering workstream • Informing the Planning Screening Opinion • Data for the EIA (if required).
Environment	• Ground water modelling • SAGIS water quality modelling • Gate 3 Environmental Feasibility Statement • Environmental permit preparation • Abstraction Licence Application preparation	• Confirmation that groundwater is available • Informing abstraction licence application • Assessment of field data and implications on Sub-option viability • A programme of works, agreed with environmental regulators, to address any remaining significant risks. • Adequate temporal and spatial evidence to assess the risk of the solution on the environment • Gathering information and liaising with regulators for environmental permit and abstraction licence application
Planning	• Planning Screening Opinion • Planning Application preparation	• Confirmation of EIA requirement for sub-options • Readiness for Planning Application submission • Non-statutory planning consultations • Stakeholder engagement is underway • Confirmation of preferred site(s) • Understanding of impact on cost estimates • Updated land and planning strategy • Breakdown of estimated costs for acquisition of land rights and compensation
Water Quality	• Water quality sampling • Customer engagement for changing water source	• Updated DWSP's for Sub-options • Hazards and risks (including emerging contaminants) identified, mitigation considered and costed • Well- developed and progressed customer engagement • Identification of any elements of the treatment design which may require Regulation 31 approval
Programme and Procurement	• DPC assessment against revised criteria • Preferred procurement route/procedure identified • Procurement and commercial strategy completed • Early market engagement • Initial draft Heads of Terms developed • Optimism Bias updated • Efficient expenditure	• Updated DPC strategy • Clarity around commercial trading agreements (e.g. level of service) • Recommended procurement strategy for each Sub-option (or group of Sub-options). • If DPC is applied then: Delivery of DPC Stages 1 & 2.
Access and Acquisitions	• Identification of Land Owners • Serving notices for land access • Confirmation of preferred site(s) and understanding of impact on cost estimates	• Assisting the Planning application and field assessments • Improved accuracy of cost estimates

7.5 Procurement ownership and operation strategy

7.5.1 In partnership with independent consultants, we have assessed the scheme's suitability for Direct Procurement for Customers (DPC) and outlined a preferred procurement strategy. UU are pioneers in application of the DPC approach

through the Haweswater Aqueduct Resilience Programme (HARP), and are familiar with the practicalities associated with this route.

DPC Assessment

7.5.2 In line with RAPID guidance, DPC assessments have been undertaken using the PR19 criteria developed by KPMG on behalf of Ofwat. The outcome of these assessments are summarised in Table 28 below.

Table 28 – DPC Assessment

	PR19 DPC Criteria Assessment						UU Procurement Strategy Assessment		
Sub-option	**Project Size**	**Stakeholder interactions and statutory obligations**	**Interactions with the network**	**Contributions to supply/ capacity and ability to specify outputs**	**Asset and operational failures**	**'Somewhat Suitable' for DPC?**	**Delivery Route Allocation Process (DRAP)**	**Market Engagement Methodology (MEM) Indicative Primary Procurement Route(s)**	**Market Engagement Methodology (MEM) Indicative Secondary Procurement Route(s)**
STTA4 NWT_VYRNWY_AQUEDUCT	✓	✗	✗	✗	✓	No	Not Applicable	Strategic Relationship	Design, Build, Operate & Maintain / Build Own Operate / Design & Build / Framework
WR015 SWN_RIVER IRWELL	✓	✓	✓	✗	✓	Yes	Not Applicable	Design, Build, Operate & Maintain/Build Own Operate	Strategic Relationship
WR111 GWE_WOODFORD	✗	✓	✗	✓	✗	No	Capital Delivery Partner / Managed Service Provider	Aggregated Call-Off	Spot Buy
WR113 GWE_TYTHERINGTON	✗	✓	✗	✓	✗	No	Managed Service Provider	Aggregated Call-Off	Spot Buy
WR149 ITC_WIGAN	✗	✓	✗	✓	✗	No	Capital Delivery Partner	Aggregated Call-Off	Spot Buy
WR076 SWN_RIVER BOLLIN	✓	✓	✓	✓	✓	Yes	Not Applicable	Strategic Relation ship	Build Own Operate / Design, Build, Operate & Maintain / Aggregated Call-Off
WR049d SWN_RIVER RIBBLE 49d	✓	✓	✗	✓	✗	No	Competitive Tender	Strategic Relationship	Aggregated Call-Off / Joint Full Specification / Operate & Maintain
WR107a2 GWE_AUGHTON PARK a2	✗	✓	✗	✓	✗	No	Capital Delivery Partner / Network Maintenance Services	Aggregated Call-Off	Spot Buy
WR102b GWE_WIDNES	✗	✓	✗	✓	✗	No	Capital Delivery Partner	Aggregated Call-Off	Spot Buy
WR107b GWE_RANDLES BRIDGE	✗	✓	✗	✓	✗	No	Capital Delivery Partner / Managed Service Provider	Aggregated Call-Off	Spot Buy
WR105a1 GWE_LYMM a1	✗	✓	✗	✓	✗	No	Capital Delivery Partner / Network Maintenance Services	Aggregated Call-Off	Spot Buy
WR106b GWE_WALTON_2	✗	✓	✗	✓	✗	No	Capital Delivery Partner / Managed Service Provider	Aggregated Call-Off	Spot Buy

	PR19 DPC Criteria Assessment						UU Procurement Strategy Assessment		
WR144 SWN_RIVER TAME	✗	✓	✗	✓	✗	No	Capital Delivery Partner	Strategic Relationship / Aggregated Call-Off	Joint Specification / Operate & Maintain / Spot Buy / Project Partnering
STT041b SWN_RIVER IRWELL_ROCH	✓	✓	✓	✗	✓	Yes	Not Applicable	Design, Build, Operate & Maintain / Build Own Operate	Strategic Relationship

Key: ✓ "somewhat suitable for DPC" ✗ "somewhat less suitable for DPC"

7.5.3 For those Sub-options considered "somewhat less suitable for DPC" on the basis of project discreteness, we undertook further assessment to establish whether discrete elements of scope within each Sub-option could be aggregated together to create a package of work which achieved the DPC criteria. This assessment determined that these aggregated elements not only fell below the project size threshold, but also that the package contained a large number of low value works, spread over a large geographic region, and potentially delivered over different timeframes. For these reasons, this package was not considered practical nor viable for DPC delivery, however this assessment will be revisited during Gate 3 when further design and programme definition will be available.

7.5.4 The Vyrnwy Aqueduct Enabling Works have also been assessed as "somewhat less suitable for DPC" as the solution requires significant and frequent interactions with existing UU infrastructure which directly supplies customers and is required to maintain our statutory duties.

7.5.5 Sub-options deemed 'somewhat suitable' for DPC were further assessed against Early/Late/Very Late/Split tender models. Our current assessment is that a "Late" model is most appropriate with the SRO gated process delivering the initial design, survey, planning and consent activities prior to engagement with the market for the detailed design and delivery phases.

7.5.6 Additionally, these Sub-options were also considered for the application of a "licensing model" under the Water Industry (Specified Infrastructure Projects) (English Undertakers) Regulations 2013 (SIPR). None of the Sub-options met the criterion of "the infrastructure project is of a size or complexity that threatens the incumbent undertaker's ability to provide services for its customers". On this basis SIPR has been discounted.

7.5.7 Finally, we are aware of the recent PR24 methodology consultation on DPC criteria. We do not anticipate that the proposed increase in financial threshold of £200m Totex would affect our current outcomes, however potential changes to technical criteria – such as project discreteness - may have a material impact. This will be assessed in Gate 3 following the publication of the final PR24 methodology.

Procurement Strategy

7.5.8 We have utilised our proprietary procurement tool, the Market Engagement Methodology (MEM), which takes 17 commercial approaches to create a funnel of possible contracting methods, providing primary and secondary routes to be considered for each Sub-option as illustrated in Table 28. These options will be refined further to a preferred approach during Gate 3.

7.5.9 It should be noted that the MEM assessment does not take into account the individual project discreteness of each Sub-option. Therefore, we have taken a blended approach to assessment by forming conclusions based on a combination of the DPC discreteness criteria and the MEM commercial output.

7.5.10 For those Sub-options assessed as 'somewhat less suitable for DPC', and therefore to be supplied through a traditional capital delivery route, we have applied our proprietary Delivery Route Allocation Process (DRAP). This is a standardised methodology used to select the delivery path which enables us to achieve the best time, cost and quality outcomes for capital projects. The outcome of the initial DRAP assessment can be viewed in Table 28.

7.5.11 Due to the diverse nature of the potential procurement routes for each Sub-option within our solution we are proposing a blended commercial approach that will be refined in Gate 3.

7.5.12 In respect to the operating arrangements we are actively engaged with the STT SRO in development of a co-ordinated commercial and operational model for the wider STT 'system' which is further explained in the STT SRO Gate 2 document.

7.5.13 Following more detailed designs and confirmed delivery programme during Gate 3 we will undertake value for money assessments; develop detailed procurement plans; and capture associated risks and issues related to each Sub-option.

8. Solution Costs and Benefits

8.1.1 Capital Expenditure (Capex) and Operational Expenditure (Opex) for the UU Sources and Vyrnwy Aqueduct Enabling Works elements of the NWT SRO are presented in Table 29 & *Table updated 10/03/2023

8.1.2 Table 30Table 30 below. Costs of additional works to facilitate the onward transfer of water from the NWT SRO for use in other regions are detailed in the STT SRO Gate 2 document.

8.1.3 Capex costs were generated using UUs cost database and is consistent with the approach used at Gate 1. Costs were produced in accordance with the ACWG sponsored Cost Consistency Methodology Revision E. All costs are presented at 2020/2021 prices. Gate 2 cost estimates include a tender to outturn cost uplift figure, pending completion of Quantified Costed Risk Assessment in Gate 3. The tender to outturn costs represent the historical average variance between contract award values and project outturn costs.

8.1.4 Optimism Bias was derived using the approach prescribed in the Cost Consistency Methodology Revision E.

8.1.5 Opex costs were generated for each option. Opex includes power, chemicals, and an allowance for operational maintenance. Opex costs are presented with a fixed and variable component. Fixed Opex relates to work that is required to operate the system for all flows and the variable Opex relates to power and chemical usage. Opex has been calculated using the maximum option capacity. Cape, Opex, NPV and AIC are summarised in Table 29 & Table 30

Table 29* – Base Estimated Costs (FY 2020/2021 price base)

	Units	UU Sources Gate 1	UU Sources Gate 2	% Change	Vyrnwy Enabling Works Gate 1	Vyrnwy Enabling Works Gate 2	% Change	Gate 2 Full Solution Total
Capacity	Ml/d	113.00	167.00	48%	180.00	205.00	14%	
CAPEX								
Base Capex (includes risk)	£M	255.39	534.07	109%	140.75	144.87	3%	678.94
Risk (Tender to Outurn)	£M	7.23	15.53	113%	3.82	9.54	150%	25.08
Optimism Bias (OB)	£M	58.74	145.31	147%	38.00	28.19	-26%	
Total Capex (including risk + OB)	£M	314.14	679.38	116%	178.75	173.07	-3%	852.45
OPEX								
Fixed	£M/ annum	0.72	1.24	73%	0.21	0.32	52%	1.56
Variable	£/Ml	77.62	175.58	126%	65.61	4.31	-93%	179.89

*Table updated 10/03/2023

Table 30* - Net Present Value and Average Incremental Costs (FY 2020/2021 price base)

	Units	UU Sources Gate 2	Vyrnwy Enabling Works Gate 2	Gate 2 Full Solution Total
Capacity	Ml/d	168.00	205.00	205.00
Total planning period option benefit (NPV)	Ml	268,267	240,362	508,629
Total planning period indicative capital cost of option (CAPEX NPV)	£M	791.08	217.08	1,008.16
Total planning period indicative operating cost of option (OPEX NPV)	£M	68.07	7.88	75.96
Total planning period indicative option cost (NPV)	£M	859.16	224.96	1,084.12
Average Incremental Cost (AIC)	p/m³	372.79	94.00	466.79

*Table updated 10/03/2023

Notes:

- Costs are discounted over an assumed planning period of 80 years
- AIC values have been derived separately for each individual UU Sources sub-option and VA Enabling works elements of the NWT Full Solution. The aggregated AIC values stated for the UU Sources and the Gate 2 Full Solution have been estimated by weighted average, based on sub-option capacity.

8.1.6 The Gate 2 cost estimates have been externally validated using best practice benchmarking methodologies adopted from the Royal Institute of Chartered Surveyors and Infrastructure Projects Authority. Costs were benchmarked against the historical performance of peer companies to enhance the confidence in solution

deliverability. The benchmarking exercise concluded that the UU estimate is <10% below the median industry position.

8.1.7 As highlighted in Section 3 there have been significant changes to the NWT SRO solution since Gate 1 including an increase in the overall option benefit to 205 Ml/d and therefore it is not possible to directly compare costs.

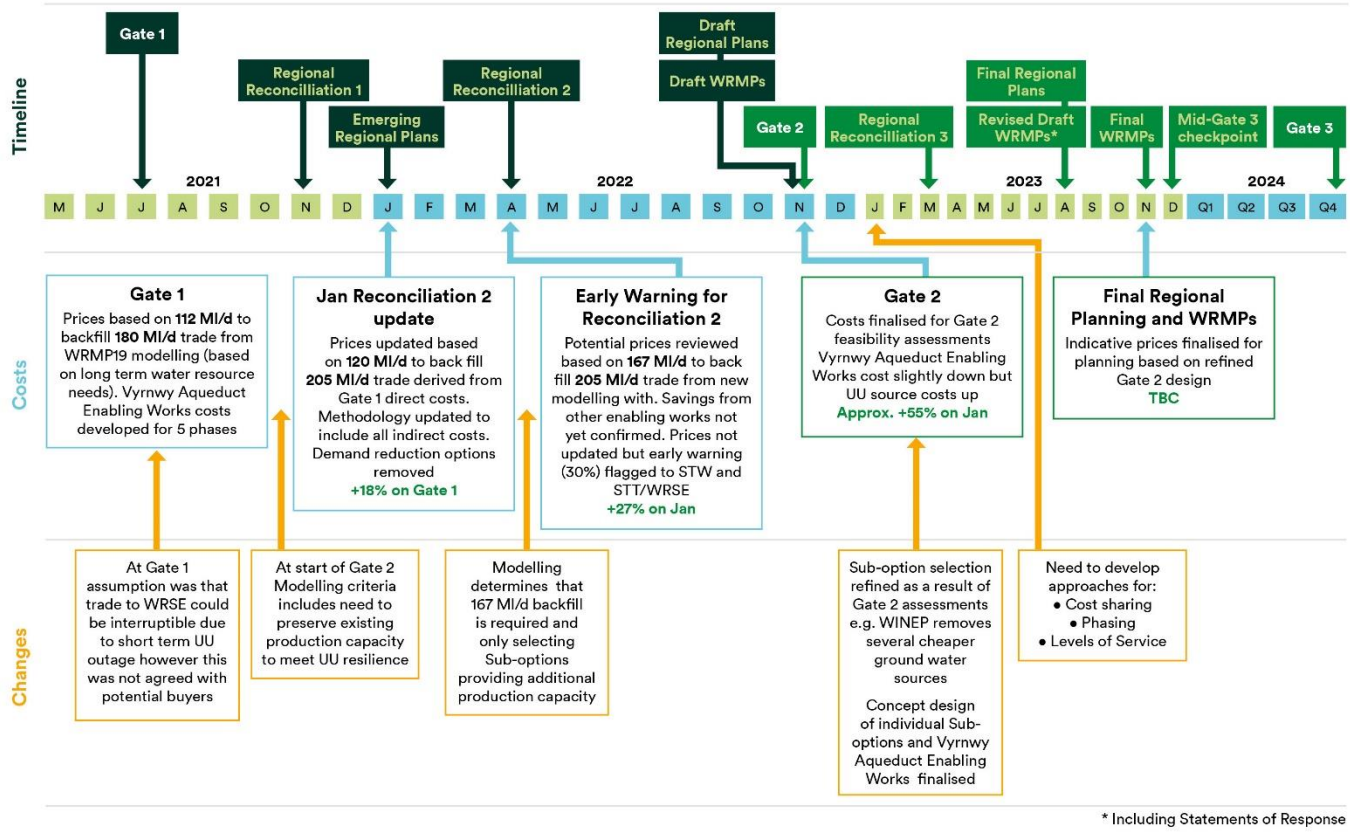
8.1.8 It should be noted that there has been a significant increase in UU sources costs as both the amount of source capacity and nature of the new sources has changed since Gate 1 due to the following reasons:

- The overall solution trade capacity has increased from 180 Ml/d to 205 Ml/d.
- The capacity of back fill sources required has increased to 167 Ml/d as a result of more developed water resources modelling.
- Many of the Sub-options have changed with only four Sub-options that have been consistently selected in the Full Solution portfolio at both Gate 1 and Gate 2. Several of the Sub-options identified at Gate 1 are no longer available having either been deemed infeasible or did not provide additional treatment capacity to contribute towards the short-term resilience of UU's system. Therefore alternative options were selected to match the deployable output requirements in line with water resource modelling.
- More detailed engineering work at Gate 2 has revealed additional scope because of changes or factors previously unidentified. In particular, additional hydraulic, geotechnical, and geo-environmental assessments have been included in Gate 2 designs which have increased the level of accuracy in the designs and in turn have identified additional items of scope.

8.1.9 The Vyrnwy Aqueduct Enabling Works costs have remained stable since Gate 1 despite the increase in overall solution capacity. This is a result of more detailed engineering design work and collaboration with existing UU capital projects revealing opportunities to reduce scope items.

8.1.10 Due to the cost factors outlined in paragraphs 8.1.5 and 8.1.6, we have provided updated indicative pricing to WRSE and impacted buying companies (primarily STW) to inform the regional reconciliation process. Revised prices were submitted in January 2022 and an early warning was submitted in April 2022 to propose a pricing sensitivity factor of +/- 30% be applied to ensure a range of financial outcomes could be modelled. We are committed to provide further updated price information in Spring 2023 to feed into the final regional reconciliation process and revised draft WRMPs. Figure 8 illustrates the timeline of cost impacts and associated pricing revisions.

Figure 8 - Timeline of NWT SRO Costs and Prices



8.1.11 As highlighted in Section 4 there is potential for customers in the North West to benefit from increased resilience in the short term from the proposed new transfer sources and therefore it might be appropriate that a proportion of the costs be met by UU during that period. This could result in a slight net reduction in trading prices to importing companies and therefore may need to be factored into the next round of price updates.

8.1.12 One of the main benefits of the NWT SRO is its scalability, however, to avoid the complexity of generating bottom-up costs for multiple different transfer scenarios we have used the costs of the Full Solution (205 Ml/d) for the NWT SRO to generate indicative prices to potential buyers for various trade volumes based on the average cost per Ml/d. The current preferred regional plan does not maximise utilisation of the NWT SRO Full Solution and the amount used is scaled up over the course of the planning horizon. We will need to take into account the timing and overall long term capacity needed from the project as we refine solution design, costs and prices as part of our Gate 3 work.

8.1.13 The financial increments and associated tipping points will be determined by the transfer volume requirements identified through the next stage of the regional reconciliation process and will be addressed in Gate 3.

9. Stakeholder and Customer Engagement

Key Messages:

- We have engaged with a wide range of stakeholders from different sectors and geography.
- We have independent reports detailing a robust consultation with stakeholders and the overall message is that there was majority support for sharing water resources, with 75% accepting of with the proposal.
- Environmental enhancements are seen as one of the main benefits of water transfers by our stakeholders along with a greater resilience of supply.
- We conducted statistically robust research into existing North West customers' views on the possible changes in water hardness that might occur as a result of proposed water transfers.
- Customers are generally willing to accept the types of changes in the relative hardness of their water supply which may occur as a result of water transfers; however there are limits, and careful management of the impact on customers' water supply will be needed in future if water trading were to be implemented.
- Customers' would expect to be informed if the nature of their water supply was being changed. The cost and other implications of these additional customer communications will need to form part of our future planning.

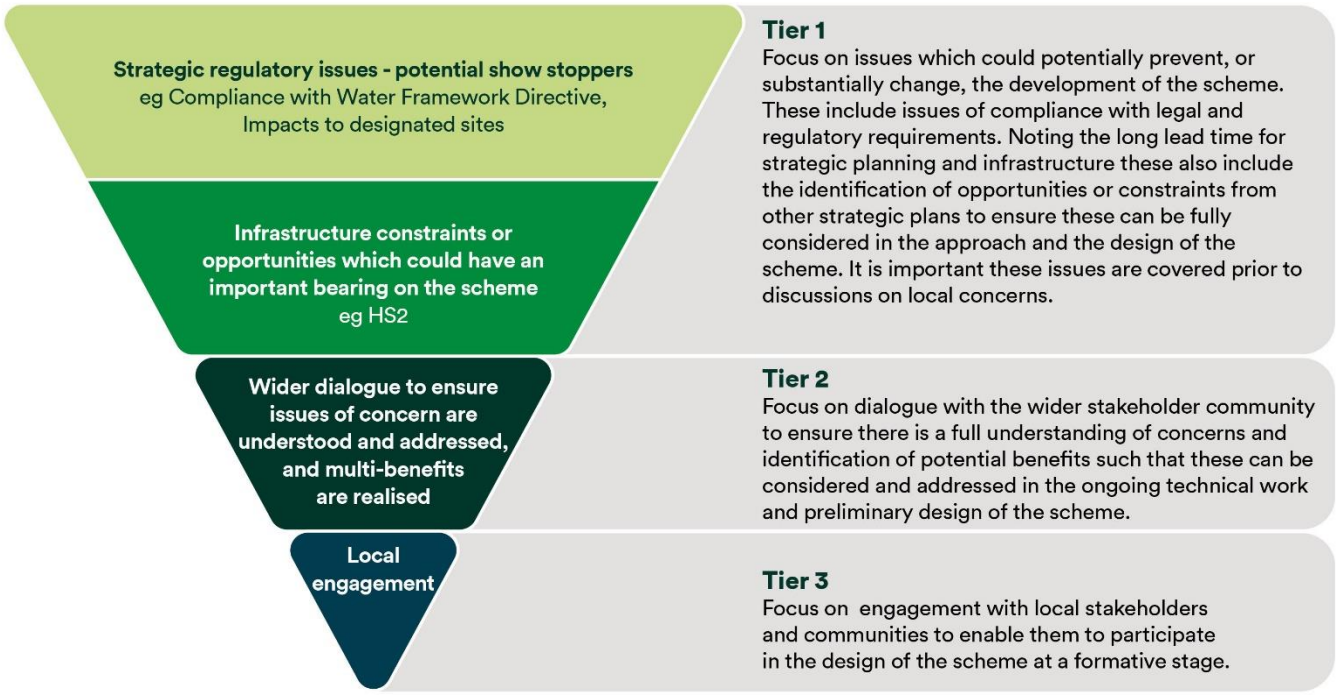
Introduction

9.1.1 This section provides an overview of the stakeholder and customer engagement undertaken during Gate 2. It summarises the main feedback points and how they have been considered in the development of the NWT SRO scheme. It also sets out next steps and any issues that require further investigation.

An Overview

9.1.2 The engagement programme has built on the work undertaken in Gate 1 and has taken account of the feedback from RAPID around further engagement with Welsh stakeholders. We have continued to work closely with partners and regulators to ensure clear, timely and coordinated engagement with stakeholders on the NWT and STT SRO schemes. We have an established Stakeholder Steering Group, with representatives from each of the partner water companies and have jointly developed the principles for stakeholder engagement and the activity plan to Gate 2. We have been predominantly working with Tier 1 stakeholders and during Gate 2 we have initiated wider dialogue encompassing communities in Tier 2 as illustrated in Figure 9.

Figure 9 – Stakeholder Tiers



9.1.3 The engagement approach throughout Gate 2 has been:

- To continue to work with WRW and Water Resources South East WRSE on their engagement and via our own WRMP, to use the opportunity to introduce water transfers and indeed NWT SRO to interested stakeholders and customers to gain feedback to help shape plans.
- Continue the technical engagement with regulators and other key stakeholders to help inform plan development.
- Further customer preference research following on from that conducted at Gate 1 to address the issues and concerns raised by customers.
- Landowners, local stakeholders, residents and businesses that are affected by any of the options taken forward will be engaged with at Gate 3, when the Full Solution will be in sufficient detail to enable stakeholders impacted to be clearly defined and consulted.

Stakeholder consultation on water transfers

9.1.4 For Gate 2 our focus has been to continue engagement with the wider stakeholder population regarding the development of the regional plans, the selection and prioritisation of solutions and the inter-regional reconciliation of plans. This has involved a wide spectrum of stakeholders including Local Authorities, Regulators, Environmental and Societal NGOs along with special interest groups and businesses. We have continued to consult on water transfers via the medium of the regional plan and have undertaken two pieces of consultation to a wider audience. Overall there has been high support for transfers and most of the focus has been on the importance of protecting the environment in source areas along with realising opportunities for environmental net gain and economy boost from transfers. See Section 13, NWT-G02-009-004 and NWT-G02-009-005.

- **IdeaStream consultation** - WRW have developed an online platform that allows stakeholders to engage in their own time. A consultation was undertaken via IdeaStream from November 2021 to January 2022 on the topic of water transfers. From the responses, we saw that there was broad acceptance of trading. Although this was the case, respondents wanted both themselves and the environment to be protected from any detrimental effects of transfers. For example, they felt that in areas that became transfer sources, there should be no reduction in drought resilience and there should be no detrimental effect on the environment. Respondents also felt that the cost of trading should be borne by those who consume the water. Of the transfer schemes discussed, there were few that disagreed with them, although the largest proportion of consultees were non-committal. For more details see Section 13, NWT-G02-009-004 and NWT-G02-009-005.
- **The WRW Emerging Regional Plan consultation** - The plan was published in January 2022 and following this, a regional stakeholder consultation exercise was launched to over 1000 stakeholders including around 200 from Wales. See Section 13, NWT-G02-009-004 and NWT-G02-009-005. There was majority support for sharing water resources, with 75% agreeing with the proposal. However, there were also contrasting views that

reflected regional concerns and differences: some delegates objected to their more water-rich regions losing out to development in the South, while others felt that ethically it was correct to share water resources. When asked to rank the benefits of water transfers, enhancements to the environment was first, followed by improvements to water supply and resilience, and investment into the area.

9.1.5 One of the key areas of feedback from RAPID on Gate 1 was around the level of engagement within Wales. Through the above mentioned consultations we have engaged extensively with Welsh stakeholders focusing on the strategic need for the scheme. This has involved working with key bodies in Wales such as NRW, Welsh Water and the Welsh Water Forum to ensure correct identification of key stakeholders. This led to a number of specific engagements and over 200 Welsh stakeholders were invited to take part in the WRW consultations. Overall Welsh stakeholders' views were split, with some stating that local water needs should take precedence, whilst others believe that water transfers could be justified provided Welsh water requirements are reliably being met first. See Section 13, NWT-G02-009-004 and NWT-G02-009-005.

Table 31 - Technical stakeholder engagement

Organisation	Scope of interest	Activity to date
Regulators- EA/NAU/NE/NRW	Water quality and environmental monitoring and assessment; compliance with, Water Framework Directive and other legislation; Legal and regulatory requirements with respect to natural environment Delivery of wider environmental ambition and objectives – net gain.	Monthly progress meeting with the EA/NAU/NE/NRW to ensure they are briefed and have the opportunity to input to the programme of work and studies. For both the NWT SRO and as part of the wider STT SRO Programme Management Board (STT PMB). This approach has ensured comprehensive and timely engagement to identify issues and risks at an early stage.
Welsh focused stakeholders	Ensuring compliance with the legal and regulatory requirements, including Welsh Wellbeing Act, plus understand strategic priorities. Interest in whether scheme Sub-options would impact Wales, particularly on flooding, INNS, water quality and impact on Severn Estuary. Specific questions on whether scheme would impact Clywedog Reservoir, the condition of Vyrnwy Aqueduct, and consideration of long-term water trading opportunities between Wales and England.	Transfers have been discussed in the wider context of the regional plan for WRW. Key to note there is no plan to change existing arrangements at Lake Vyrnwy or any construction in Wales. Presentations explaining that no net increase in water abstracted from reservoirs in Wales and description of environmental studies and assessments to consider water quality and impact on the Severn Estuary. Further engagement planned for Gate 3 with local stakeholders to explain preferred Vyrnwy bypass pipeline option and alternatives.
DWI	Compliance with regulatory requirements with regard to drinking water quality.	UU have met with the DWI to discuss the programme and the work we were doing to ensure customers were consulted on the acceptability of potential changes to water quality.
CCW	Protecting customer interests	WRW and WRSE have facilitated a regional Customer challenge Group (rCCG) bringing in reps from CCW and Regional challenge groups to share and input on the approaches and materials used to engage customers.
Windermere & Lake District National Park	There are a wide range of stakeholders with an interest in the work to examine potential Sub-options. They are keen to ensure resilience is maintained to protect water bodies in the National Park.	UU has an established relationship, and Windermere & Lake District National Park are active stakeholders on WRW. UU has held introductory discussions around water resources and the potential transfer. Relationships are positive and they are initially in support pending further information.
Local Authorities and the wider stakeholder community	There are a wide ranging views depending on the purpose/role of the stakeholder organisation. Some stakeholders support inter-regional water transfers whilst others have concerns.	The wider stakeholder community are currently briefed through regional planning activity and company specific activity such as WRMP. While the feasibility studies are progressed there has not been specific engagement. Following further work on the Sub-options there will be proactive engagement throughout Gate 3.

Customer Research

9.1.6 This section presents the customer research study completed to understand how customers react to changes in water composition (i.e. customer acceptability) and to understand customers views on water transfers.

(a) Water Quality acceptability (Hall Tests)

The purpose of this study was to explore customer reactions to the proposition that, from time to time, the water quality (hardness of tap water) that they receive may deviate from their usual blend. This is to understand how changes in water quality (hardness of tap water) may be received in different areas, varying from those whose current water is soft to harder water areas. The project followed on from the online survey conducted in December 2020 and other water trading research conducted in Gate 1.

(b) Research approach

This research comprised 9 focus groups and 12 Hall Tests. This was spread across 4 different areas of UU's operating region (Crewe, Wythenshawe, Southport, and Widnes) and across multiple days with customers testing samples of different levels of hardness/softness. 427 customers were interviewed in total, with the number testing each sample ranging from 36 – 150. Participants were recruited locally and invited to test different Twort levels. 4 locations were selected based on a number of criteria. Each location had supplies with differing Twort levels, and some areas were more likely than others to be affected by water transfer activity in the future.

(c) Research results

Table 32 outlines the Hall Tests gathering customer research results by location. Each location was provided with a range of water samples of different Twort levels including their current water supply as indicated by the T*X* value shown in the table.

Table 32 - Hall Tests

Group	Measure	Wythenshawe Results (T1)	Crewe Results (T2)	Widnes Results (T4)	Southport Results (T5)
Customer perceptions of current supply	Satisfied with overall quality	72%	80%	70%	70%
	Satisfied with taste	63%	68%	63%	66%
Desire to know about water supplied	Claim to be aware of current supply source	16%	20%	19%	20%
	Important to know where water is sourced from	68%	51%	48%	44%
	Care whether home is supplied with hard/ soft water	61%	43%	35%	39%
Desire to know about changes	Want to be notified about change in water supply	78%	84%	80%	80%
	Likely to contact United Utilities if notified of change	59%	34%	49%	40%
	How concerned would you be if United Utilities changed the source of the water	4.8/10 (mean)	4.8/10 (mean)	4.6/10 (mean)	4.1/10 (mean)

Table 33 - Acceptability of Twort Levels by Location

Location	Twort 1	Twort 2	Twort 3	Twort 4	Twort 5	Twort 6
Wythenshawe (T1)	71%	64%	67%	78%	-	-
Crewe (T2)	77%	85%	77%	67%	-	-
Widnes (T4)	73%	79%	69%	79%	72%	-
Southport (T5)	-	74%	74%	-	80%	76%

9.1.7 The research results were divided into the different areas:

- Overall Acceptability - The majority found the taste of all Tworts acceptable across the 4 locations, suggesting that changing Twort level will be accepted in the majority of cases (minor concerns of Wythenshawe at T2). Acceptability is generally higher where levels are kept within two Twort levels of the current Twort level supply in the area (with the exception of Wythenshawe at T2).
    - Lather - Generally, lather-ability was acceptable, but less acceptance of harder water in soft water areas.
    - Hot water tests - In the hot water tests, the higher Tworts resulted in duller looking tea and an accompanying scum.
- Water Transfer – Over 3 in 4 customers are accepting of the need for water transfers and other reasons such as water quality issues, dry weather and burst pipes which could result in a change of water supply to the home. Supporting evidence can be found in Section 13, NWT-G02-009-001, NWT-G02-009-002 and NWT-G02-009-003.
- Communication – 78% to 84% of customers would want to be notified of a change to the source of their supply. This leads to just under half of customers likely to contact UU in the event of a change, although this differs by location (please see Table 33 for the full breakdown)

9.1.8 The research results show that customers are sensitive to changes in water sources and therefore any project that involves changing supply has customer acceptability as an inherent requirement. Customer acceptability therefore remains a key risk for the NWT SRO project. The research also supports the theory that stability and familiarity of water source is of greater importance to customers than overall water hardness parameters. As a result of this work we are taking the following principles forward to developing our trading plans:

- Where practical, select and design sources that are of comparable water hardness to those currently received by customers. This includes blending and softening of new sources where appropriate.
- Develop operating plans that prioritise the stability of customer water quality parameters.

- Proactively engage with customers to inform them of changes and provide confidence that drinking water standards are maintained.

(d) WRW Customer Research Synthesis

In May 2022, a customer research synthesis report was created to triangulate all water resources research from WRW companies. The report was extensive, but from a water trading perspective, views on transfers remain consistent across companies, with the concept broadly supported but several issues to be aware of including split views on sharing water with Southern areas of England, customer reassurance needed around cost, environmental impact and reliability of their own supply and transfers in Wales being less popular with customers in receipt of a reduced social tariff. More information on this can be found in Section 13, NWT-G02-009-004 and NWT-G02-009-004.

Conclusions

9.1.9 It is evident from this research that water quality is something that many customers hold strong views on but the majority are likely to be tolerant of changes in the levels of water hardness likely to be experienced if water trading proposals progress. Some appear to simply prefer the taste of softer water whilst others prefer harder water.

9.1.10 The majority found the taste of all Tworts acceptable across the 4 locations, suggesting that changing Twort level will be accepted in the majority of cases. Customer acceptability levels by Twort are highlighted in Table 33, and this is above 60% acceptability for all locations.

9.1.11 Customers require reassurance about the quality and compliance of their water and wish to be notified of any changes and the reason behind these. Letter was the most preferred channel, followed by email.

9.1.12 Whilst most would not notice a change if not informed, some people are highly sensitive to changes to their supply which can aggravate medical issues such as irritated skin and irritated bowels.

How this consultation has informed our plan

9.1.13 From the Hall Test conclusions above, there is customer support for water transfers and results for acceptability are positive. However, there are clearly mitigations that need to be carried out, such as communications to customers when their water sources change and ensuring drinking water safety is maintained and hazards are limited (see Section 5 - Drinking Water Considerations for more information).

Next steps:

Stakeholders:

9.1.14 Before the start of Gate 3 we plan to continue targeted engagement with key stakeholders.

9.1.15 Further consultation will be completed in the winter of 2022/23 as part of the WRMP process. This will involve greater understanding of stakeholder views at a more granular level, taking into account local opinions. The outcome of the consultations and subsequent amendment of WRMPs will inform our engagement plan.

During Gate 3:

- Landowners, local stakeholders, residents and businesses that are affected by any of the Sub-options taken forward will be engaged with during Gate 3. At Gate 3 the Full Solution will be in sufficient detail to enable stakeholders impacted to be clearly defined and consulted. This will follow our industry leading approach on stakeholder engagement in relation to our capital projects. An example of such is the DPC project Haweswater Aqueduct Resilience Programme (HARP), where more information can be viewed here https://harpconsultation.co.uk/. We plan to start this engagement in Spring 2023 once consultation on the WRMPs has concluded.

Customers:

- Analysis is currently being undertaken to understand lessons learnt from previous instances of changing water sources in the North West.
- Engineering solutions will be designed to remain within two Twort level changes as suggested is acceptable by the research, due to the design of the treatment process and blending within the distribution system.
- As there is majority support to be notified of a change in water quality, getting communications right is key. Further testing is recommended to aid production and refinement of key messages and tone and mitigate against potential rises in customer contacts which can negatively impact performance for taste, smell and appearance ODI's.

10. Board Statement and assurance

10.1.1 We have prepared our submission in accordance with the stated assessment criteria outlined in the "Strategic regional water resource solutions guidance for gate two" document, published April 2022. This document highlights the following three key quality assessment criteria:

- *Robustness* – throughout the programme we have adopted an approach to optioneering and feasibility that demonstrates appropriate and proportionate evidence in support of assertions. Where evidence is less compelling we have identified this alongside any plans to address it.
- *Consistency* – we have ensured consistency throughout the NWT SRO submission. Our methodologies and approach align with both internal UU and national policies and guidance. Our approach to assurance is in line with our published assurance framework. This has included external assurance as identified by our risk assessment, and both first and second line assurance undertaken internally. This assures the both the integrity and consistency of the information provided
- *Uncertainty* – an active RAID log has been in place during the programme and all options considered for the Gate 2 submission have assessed risks and mitigations as part of their criteria.

Assurance framework and findings

10.1.2 Our published assurance framework has evolved over time adopting an industry recognised risk based approach. We have utilised this structured assurance framework and tailored it accordingly to ensure that the assurance that we have applied to each area of the plan is both proportionate and comprehensive. In line with our PR24 and Annual Performance Reporting (APR) assurance framework, it is comprised of five linked processes summarised below. In addition to this, where possible we have aligned the assurance framework with the STT SRO, delivered jointly with Thames Water and Severn Trent Water, in order to ensure a consistency of approach. This approach was mandated by both the STT and NWT SRO Programme Boards during the initial set up phase of the programme.

- Requirements— all requirements set out by RAPID have been cross referenced to a set of deliverables within each identified workstream, enabling us to ensure relevant success criteria were being met. These requirements have remained under review and when changed, deliverables have been reassessed to reflect the nature of this changing environment.
- Accountability — A RACI (Responsible/Accountable/Consulted/Informed) matrix was developed and each owner was responsible for the management, risk assessment and assurance of their deliverables.
- Programme management — an experienced programme management team was formed, managing the programme through a central plan reporting to the NWT SRO Programme Board.
- Risk assessment — each deliverable went through a risk assessment, with this process being used to determine both the level of governance that was to be applied to the deliverable and the level of assurance required. This is in line with our published assurance framework.
- Robust assurance processes — a structured and risk-based three lines of assurance process was applied to the deliverables within the programme. This included the use of an assurance partner (Jacobs), internal corporate audit reviews and a range of subject matter expert (SME) reviews and challenges.

Confidence and assurance in our programme

10.1.3 Utilising this existing approach provides confidence to the UU Board that we are addressing all RAPID's requirements. The coverage of each line is summarised below:

- First line assurance: Developing and maintaining sound processes, systems and controls.
- Accountability for first line assurance of each area of the programme was assigned to the workstream leads that owned and managed that area of the plan. Fundamental to this concept is that those responsible for delivery are ultimately responsible for assurance of that deliverable.
- Second line assurance: Providing the enabling framework and governance for the development of the plan.
- Second line assurance and approval of the programme was provided by SMEs. Second line assurance was delivered independently of the deliverable owner, but was coordinated with the owner. The second line also monitored and provided assurance on the quality and robustness of the submission through peer review and challenge. All second line assurance was recorded when carried out, centrally collated with an auditable trail.
- Third line assurance: Providing independent review and assurance of the plan.

10.1.4 We undertook a detailed and wide-ranging independent review of our programme. The main purpose of the independent assurance was to provide external review and feedback to the deliverable owner and sponsors; with this being used to provide the UU Executive and Board with independent assurance and confidence in the quality

of the submission prior to sign off. Since accepting the PR19 Final Determination (FD) in January 2020, our approach to assurance was presented to the UU Board in October 2020 with further updates during this period, prior to the final sign off which took place in September 2022.

10.1.5 For our Gate 2 submission we felt it appropriate to appoint an assurance provider with experience in the engineering discipline, Jacobs were awarded this role and have undertaken our assurance for this submission.

10.1.6 The scope of the initial review was based around the set up and the structure of the programme, the scope of the assurance activity and targeted reviews of deliverables during the development of the plan. The subsequent reviews were more detailed reviews in to deliverables and project cost allocations as well as confirming the assurance was completed in line with the plan. Jacobs reported no significant issues requiring senior management intervention. All actions raised as a result of these reviews have been addressed and closed off as complete. The Jacobs report concluded "*Following the completion of our work as above, UU has confirmed to us that the programme teams have completed the recommendation actions raised in respect of our findings, and these have been assured through the programmes' internal governance mechanisms. Based on completion of these actions as advised by UU, on the basis of the work we performed, we are not aware of any matters that would affect UU's decision to progress to Gate 3".*

10.1.7 The UU Board have provided a supporting Assurance Statement confirming they are satisfied that the data and approaches used to develop the design and decision making information meet the requirements of the Gate 2 submission.

11. Efficiency of expenditure for gate two and forecast

11.1.1 The NWT SRO has been efficiently delivered within the budget for Gate 2, with an underspend against the Gate 2 FD funding allowance of circa 11%.

11.1.2 The RAPID budget for the NWT scheme at Gate 2 is £3.285m (2017/2018 price base). With additional £0.558m surplus budget retained from efficient Gate 1 delivery.

11.1.3 The total cumulative expenditure for Gate 1 and Gate 2 activities is summarised in Table 34.

Table 34 - Expenditure for Gates 1 and 2

	Funding Allowance (£,000)	Expenditure (£,000)	Expenditure (£,000)	Percentage of expenditure against funding allowance
	17/18 price based	**Actuals**	**17/18 price based**	
Gate 1 actual expenditure	2,191	1,709	1,633	75%
Gate 2 forecast expenditure	3,285	3,325	2,891	88%
Kielder & Advanced Gate 3		*399*	*340*	*10%*
Total	**5,476**	**5,433**	**4,864**	**89%**

11.1.4 The Gate 2 activities are solely in respect of delivering the NWT SRO and therefore costs for parallel regulated processes, including regional and WRMP planning, are not included.

11.1.5 Excluding internal resources, regulator charges, company overheads and other similar items that are not appropriate to procure, activities have been secured under UU frameworks with over 60% of activities (by value) subject to procurement competitions.

11.1.6 The Gate 2 expenditure has been subject to both internal and external third-party assurance which has verified the efficient and relevant expenditure of NWT SRO Gate 2 activities.

11.1.7 A breakdown of Gate 2 expenditure is set out in

11.1.8 Table 35**.** Incurred costs for the Gate 2 activities are presented in the 2017–18 price base and in accordance with the RAPID Gate 2 efficiency of spend template. An additional breakdown is provided for any spend categories that exceed £0.5 million in value.

Table 35 – Expenditure & Description of Activity

Category	Activity	Expenditure (£, 2017-2018 prices)	% of Total Expenditure	Description of Activity
	Total	£702,653	22%	

Category	Activity	Expenditure (£, 2017-2018 prices)	% of Total Expenditure	Description of Activity
Programme & Project Management	Programme Direction Programme Management	£115,777 £448,473		Part-time support Full-time programme and direct part-time support
	Assurance	£138,403		Independent third line assurance & part-time assurance co-ordinator
Feasibility Assessment and Concept Design	Total	£1,074,173	33%	
	Engineering	£216,484 £448,697 £408,992		Senior Engineering Design development and costings of the Full Solution, Vyrnwy Works. Design development and costings of the Full Solution, UU Sources Sub-options
Option benefits development and appraisal	Total	£198,280	6%	
	Modelling	£198,280		Detailed appraisal of UU Sources Sub-options and existing UU operational area and Vyrnwy Works.
Environmental Assessment	Total	£693,056	21%	
	Environmental Advisors	£392,131		Independent oversight and review of all environmental deliverables
	Regulators & Regional charges			
	EA	£209,662		
	Natural England	£69,465		
	NRW	£21,799		
Data Collection, Sampling, and Pilot Trials	Total	£0	0%	
Procurement Strategy	Total	£147,997	5%	
	Commercial	£147,997		Developing commercial operating model and procurement approach
Planning Strategy	Total	£17,368	1%	
	Planning	£17,368		Developing planning consents strategy, including land
Stakeholder Engagement	Total	£57,557	2%	
	Stakeholder engagement & customer research	£57,557		Customer research Hall Tests & stakeholder management
Legal	Total	£0	0%	
Other	Total	£339,738	11%	
	Kielder	£44,737		Investigation into the viability of Kielder as a water source
	Gate 3 advanced spend	£295,001		
Total		£3,230,823		
Gate 2 Allowance		£3,285,000		
Gate 1 Underspend		£558,000		
Gate Under/Overspend		£612,177		

Future Gate 3 expenditure

11.1.9 An estimate of the funding required to deliver the NWT SRO through to Gate 3 has been undertaken as summarised in Table 36. This assumes that the cumulative underspend from Gates 1 and 2 is made available for Gate 3 activities.

11.1.10 If the Full Solution for the NWT SRO is to be progressed beyond the proposed Mid-Gate 3 Checkpoint to Gate 3, there is a forecast shortfall of £3.171m against the Gate 3 FD funding allowance.

11.1.11 However, at this stage, there are significant uncertainties around both the transfer volume requirement and delivery pace of the NWT SRO beyond the Mid-Gate 3 Checkpoint. Recognising this it is proposed that funding is reviewed further with RAPID at the proposed Mid-Gate 3 Checkpoint in December 2023.

Table 36 – NWT SRO Funding

Ref	Description	Expenditure, 2017/18 cost base, (£,000)	Notes
NWT SRO funding			
1	Total SRO funding	£21,900	Based on PR19 FD
2	Total funding to Gate 3 (60%)	£13,140	Based on PR19 FD
3	Gate 1 expenditure	£1,633	Actual
4	Gate 2 estimated expenditure	£3,231	Subject to revision based on final out-turn cost
5	Total balance of funding available for Gate 3	£8,276	Assumes underspend at previous gates is carried over. Represents current balance of AMP7 / Gate 3 funding.
NWT SRO Gate 3			

Ref	Description	Expenditure, 2017/18 cost base, (£,000)	Notes
6	Estimate of expenditure required through Mid-Gate 3 Checkpoint, December 2023	£6,460	
7	NWT Mid-Gate 3 Checkpoint funding balance	£1,816	Gate 3 Funding balance at Mid-Gate 3 Checkpoint
8	Estimate of total expenditure required for completion to Gate 3	£11,447	Inclusive of Mid-Gate 3 Checkpoint expenditure. Assumed to occur within AMP7
9	Potential Gate 3 NWT funding shortfall	£3,171	Reviewed with RAPID at the proposed Mid-Gate 3 Checkpoint

12. Conclusions and recommendations

- NWT SRO Gate 2 programme has been delivered on time and within budget.
- We recommend that the NWT SRO is progressed to Gate 3.
- There is the potential to offer a scalable transfer solution up to 205 Ml/d supported by a number of Sub-options.
- The submission has been externally assured and a supporting UU Board Statement has been provided.
- We expect to maintain supply to customers fed directly from the Vyrnwy Aqueduct during a transfer period of up to 250 days.
- No additional abstraction from Lake Vyrnwy above currently permitted levels is required and we do not anticipate any construction activity in Wales.
- We have identified an opportunity to drive efficiencies in scheme delivery through co-ordination with the current Vyrnwy Aqueduct Modernisation Programme (VAMP).
- We are recommending that 4 Sub-options (equivalent to a trade of 75 Ml/d) are delivered to Severn Trent Water (STW) in 2031 in line with the November 2022 Draft WRMP.
- The Town and Country Planning Act 1990 (TCPA) is the current recommended planning route for all elements of the NWT SRO.
- Our initial assessment is that 2 Sub-options in our Full Solution (WR076 SWN_RIVER BOLLIN and WR015 SWN_RIVER IRWELL) would be 'somewhat suitable' for a Direct Procurement for Customers (DPC) approach against the current PR19 criteria.
- We are proposing a Mid-Gate 3 Checkpoint in December 2023 following the outcome of the WRMP and Regional Planning process to confirm the requirement for the NWT SRO and associated pace of delivery.
- The earliest delivery date for the NWT SRO Full Solution of 205 Ml/d is 2033.
- We are working in conjunction with Northumbrian Water (NWL) to assess whether the Kielder Reservoir Sub-option should be proposed as a separate SRO.

13. Supporting documentation

Document Name	Document Reference
NWT SRO Detailed Feasibility and Concept Design Report	NWT-G02-001-000
UU Sources CDR	NWT-G02-003-001
Vyrnwy Aqueduct Enabling Works CDR	NWT-G02-003-002
SWQRA_NWT_Gate 2_Boreholes	NWT-G02-005-001
SWQRA_NWT_Gate 2_Rivers	NWT-G02-005-002
SWQRA_NWT_Gate 2_Reservoirs	NWT-G02-005-003
SWQRA_NWT_Gate 2_Vyrnwy Aqueduct	NWT-G02-005-004
SWQRA_Templates v2	NWT-G02-005-005
Assessment of Sub-options Involving Groundwater Abstractions	NWT-G02-006-001
Assessment of Sub-options Involving Surface Water Abstractions	NWT-G02-006-002
Water Framework Directive (WFD) Compliance Assessment	NWT-G02-006-003
Informal Habitats Regulation Assessment (HRA)	NWT-G02-006-004
Invasive non-Native Species (INNS) Assessment	NWT-G02-006-005
Biodiversity Net Gain (BNG) and Natural Capital (NC) Assessment	NWT-G02-006-006
Initial Environmental Appraisal Report (IEAR)	NWT-G02-006-007

Document Name	Document Reference
Planning Assessments Cover Sheet	NWT-G02-007-001
Planning Assessment WR015 SWN_RIVER IRWELL	NWT-G02-007-002
Planning Assessment WR111 GWE_WOODFORD	NWT-G02-007-003
Planning Assessment WR113 GWE_TYTHERINGTON	NWT-G02-007-004
Planning Assessment WR149 ITC_WIGAN	NWT-G02-007-005
Planning Assessment WR076 SWN_RIVER BOLLIN	NWT-G02-007-006
Planning Assessment WR049d SWN_RIVER RIBBLE 49d	NWT-G02-007-007
Planning Assessment GWE_AUGHTON PARK a2	NWT-G02-007-008
Planning Assessment WR102B GWE_WIDNES	NWT-G02-007-009
Planning Assessment WR107b GWE_RANDLES BRIDGE	NWT-G02-007-010
Planning Assessment WR105a GWE_LYMM a1	NWT-G02-007-011
Planning Assessment WR106b GWE_WALTON_2	NWT-G02-007-012
Planning Assessment WR144 SWN_RIVER TAME	NWT-G02-007-013
Planning Assessment STT041b SWN_RIVER IRWELL_ROCH	NWT-G02-007-014
Gate 2 Procurement Route Assessments	NWT-G02-007-015
Cost and Carbon Report	NWT-G02-008-001 Rev01
UU_Water Quality research _HallTests_Full_Report	NWT-G02-009-001
UU_Water Quality research _Report_FINAL	NWT-G02-009-002
UU_WRMP_Final Report 15.07.22 v3	NWT-G02-009-003
Water Resources West - Emerging Plan Stakeholder Workshops - Feedback Report	NWT-G02-009-004
Water Resources West - Transfers Consultation Report	NWT-G02-009-005

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