STRATEGIC REGIONAL WATER RESOURCE SOLUTIONS

Gate one submission for

Mendip quarries - new solution

December 2021

Submitted to:

RAPID

Submitted by:

South West Water

Wessex Water
YTL GROUP

Contents

1. Executive summary

This is the Gate 1 report for the Mendip Quarries strategic resource option, which is an innovative new solution proposed by scheme partners, Wessex Water and South West Water. The purpose of the report is to summarise the solution and present initial assessments on all the key issues such that RAPID can accept the solution into the gated process and development of the scheme can be progressed.

The report follows the template for the standard Gate 1 reports, with the addition of section 16 on RAPID's criteria for a new solution.

Solution summary

Mendip Quarries is a strategic regional resource option being proposed to provide additional water supply in the West Country and South East regions. Four transfer options have been proposed that could provide benefits to customers from Bristol Water, Wessex Water, Bournemouth Water; and water companies in the South East region either via a raw water transfer to the River Thames or a treated water transfer to Southern Water in Hampshire.

A quarry has been identified in the Mendip Hills suitable to be re-purposed at the end of its working life as a reservoir. Further quarries will be looked at in Gate 2 to identify the most preferable site. The quarry would fill naturally with groundwater, but the rate of recharge would be relatively slow and so it is proposed to augment the refilling of the reservoir with water abstracted from the River Avon (Bristol) utilising high river flows in winter.

The water resource benefit from the reservoir is estimated at between 29Ml/d and 87Ml/d, depending on the abstraction licence from the River Avon. Capacities of the four proposed transfer options are dependent on the yield of the resource, demand patterns and the capacities of the downstream infrastructure or water bodies. The four transfer options comprise:

- Raw water transfer to the Kennet & Avon Canal, to be abstracted downstream using existing/new infrastructure on the canal or River Thames. This could supply water companies with abstractions from the River Thames including Thames Water, South East Water and Affinity Water.
- Raw water transfer and augmentation of the River Stour. To be abstracted by existing infrastructure to serve Wessex Water or Bournemouth Water.
- Raw water transfer to the Line of Works at Chewton Mendip to join the Barrow reservoirs. This would supplement supplies to Bristol Water customers.
- Potable water transfer to a strategic SR near Warminster to supply Wessex Water customers or for onward transfer to Southern Water's Testwood WTW via the route identified in the West Country North SRO.

Initial whole life costs range from £314m to £1,189m (@ 2017-18 prices) depending on the transfer sub-option selected, but not including combination options.

Outline delivery plan

The Mendip Quarries is a new solution to the RAPID gateway process and the scheme partners have been invited to submit a Gate 1 submission to a bespoke timetable. Due to the decommissioning date of the identified quarry, construction will not start until AMP9 (2030-35), although an agreement with the quarry owner to secure the site for water resources purposes along with other consents would be beneficial in AMP8 (2025-30) if the option is selected in regional plans. There is considerable flexibility in the overall programme with the opportunity to adjust the construction programme to suit the need for the water and investment expenditure profiles.

Gate 2 activities will ensure there is a robust planning and procurement route in place. It is anticipated the scheme will be promoted as a Nationally Significant Infrastructure Project, requiring a Development Consent Order.

Water quality considerations

A high-level Water Quality Risk Assessment has not highlighted any significant raw water quality concerns although there are a number of raw water quality considerations which will need to be taken into account including the blending of river and groundwater, and raw water transfers to other waterbodies.

Key environmental outcomes

Initial environmental assessments indicate that some environmental and social impacts are likely to result from construction and operation of each of the elements, but that mitigation can be applied to lessen and, in some cases, avoid these impacts. There are opportunities for environmental enhancement, social benefits, improved climate resilience and low-carbon delivery. The abstraction licences will be discussed with the Environment Agency to ensure no likely significant effects on designated sites and springs. A monitoring programme will be agreed to gather additional information to inform further assessments.

Stakeholder engagement

Customer research by WRSE and through previous WRMPs has demonstrated that in general customers agree with the need for regional resource collaboration and inter-regional transfers where the donor regions needs are met. Reservoirs are widely accepted by customers with the majority of the view that the long-term resilience and environmental benefits outweigh the short-term disruption of construction activities and localised impact. Stakeholders have been consulted on the scheme, with further engagement planned in Gate 2.

Scheme viability

Mendip Quarries is a viable solution that has the potential to supply water companies in both the West Country and South East, and provide considerable customer value and biodiversity net gain. Data will be provided to the regional groups for inclusion in their modelling and regional plans in 2022 in order to determine the best set of transfer options.

A major advantage of the project is that creation of the quarry void / water storage already has planning permission and is under construction with minimal impact on the environment or public. This provides a significant deliverability advantage over schemes seeking to construct new impounding reservoirs or fully bunded reservoirs of an equivalent capacity.

Key risks

There is some uncertainty around the quarry owner's plans for the site and the precise date when quarrying will cease. Based on an assessment of the demand for aggregate decommissioning is expected around 2040, but it could be sooner or later depending on market conditions and the geological challenges as the quarry goes deeper. This will be mitigated by investigating other potential quarries which could be restored in a similar way. An option agreement setting out the commercial arrangements for acquiring the quarry site at the end of its mineral extraction life will also be needed. Further investigation is needed around the impacts of the scheme on the local hydrogeology, acceptability of INNS transfer risks (and the associated mitigation measures) and the proposed abstraction licence at Newton Meadows.

RAPID's criteria for a new solution

We have assessed the five criteria set by RAPID for a new solution to enter the gated process and consider that the Mendip Quarries SRO meets all of the criteria. We have also engaged with RAPID, the Environment Agency, the Drinking Water Inspectorate and Natural England in the run up to entering the solution and during the preparation of the Gate 1 report.

Conclusions

Mendip Quarries is an innovative reservoir solution and there are a range of transfer options that could be selected in regional and water company plans. Based on our initial assessment as set out in this report, no environmental or drinking water quality showstoppers have been identified.

Our boards have approved the Board statement and recommend that the development of the Mendip Quarries options should be continued into Gate 2.

Recommendations

It is recommended that the solution is accepted into the RAPID gated process, with the next milestone being Gate 2.

2. Solution description

Solution overview

The aim of the Mendip Quarries solution is to provide a strategic water resource for the West Country and/or South East regions by re-purposing an existing quarry into a public water supply reservoir. The first quarry considered under this SRO has planning permission to extract minerals up to the end of 2040. The quarry will fill naturally with groundwater, but the rate of recharge would be relatively slow. The proposed solution will include use of an existing surface water abstraction licence from the River Avon to augment the reservoir refill. Options to increase the abstraction licence are also considered to increase the scheme output.

It is estimated that the gross volume available is approximately 52.8MCM, with a usable net storage of at least 28.7MCM providing a potential yield of between 29Ml/d and up to 87Ml/d (with the 'enhanced licence'). The location of the proposed reservoir is such that it provides transfer options to water companies within WCWRG and WRSE. Four transfer options have been developed following discussions with Wessex Water, Bristol Water, Thames Water and Bournemouth Water. The solution schematic is presented in Figure 2.1.

Figure 2.1: Mendip Quarries - Solution Schematic

Option configurations

A new intake on the River Avon at Newton Meadows, near Bath, is proposed to support refilling of the reservoir. The reservoir could provide a baseline flow on a normal-year basis, or it could be used as drought storage, supplying water to meet peak demands in dry summers. The operation of the reservoir will be defined by the need in the regional and water company plans. This is discussed further in Section 6. Surface water would be treated to manage invasive species and other drinking water quality risks before being conveyed to the reservoir via a new pipeline. Flows will enter the reservoir via a shaft built into the side of the quarry.

Table 2.1 sets out the transfer scheme options from the Reservoir created as part of Mendip Quarries solution. The regional plan and water company WRMPs will inform the best value combination of options to progress.

Table 2.1:Transfer Scheme Options from the Mendip Quarries Reservoir

Option number	Recipient location	Flow Ml/d	Transfer scheme details
1	Kennet & Avon Canal	30/50	Conveyance of raw water via gravity pipework to a new discharge point, East of Devizes, into the Kennet & Avon Canal. CRT have provided an outline proposal based on raw water being received into the Crofton summit pound. The Canal would aid transfer to Thames Water by taking flows via the River Kennet either for abstraction at Fobney or all the way to the River Thames. South East Water or Affinity Water could benefit from the transfer via abstractions at Bray or in West London, respectively. The CRT suggest that canal transfers of less than 50Ml/d are likely to be favourable but higher transfers may be possible following further hydraulic assessments.
2	Service Reservoir near Warminster	30/90	Transfer of potable water, treated at a new WTW at the Mendip reservoir, to Wessex Water's strategic SR near Warminster. Water could enter the Wessex Water network at this point or be redirected for onward conveyance to Southern Water. Depending on demand, the existing network may need to be strengthened and/or dedicated pipelines constructed for onward conveyance; this is considered as part of the 'West Country North – Sources and Transfers' project.
3	River Stour	30	Conveyance of raw water to the River Stour close to Hinton St Mary with a potential discharge location upstream of Cutts Mill. The river would transfer flows for abstraction in the Bournemouth area by Wessex Water or Bournemouth Water. It is assumed that water transfers to water courses can be abstracted by existing infrastructure. Further studies will confirm discharge location and capacity in the river. A transfer with a defined output of 30Ml/d has been considered at this stage.
4	Chewton Mendip	16	Conveyance of raw water to Chewton Mendip, which is the head of Bristol Water's Line of Works Aqueduct, for onward transfer and discharge to the Barrow reservoirs. The supply from the Mendip reservoir could supplement flows to the reservoirs during the summer months as the existing culvert there operates at full capacity during winter. At this stage, a 16Ml/d transfer has therefore been considered but investigation of a higher capacity could be undertaken subsequently.

Cost

The option costs are presented in Section 10 at 2017-18 prices. In summary, the Net Present Value (NPV) of the common elements of the water resource and reservoir is £282m (existing licence) and £558m (enhanced licence). The transfer options vary between £32m and £631m due to size, length and type of transfer. The costs at this stage have not been independently benchmarked but have been built up using standard water company cost models.

Resource benefits

Depending on regional need, the Mendip reservoir could be used as a drought resilience option or to meet baseline demand. The operation of the reservoir will be defined by the outcome of regional modelling. This is discussed further in Section 6.

Two surface water abstraction options are being considered to augment supply to the reservoir; use of the existing (unused) Wessex Water abstraction licence from the River Avon at Newton Meadows, or applying for an enhanced licence at the same location.

With the existing abstraction licence, the potential reservoir yield is constrained by the licence rather than the available storage. Simulations have been run to give preliminary enhanced licence values of 101Ml/d for a 1 in 2 year yield and 87Ml/d for a 1 in 500 year yield.

Table 2.2: Resource benefit of the reservoir

Option variant	Outline Yield Estimates (Ml/d)	
	1-in-2	1-in-500
Existing River Avon abstraction licence	29	29
Potential enhanced licence (maximum abstraction 150Ml/d)	101	87

Purely using the volume stored, the reservoir could be used to supply water for a limited period in a drought. This is estimated as 24Ml/d for a 3-year period, or 70Ml/d for a year. These are significant volumes when compared to other reservoirs in the West Country and comparable to some reservoir options proposed in the South East.

The design capacities for each transfer varies due to limitations on capacities in the receiving infrastructure or water bodies. Further details are provided in Section 4.

Social, environmental and economic assessment

Initial environmental assessments have been undertaken for the inlet transfer, the reservoir and four transfer routes, including a Stage 1 Habitat Regulation Assessment (HRA), Level 1 Water Framework Directive (WFD) assessment and Strategic Environmental Assessment (SEA). Assessments for Biodiversity (BNG), Natural Capital (NC), carbon and a review of wider benefits have also been conducted.

The abstraction licence requirements at Newton Meadows and the reservoir will be agreed with the Environment Agency and Natural England to ensure no adverse effects on any designated sites and springs. Further work will be undertaken in Gate 2 to collate available information and develop the scheme to ensure any WFD compliance risks are considered and addressed.

Initial assessments indicate there are opportunities for wider benefits to be delivered as part of the scheme, including opportunities for biodiversity net gain, positive social outcomes and improved climate resilience.

The Gate 1 environmental assessment does not include an in-combination assessment with other SROs, water company capital investments or third party development plans or projects; the assessment will be updated as further details become available. A programme of additional monitoring and environmental studies has been proposed to develop the environmental assessments for the Gate 2 submission.

Drinking water quality

A high-level Water Quality Risk Assessment (WQRA) has been completed in accordance with the guidance developed for the ACWG. The WQRA covers the water quality considerations of all transfer options and no significant water quality concerns have been identified at this stage; there are a number of water quality considerations which will be taken into account as the scheme develops, including further investigation and sampling.

Scheme interdependencies

Mendip Quarries is not itself dependent on any other SROs or other company options. The West Country North SRO considered the potential to increase potable water transfers at Newton Meadows booster pumping station but it was not been taken forward to Gate 2; this is completely separate from the proposal in this report to utilise the river abstraction licence at Newton Meadows. There are other water resource options that could either benefit, or be dependent on, raw or potable water supply from Mendip Quarries. Relevant options include:

- Thames to Affinity Transfer (T2AT) SRO: Dependant on a transfer of raw water into the River Thames.
- Thames to Southern Transfer (T2ST) SRO: Dependant on a transfer of raw water into the River Thames.
- Thames Water non-SRO options for increasing abstractions from the River Thames in London, supported by upstream resources: Dependant on additional flows in the River Thames.
- West Country North SRO: Proposes a potable transfer to Testwood SR. Mendip Quarries could provide an additional or alternative resource for inclusion in the transfer to Wessex Water's strategic SR near Warminster and onward to Testwood.

- Environmental ambitions on the River Avon (Hampshire): Augmentation of the River Stour could allow further abstractions and reduce the abstraction requirements on the River Avon.

The initial estimate of the DO for the reservoir is large enough that the reservoir has the potential to support more than one transfer option. Possibilities of combination options will be investigated further in Gate 2 alongside the water company WRMPs.

Regional planning context

The WCWRG regional plan, which will be the subject of informal consultation in early 2022, has considered a range of possible future water needs by 2050, which all show that the region is likely to face a deficit in water availability without intervention. One of the key themes of the plan is the need to continue with the development of options alongside further work to reduce the uncertainties related to the forecast in particular the impact of the environmental destination requirements.

Mendip Quarries is identified as one of the strategic resource options that could assist in meeting the future needs. As there are uncertainties about the feasibility and deliverability of the strategic resources options and the lead times are long, the plan proposes that they continue to be developed so that they can be deployed when required.

Thus the Mendip Quarries solution fits with the long term ambitions and strategies for both companies and for the region. The solution would provide supply resilience as abstraction reductions and climate change begin to impact on existing sources yields. Subject to detailed consideration of need and scheme operation there are options to provide additional supplies into WRSE as well.

3. Outline project plan

Programme overview

The feasibility and concept stages of this project align with RAPID milestones, albeit with a delayed Gate 1 submission of December 2021. Discussion with RAPID regarding the later milestones (Gates 3-5) has indicated that it would be acceptable to align later gates with the project timeline rather than be fixed by the specified dates. The difference between the standard RAPID milestones and the project milestones proposed for this project are shown in Figure 3.1.

The plan presented in Figure 3.1 targets all preparations to be completed by 2030 and the construction phase to commence in 2031. A possible short and long construction programme are shown in Figure 3.2. The construction programme will be influenced by the chosen transfer option(s) and the decommissioning date of the existing quarry (expected to be around 2040) which are yet to be determined.

Key activities

The project plan shown in Figure 3.1 shows the planned work for each workstream to show how key activities need to align to meet RAPID and WRMP milestones. The key activities within each workstream are as follows:

Planning

It has been assumed that the project will be considered a NSIP and therefore require a DCO. If a DCO is not required to consent the scheme it has been assumed that the relevant permissions could be achieved within the period currently allowed for the DCO process.

Three consultation periods are planned to align with each design phase of the scheme to comply with the requirements and guidance associated with the Planning Act 2008. This requires consultation with a range of stakeholders, including statutory consultees, local authorities and the community; and for the responses to be developed into the Mendip Quarries plans.

The DCO application is planned for Spring 2028, however it will be a focus throughout the programme to ensure the ongoing assessments and studies are robust and well evidenced.

Procurement

The initial assessment has confirmed Mendip Quarries to be eligible for DPC (see Section 6). The tender model and value for money assessment will be developed in Gate 2. The Strategic Outline Case will be submitted in 2025 once the developed design is agreed and the regional need understood, and the CAP agreement is planned for Winter 2029.

Design

A suitable quarry has been identified for this project, however a site selection study prior to Gate 2 will confirm whether there are other quarries in the area that are preferrable. The transfer options will be developed further, and based on the regional plans a preferred transfer(s) will be selected for Gate 2. Further detail is provided in Section 15 for proposed Gate 2 activities.

Environmental

A programme of ecology surveys (to include aquatic and terrestrial ecology), and water quality monitoring (to include flow and algal sampling) is planned to inform the design. The EIA scoping is planned for Gate 2, with environmental surveys in Gate 3 to inform the design development. Surveys will likely need to be reconducted to be in date at time of DCO application.

Construction programme

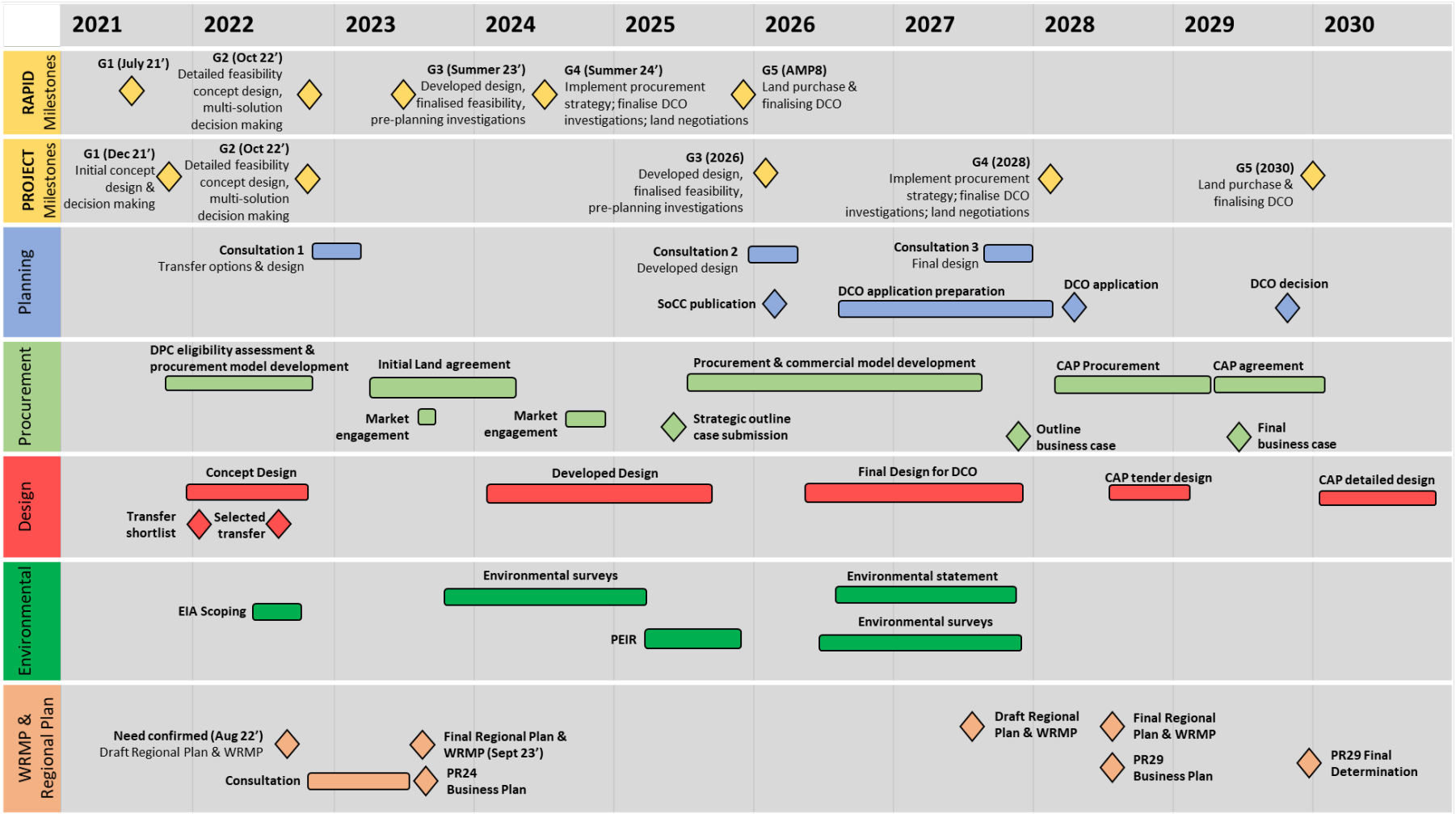
The decommissioning date of the quarry site is not fixed. The current estimate is for the site to be decommissioned by 2040 which coincides with the current planning permission for mineral extraction. To demonstrate the impacts of an early or late decommissioning date an early date of 2038 and late date of 2042 are shown in the long and short programmes in Figure 3.2. The majority of the proposed infrastructure would be sited outside the quarry site, and therefore scheme components could be constructed before activity in the quarry has ceased as shown in the two possible construction programmes in Figure 3.2.

The duration of the construction programme is driven by the quarry decommissioning date and the first fill of the reservoir. Construction of the abstraction, inlet conveyance and raw water treatment infrastructure are programmed prior to the quarry decommissioning date so that commissioning of the water treatment works can be conducted and filling of the reservoir can commence as soon as possible once the quarry is decommissioned. The outlet conveyance is programmed so that commissioning can align with the timing of initial resource availability. The timing of the outlet conveyance will also be driven by timing of the requirements in the receiving WRZs and so the outlet conveyances may be staggered depending upon the expected timing of needs.

As both programmes show, the filling of the reservoir along with the quarry decommission date are the critical path elements and key to determining the operational date. The enabling, construction and commissioning is included in the timescales for each item on the construction plan.

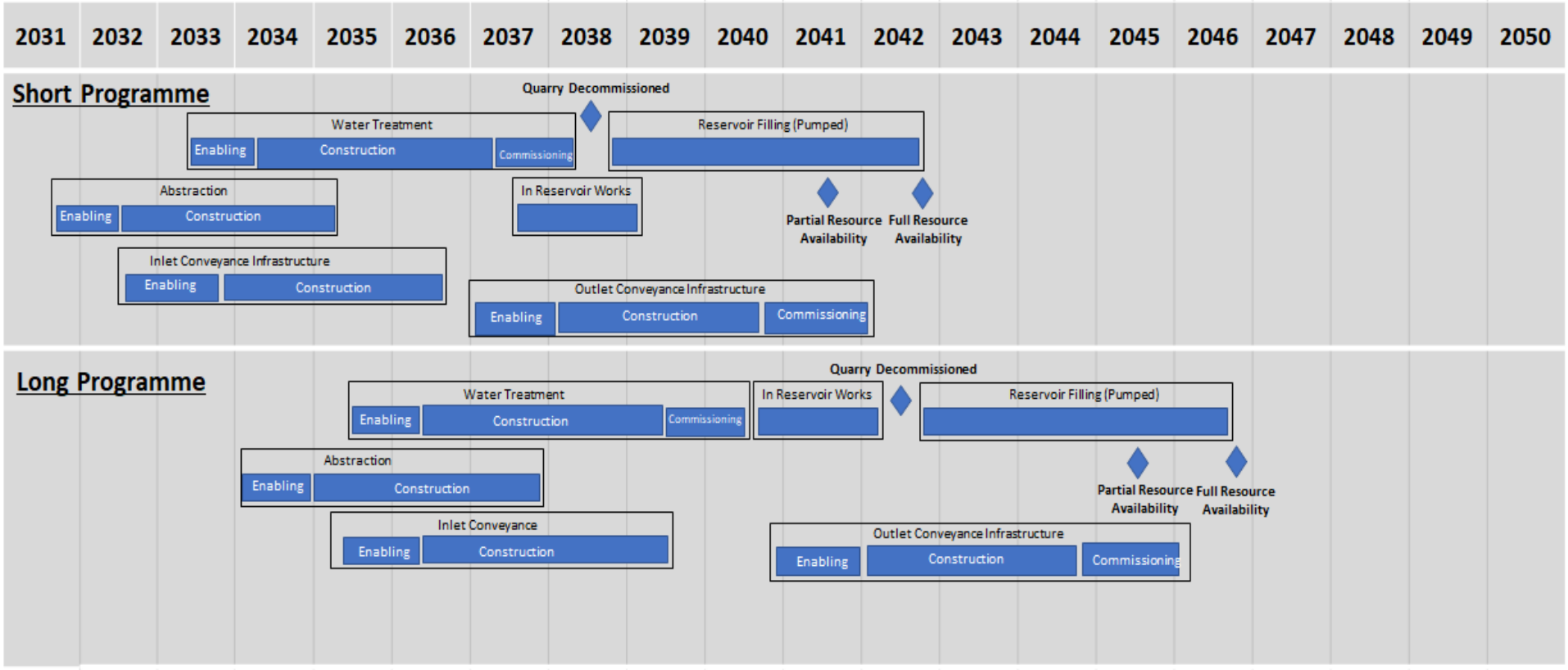
The project plan shown in Figure 3.2 highlights that the programme is flexible and can be adjusted to suit the needs for the various transfers and investment expenditure profiles.

Figure 3.1 Project-level plan corresponding to RAPID gates



CAP = competitively appointed provider; **DCO** = development consent order; **DPC** = direct procurement for customers; **EIA** = environmental impact assessment; **PEIR** = preliminary environmental information report; **SoCC** = statement of community consultation; **WRMP** = water resources management plan

Figure 3.2: Project-level plan showing indicative construction timescales

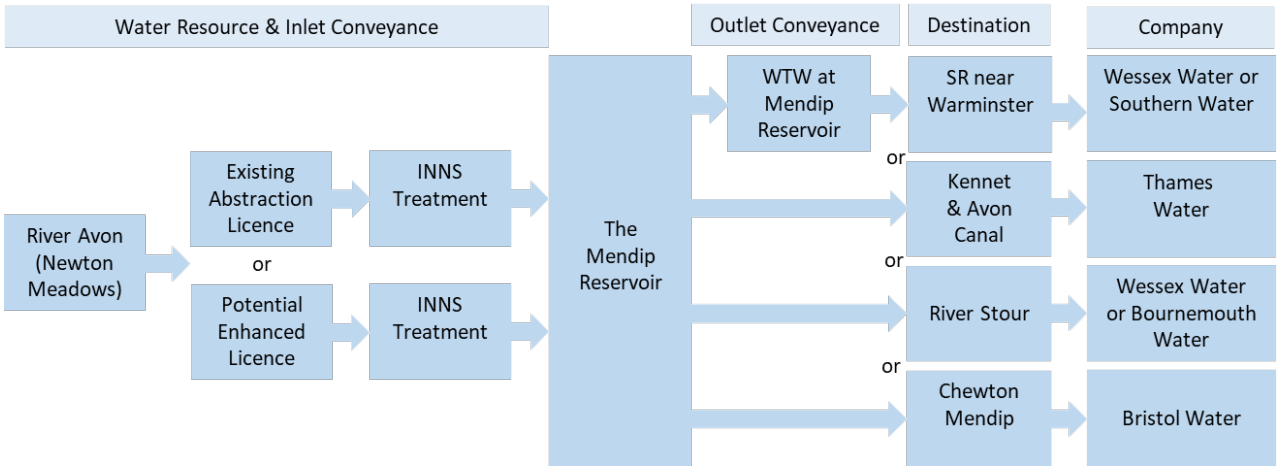


4. Technical information

Options Configuration

There are several sub-options for each of the following solution elements: raw water resource and inlet conveyance, outlet conveyance and recipient destinations, as presented in Figure 4.1.

Figure 4.1: Schematic of Mendip Quarries scheme



For supply from the River Avon to the reservoir, two different abstraction licence options at Newton Meadows have been considered, presented in Figure 4.1. Analysis of 50 years of river flow records shows that full abstraction under the existing licence would be possible nearly all the time with the Avon providing only minor and occasional constraints on abstraction. Under the existing licence, abstraction would therefore be constrained by the licence's allowance, rather than the availability of water in the river, so a potential enhanced licence has also been proposed and preliminarily discussed with the EA.

Table 4.1: Options for water source and abstraction

Option	Licence Details
Existing Licence	• Maximum 31.9Ml/d with HOF 120Ml/d. • Maximum 10797Ml/year (equivalent to average 29.5Ml/d).
Potential Enhanced Licence	Making use of high river flows in winter, subject to: • Maximum abstraction 150Ml/d with HOF 600Ml/d. • When river flow is below 600Ml/d, maximum 31.9Ml/d abstraction with HOF 120Ml/d

A new abstraction facility at Newton Meadows and INNS treatment facility will enable the transfer of raw water to augment the storage in the reservoir. A site selection study is proposed in Gate 2 to identify a suitable location for these facilities, however, to manage INNS risk the treatment facility will be positioned close to the abstraction site.

Water will enter the reservoir via a shaft and tunnelled adit which will be constructed into the wall of the quarry. A turbine will act as an energy capture facility to offset the energy required to pump water from the INNS treatment facility.

A similar shaft and adit facility will provide three draw off levels, to abstract raw water for onward transfer. Water will be pumped to the highpoint of the quarry and flow by gravity into the transfer pipelines or to the new water treatment facility (additional booster pumping stations are required due to the topography of the transfer routes).

Table 4.2 sets out an initial assessment of these options with different licences at Newton Meadows and the four destinations to which flows from the Mendip reservoir may be transferred. The outgoing flows may be constrained by the destination, as detailed in Table 2.1.

Table 4.2: Configurations of initial options for operation of the Mendip reservoir

Approximate Reservoir Yield	Incoming Conveyance			Outgoing Conveyance		
	Source[3]	Transfer Capacity	New Transfer Pipeline	New Transfer Pipeline	Peak Flows	Destination
90[2]Ml/d	River Avon - Potential Enhanced Licence	150Ml/d	24.7km Ø1300mm	20.9km Ø1000mm	100Ml/d	SR near Warminster
				47.5km Ø700/900mm	50Ml/d	Kennet and Avon Canal
				31.5km Ø600mm	35Ml/d	River Stour
				13.9km Ø400/500mm	16Ml/d	Chewton Mendip
30Ml/d	River Avon - Existing Licence	35Ml/d	24.7km Ø600mm	20.9km Ø600mm	35Ml/d	SR near Warminster
				47.5km Ø600/800mm	35Ml/d	Kennet and Avon Canal
				31.5km Ø600mm	35Ml/d	River Stour
				13.9km Ø400/500mm	16Ml/d	Chewton Mendip

[1] Design flows selected at this time are c. 10% higher than average flows.
[2] When limiting drawdown to 95mAOD and assuming abstraction from the River Avon of up to 150Ml/d throughout the year (with HOF of 600Ml/d).
[3] It is assumed that flows would be abstracted at Newton Meadows as this is the location of the (unused) existing licence; other possible abstraction locations closer to the quarry could be considered at a later stage.
[4] Ø- Diameter

Option operation

Depending on regional need, the Mendip Quarries could be used as a drought resilience option or contribute to normal year-round supplies in the West Country or South East.

Based on current understanding of need and initial regional plans, it is considered most likely at this stage that the scheme will be used to help Wessex Water and/or Bournemouth Water meet peak demands during extreme droughts and/or when groundwater use is constrained.

Different scheme utilisation options will be incorporated into WRMP and regional plan decision-making to determine the best scheme-use in the region, when considered as part of overall programme appraisal, and best-value planning outcomes.

Option costs

The NPV, AIC and carbon quantification of the different options are provided in Section 10.

A risk register has been developed, assessing risk scores in line with the ACWG Cost Consistency Methodology Technical Note. Optimism bias has been incorporated into the costs, however a costed risk value has not been calculated at this stage. A table of the key risks is included in Section 9.

The variable operating cost associated with operating Mendip Quarries relates to the treatment and pumping required to fill the reservoir. These will vary from year to year depending on the operation of the reservoir. The annual energy required for pumping will be partially offset by energy recovery turbines in the inlet shaft.

An allowance has been made for capital replacement costs based on the asset life classes recommended in the ACWG Cost Consistency Methodology.

Water resource benefit

A potential reservoir yield of about 29Ml/d is estimated if the reservoir is filled by pumping from the River Avon at Newton Meadows using the existing abstraction licence. A potential enhanced licence was also investigated, giving an indicative yield of about 87Ml/d. The existing licence allows abstraction at up to 31.9Ml/d subject to a HOF of 120Ml/d, with an annual limit equivalent to average daily abstraction of about 29.5Ml/d. The potential enhanced licence was assumed to allow increased abstraction at up to 150Ml/d subject to a secondary HOF of 600Ml/d, with an appropriate increase to the annual licence.

These reservoir yield estimates were based on the available flow series for the Avon that covered a 50-year period (1969-2019), and represent a “worst historic drought” estimate. For the enhanced licence the simulation of the reservoir and the abstraction with a demand of 89Ml/d showed drawdown over an extended period from 1989 to a low point in 1997. The assessment included allowing for emergency storage equal to 30 days’ demand.

The yield derived from simulation over a 50-year period would typically represent a return period of between 50 and 100 years. For the existing licence it can reasonably be assumed that the 1-in-500 year yield would be the same because of the large remaining reservoir storage unused during the simulation. This does not apply for the enhanced licence assessment.

In order to estimate what a more severe event yield might be under the enhanced licence the flow dataset was modified by replacing the values for the wettest year in the drawdown period by those for a year from the rest of the record. The wettest year in the drawdown period was 1993-94 (water year from October to September). Replacing that year by each of the other years in turn gave a yield ranging from 83 to 91Ml/d, with an average of 88Ml/d. The worst case arose from using the 1975-76 drought year. The next worst was a yield of 85Ml/d from using either 2010-11 or 2016-17.

Replacing a wet year in this way is a stress-test on the yield estimate, but without a corresponding estimate of the return period. A much more severe stress test was also used in which the driest years were placed consecutively. This is considered an extreme scenario, far beyond a 500-year return period, but it only showed a reduction in yield of about 12%, from 89 to 78Ml/d.

A full assessment of the 1-in-500 yield is proposed for Gate 2. This will include rainfall-runoff modelling and the use of stochastic datasets. As a preliminary stage, extreme value analysis was undertaken on the annual flow series, and the fitted relationship used in conjunction with a series of random numbers (representing exceedance probabilities) to produce a long-term flow series (10,000 years). These were accumulated over 8-year periods (representing the critical drawdown period in the baseline assessment) and the 0.2% value determined to represent a 1-in-500 year flow over that period. An 8-year flow sequence approximating to this was then produced by stitching together historical years with flow close to those in the 8-year period closest to the 0.2% value. A similar approach was followed for two more 8-year periods with flow next closest to the 0.2% value.

Yield assessment with the three series gave yields of 84, 88, and 90Ml/d; with the average of 87Ml/d only marginally below the baseline figure. It should be noted that various assumptions were required, including that the annual flow values are independent; in practice there is some inter-dependence between flows in successive years, but probably small enough that the assumption is acceptable for this purpose. The fitted relationship is also important; an alternative relationship with a broadly similar degree of fit might give a significantly different flow when extrapolated to 1-in-500.

Following this analysis it is considered reasonable to adopt a value of 87Ml/d as the preliminary 1-in-500 year yield.

1-in-2 year yields are generally higher than those for higher return periods, but this is not the case for the existing abstraction licence as the yield is constrained by the licence rather than the available storage. For the enhanced licence the 1-in-2 year yield is estimated to be 101Ml/d; at this level the simulated level encroaches on the emergency storage in 23 out of 50 years, and would do so in more than half of the years if the demand is raised higher. In 10 of the 23 years the demand could still be met by utilising the emergency storage, while in 13 years there would be some period with the supply either zero or less than the demand.

All of the above is on the basis of annual average yield, assuming a constant demand. Since there is a multi-year drawdown period the demand could be varied seasonally without significantly impacting on the average yield. This could include a summer-only licence with yield close to double the annual average figure if the source were not used at all in winter, or a high peak sitting within an overall 3-year or 5-year licence. The source would therefore have considerable potential to meet peak dry weather demand, perhaps at times when supply from other sources has to be reduced.

Data provided to WRSE/WCWRG

Information on the scheme has yet to be issued to WRSE. This is planned for January 2022 when cost, carbon, lead-time, deployable output and dependency data will be issued. The scheme has been assessed against the WRSE environmental metrics.

Data to be provided to WCWRG and WRSE will enable the various configurations to be considered against all other options to enable the assessment of the best value regional plans.

5. Environmental and drinking water quality considerations

Overview

An environmental assessment has been undertaken on each of the elements of the Mendip Quarries SRO in accordance with the methodology in the ACWG[1] and WRSE environmental assessment guidance[2].

Environmental assessments undertaken are a Stage 1 HRA; a Level 1 WFD Assessment; and an (options level) SEA. In addition, BNG and NC assessments have been undertaken; the wider benefits of the scheme have been reviewed; and opportunities to contribute to net zero carbon emission objectives were investigated.

The Gate 1 environmental assessment does not include an in-combination assessment with other SROs, water company capital investments or third party development plans or projects, due to a lack of knowledge, including certainty and timing. The assessment will be revised for Gate 2 to include potential in-combination effects.

All assessments considered six elements of the Mendip Quarries SRO as follows:

- Abstraction (existing and enhanced licence rates) at Newton Meadows and associated intake pipeline to convey raw water to the reservoir;
- Mendip reservoir and drawdown abstraction;
- Four water transfer options (each considered independently) as presented in Table 2.1.

As sites have not been selected for the INNS treatment facility, WTW, or other infrastructure required for the pipeline transfers (i.e. pumping stations), these elements have been excluded from the environmental assessment but will be included in Gate 2.

Strategic Environmental Assessment

An options level SEA was applied to the options following the WRSE methodology[2].

The SEA outputs for residual effects (post mitigation) are shown in Table B.1 in Appendix B (showing positive, neutral or negative effects across all the SEA objectives in construction and operation). Mitigation measures included in the SEA outputs are listed in Appendix B.

Intake pipeline from Newton Meadows: For the Water objective, this element will have major beneficial effects during operation due to the transfer of water providing a resilient supply. For the Climate objective, minor adverse effects are predicted during operation due to abstraction of water which could have a negative

1 All Companies Working Group water resources management plan environmental assessment guidance and applicability with SROs, October 2020

2 Mott MacDonald, June 2020, "WRSE Regional Plan Environmental Assessment Methodology Guidance"

effect on the resilience of the local environment to climate change. Effects of other objectives are similar across the other Mendip Quarries SRO elements.

Mendip Reservoir: For the Biodiversity objective, the Mendips Woodland SAC is immediately adjacent to the overall construction boundary so the design should aim to avoid this area of the site; in the unlikely event that it can't be avoided major negative effects have been identified during the construction phase due to the likely significant effects identified by the HRA on the woodland. Major negative effects may occur for the Biodiversity objective during operation, as the HRA identified the reservoir has the potential to result in likely significant effects on Mendip Woodland SAC due to permanent changes to the water table, as a result of the new reservoir affecting the hydrological processes underlying the Mendips Woodland SAC. A HRA Appropriate Assessment will therefore be required and effects may be mitigable and reduced, however this is unknown at this stage. Best practice methods should be implemented to minimise disturbance effects and habitat loss, and habitat should be reinstated on completion, or if unavoidable compensatory habitat to be considered to replace damaged or lost habitat. During operation, the reservoir will have moderate major beneficial effects for biodiversity as it will likely create new natural habitats for birds.

For the water quality objective, the reservoir will have moderate adverse effects during construction and operation due to potential WFD effects and WFD Level 2 assessments will therefore be required. Groundwater modelling in Gate 2 will evaluate the impact of reservoir drawdowns on the groundwater table, however given the current dewatering activities, the scheme will help restore the natural groundwater level. Major beneficial effects are identified for the water resilience objective likely during operation due to the transfer of water providing a resilient supply.

For the Carbon objective, moderate adverse effects are predicted during construction due to the carbon generated from materials used to construct the new infrastructure (embodied carbon) and construction activities. For the Population and Health objective, the reservoir will have major beneficial effects during operation as there is potential that the reservoir will create new recreational opportunities if it is open to the public. By creating a new reservoir from an existing quarry there is potential for moderate positive effects on the Landscape objective as there is likely to be an overall improvement in the visual amenity and setting of the current landscape. The reservoir will also utilise a brownfield site therefore positive effects have been identified for the Resource and Waste objective.

Water transfer options: The Air, Historic Environment, Population and Health and Material Assets objectives resulted in similar effects for each of the four options during construction and operation. For the Biodiversity objective, all options have major adverse effects during construction due to potential direct and indirect effects on habitats. For the Water objective all options have beneficial effects in operation, however the larger the transfer, the more positive the result due to the provision of a resilient supply.

For the Biodiversity objective, Option 1: Kennet and Avon Canal and Option 3: River Stour are likely to have major adverse effects in operation due to the potential for likely significant effects on a number of Natura 2000 sites and requirement for further HRA investigation. Option 2: Service Reservoir near Warminster and Option 4: Chewton Mendip are likely to have neutral effects in operation.

For the Soils objective, Option 1: Kennet and Avon Canal, Option 2: Service Reservoir near Warminster and Option 4: Chewton Mendip have minor adverse effects during construction due to the disturbance of priority soils. Option 3: River Stour is likely to have a neutral effect in operation.

For the Water objective, Option 3: River Stour has a moderate adverse effect in operation due to the further WFD assessment required. The other options are likely to have neutral effects in operation.

For the Climate objective, Option 1: Kennet and Avon Canal and Option 3: River Stour have minor beneficial effects during operation due to the increased flow into the outlet water courses providing environmental resilience benefits. The other options are likely to have neutral effects during operation.

For the Landscape objective, Option 2: Service Reservoir near Warminster is likely to have minor adverse effects during operation due to above ground infrastructure being located within the Cranborne Chase & West

Wiltshire Downs AONB which could have a permanent impact on the landscape. The other options are likely to have neutral effects during operation.

Overall, Option 2: Service Reservoir near Warminster is likely to provide the most beneficial balance of positive and negative effects on SEA objectives. Option 3: River Stour is likely to provide the most adverse balance of positive and negative effects.

Habitats Regulations assessment

The Stage 1 HRA (Test of Likely Significance - Screening Principles) was undertaken following the WRSE methodology[2].

The outputs of the Stage 1 assessments are summarised in Table B.2. In accordance with the methodology, all elements are considered to result in likely significant effects, and all elements should be subject to Stage 2 during Gate 2.

Mendip reservoir has the potential to result in significant effects on Mendip Woodland SAC which is immediately adjacent to the construction boundary. The concept design should look towards developing a design to minimise the potential effects on this site, and investigation should be undertaken to consider what mitigation would be acceptable to reduce and/or avoid effects on this SAC.

Water Framework Directive assessment

The Level 1 WFD assessment was undertaken following the WRSE methodology[2]. Table B.3 (in Appendix B) shows the output of the WFD assessments.

The Level 1 WFD assessment indicated that three of the six elements of the Mendip Quarries SRO had one waterbody which requires further Level 2 assessment. For the intake pipeline from Newton Meadows, a Level 2 assessment is required on the Bristol Avon (By Brook to Netham Weir), due to the potential for some WFD effects related to new abstraction infrastructure or the operation of abstraction directly from the waterbody. For the Mendip reservoir, a Level 2 assessment is required on the Mendip groundwater due to potential interaction between the quarry and local groundwater (both levels and quality). Of the transfer options, only Option 3: River Stour requires a Level 2 assessment due to increased discharge of water of a different quality to this waterbody.

The Cycle 3 River Basin Management Plans are due to be published in 2022, which may bring about changes in the baseline status and objectives for waterbodies. Where necessary, changes will need to be accounted for in updates to the WFD assessments at each Gate stage.

Natural Capital and Biodiversity Net Gain Assessment

An initial assessment of NC and BNG has been undertaken for the six elements of the Mendip Quarries SRO, using the WRSE methodology[2] following the latest guidance from the Environment Agency, Natural England and the ACWG. Whilst most of the elements show a net loss in NC and BNG, the Mendip Quarries SRO itself provides a potential opportunity for an overall net gain within the region, following updates to the scheme design and creation of compensation and mitigation strategies.

Summary of the results of the Natural Capital Assessment

Table B.4 (in Appendix B) presents a summary of the area of NC stocks that would likely be permanently lost as a result of construction of the elements or created during construction. Only stocks which result in a change in area post construction are included in this table.

Orchards are priority habitat and, if lost, cannot be easily or quickly re-created. Therefore, it is presumed that the elements cause the permanent loss of natural capital stock. Ancient woodland is a high value natural capital stock that will likely be permanently lost due to some elements. Ancient woodland cannot be replaced or replicated once lost.

In each case, the element will likely cause the temporary loss of stocks during construction. However, best practice mitigation (such as directional drilling pipelines) and reinstatement/compensation of habitat means that most Natural Capital stocks post construction will have no to little change.

The concept design should look towards developing a design to avoid or minimise the permanent loss of stocks, including ancient woodland due to construction, especially at Mendip reservoir (where ancient woodland is situated within the construction zone of the scheme but outside of the area designated as the reservoir).

Summary of the results of the Biodiversity Net Gain metric

Table B.5 (in Appendix B) presents the summary of the BNG metrics for the elements. The habitat units in this table consist of the natural capital stocks listed in Table B.4 (in Appendix B). Note that ancient woodland is excluded from BNG calculations as this is irreplaceable habitat and outside the BNG metric parameters.

Applying the methodology, most elements are likely to result in some loss of BNG habitat units due to the removal of habitats during construction and the time taken for compensatory habitat to reach maturity. The reservoir will result in an increase in biodiversity units due to the creation of surface water, both reservoir and lake, post construction.

Summary of the results of the ecosystem services screening

Table B.6 (in Appendix B) presents the summary of the ecosystem services quantitative assessment which monetises the values for natural capital benefit or loss for all elements. The guidance for the monetisation of stocks can be found in Section 4 of the WRSE Natural Capital & Biodiversity Net Gain Method Statement[3].

Quantitative ecosystem services for the elements of the Mendip Quarries SRO are:

- Carbon storage – scoped in when an element causes the temporary loss of associated stock;
- Natural hazard management – scoped in when an element causes the temporary loss of stocks within an active floodplain;
- Food production – scoped in when an element causes the permanent loss of associated stock.
- Air pollutant removal – scoped in when an element causes the temporary loss of associated stock within built up area; and
- Recreation & amenity value – scoped out as none of the elements permanently impact greenspace.

A qualitative assessment for water purification was scoped in as all elements cause the temporary loss of associated stock during construction. Associated stock are the natural capital assets which contribute to the provision of an ecosystem service. The contributing stocks is expected to be replaced/compensated through inset re-planting schemes. However, broadleaved/coniferous/urban woodland have a significant maturity time with a delay of 30 years. As a result the potential provision of these stocks will be reduced. Ancient Woodland is a high value natural capital stock that cannot be replaced or replicated once lost, therefore, future provision of stock is presumed permanently lost.

All of the elements are likely to generate the permanent loss of natural capital stocks associated with the provision of several ecosystem services.

Construction impacts include the release of CO_2, loss of natural hazard management and water purification due to habitat clearance. The options are also likely to generate a loss of some natural capital stocks during construction, however, if the affected sites are returned to pre-construction condition following best practice techniques then there should be no permanent impact on ecosystem services provision.

3 WRSE Natural Capital & Biodiversity Net Gain Method Statement (Mott MacDonald, 2020)

The elements present an opportunity to improve the existing habitats through post-construction remediation and replacement of low value habitats with higher value habitats. The elements also cross several Natural England Habitat Network Enhancement Zones[4] and are therefore suitable for the planting of new high value habitats. Mendip reservoir also presents a potential opportunity to provide recreation and amenity value if the option was to be opened to the public post construction.

Invasive non-native species risk assessment

The transfer of raw water from one location to another may increase the risk of spreading INNS. The introduction of INNS to a waterbody can have a significant detrimental effect on ecosystem structure and function, as well as jeopardising compliance with environmental legislation. The Environment Agency position statement *Managing the Risk of Spread of Invasive Non-Native Species Through Raw Water Transfers* outlines the organisation's position on how it will manage INNS risks associated with raw water transfers[5].

All elements of the Mendip Quarries SRO were screened to determine if the proposed raw water transfer will create a link between isolated catchments, as mapped in the Environment Agency document *Invasive Non-Native Species Isolated Catchment Mapping*[6].

For the intake pipeline from Newton Meadows, it is expected that appropriate treatment will be required to prevent the transfer of INNS from the River Avon to Mendip reservoir.

Of the outlet options, further investigation should be undertaken to assess the potential INNS risks associated with the raw transfers. The Kennet and Avon Canal, the River Stour and the Chewton Mendip aqueduct could be affected by spread of invasive species in the raw water transfer. Further investigation is needed on possible overflows/washouts from the Line of Works and raw water storage to better understand the INNS transfer risks.

The level of treatment required for mitigating INNS transfer risk will depend on the potential INNS present at the donor waterbody which initially will be low as it is assumed that any raw water entering Mendip reservoir would be treated before entering. It is possible that in the future other pathways could be established depending on the future use of the new reservoir. Public and recreational use for example as well as the presence of anglers can pose a risk of the spread of INNS into the reservoir which in turn can be spread to other water bodies via water transfer.

Further investigation into the potential INNS risk, and development of mitigation measures to eliminate the INNS risk will be required at Gate 2.

Benefits assessment

This section summarises the potential social benefits of the Mendip Quarries SRO and suggests potential mitigation and recommendations for Gate 2.

4 This is a spatial dataset that describes the geographic extent and location of Habitat Networks for 18 priority habitats based primarily, but not exclusively, on the priority habitat inventory with additional data added in relation to habitat restoration-creation, restorable habitat, plus fragmentation action, and network enhancement and expansion zones. Source: Natural England (2020) https://naturalengland-defra.opendata.arcgis.com/datasets/habitat-networks-combined-habitats-england

5 Environment Agency (2017). Managing the Risk of Spread of Invasive Non-Native Species Through Raw Water Transfers. Position 1321_16.

6 Environment Agency (2018). Invasive Non-Native Species Isolated Catchment Mapping. v3.

Social benefits

Localised impacts

The options-level SEA includes consideration of social effects, principally through the following SEA objectives:

- Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing (Population and Human Health);
- Maintain and enhance tourism and recreation (Population and Human Health); and
- Avoid negative effects on built assets and infrastructure (Material Assets).

Of the SEA objectives, the impacts that affect people relate to:

- Predicted impacts from construction activity, specifically noise and visual, affecting amenity of local residents or users of community facilities.
- The route affecting community facilities (or recreation route) through the temporary or permanent requirement for land of the community facility or access to the community facility.
- Disruption to journeys as a result of construction activity required for the options to cross transport infrastructure (A-roads, railway line) which may cause traffic congestion.
- Predicted beneficial impacts from reservoir options on health and wellbeing during operation as it is understood that the reservoir will be open to the public, creating new recreational opportunities, of which there are limited current options in the region at this scale.

In addition to the social effects considered within the SEA, temporary job creation during the construction phase of the Mendip Quarries SRO is likely to generate direct and indirect social benefits.

Mitigation of Mendip Quarries SRO social impact

The SEA work also identifies mitigation measures which can be applied as the Mendip Quarries SRO elements are refined. To avoid or mitigate potential disruption and disturbance to communities during construction and operation of the strategic water resource and transfer scheme, it is envisaged that the best practice mitigation will be implemented during construction, which usually includes:

- Setting out how engagement with local communities will be undertake during construction.
- Implementation of specific measures in relation to air quality and noise to reduce impacts on neighbouring resident communities, particularly for sensitive community resources such as educational facilities, health facilities and care homes.
- Sensitive layout and siting of potential construction compounds that take into consideration the potential impacts from noise, traffic, air quality and visual effects on communities.
- Maintenance or diversion of key routes used by the community such as footpaths and pedestrian and cycling routes.

More widely, socio-economic benefits could accrue through:

- Job and training opportunities, particularly in the construction sector. This will occur primarily during the construction period through supply chain benefits generated by the Mendip Quarries SRO, together with the spend by construction workers and contractors in local communities.
- Cascading benefits through procurement, by requiring companies in the supply chain to demonstrate how they will provide social value to local communities in executing construction works or operation and maintenance contracts.

Recommendations

At this stage, these benefits have not been explicitly included in the scheme, but the opportunity is identified for all options and will be investigated further during subsequent project stages. The wider benefits work to support Gate 2 will include:

- The design should be refined at Gate 2 to further avoid impacting communities along the route.
- The mitigation measures and enhancement suggestions that inform the SEA should be implemented to achieve positive effects.
- Programmes and initiatives to deliver public value should be implemented.
- Further detailed assessment on wider benefits to be included at Gate 2.

Assessment of opportunities for net zero carbon contributions

A key part of managing carbon is understanding the largest contributors in the whole life carbon assessment. Identifying hotspots can provide a focus for carbon reduction efforts. Early identification of these areas in the project life cycle provides the greatest opportunity to make positive changes and achieve the greatest reductions. A more detailed baseline will be analysed as the scheme progresses to provide a better understanding of the specific carbon emission courses for the scheme.

Capital carbon reduction opportunities

To reduce capital carbon of the pipeline construction, landscaping operations, tunnelling of the adits and shafts, the following key areas have been identified:

- Use of low or net-zero plant vehicles. The relies on suitable plant (such as electric and hydrogen powered) being available at the time.
- Minimising material imports/exports by optimising the landscape design accordingly.
- Choosing the right materials (reinforced concrete, pipelines); there is significant amount of embodied carbon in the reinforced concrete required for the associated infrastructure (treatment facilities etc.) and materials for the transfer pipelines. Embodied carbon reduction can be achieved by specifying low-carbon materials and working with the supply chain on reducing embodied carbon in the manufacturing stage.

Operational carbon reduction opportunities

Power consumption and power intensity of the transfer pumps and treatment processes is the most significant operational carbon contributions. Energy demands can be reduced through optimising the design and energy capture mechanisms. Other mitigation options include:

- Opportunities for renewable generation: the scheme could look to generate all, or a proportion, of the power requirements through renewables at the reservoir and treatment sites. Opportunities for PV and hydropower energy capture have been identified. Alternatively, the scheme could look for commercial arrangements to procure green power through a direct wire Power Purchase Agreement (PPA).
- Procurement of green tariff electricity: Renewable Energy Guarantees of Origin (REGO) backed green energy tariffs would reduce the generation impact of power from the grid average to zero, but would still incur the associated transmission and distribution losses associated with grid supply.

Summary conclusions and comparison between options

The assessments undertaken as part of the Mendip Quarries SRO indicate that some environmental and social impacts are likely to result from construction and operation of each of the elements, but that mitigation can be applied to lessen and, in some cases, avoid these impacts.

The intake pipeline from Newton Meadows has the potential to result in significant adverse effects on the Severn Estuary Ramsar, SPA and SAC as well as Mendip Woodland SAC. Further WFD assessment is required as it may result in some WFD effects on the Bristol Avon related to the new abstraction.

Construction of the reservoir has the potential to result in major adverse effects on biodiversity due to due to the likely significant effects on the Mendips Woodland SAC which is immediately adjacent to the construction boundary. In addition, this element may result in loss of area (ha) of NC baseline stocks, including loss of farmland (arable and pasture) and loss of Ancient Woodland, and resultingly, the greatest loss in value of ecosystem services per year of all the elements of the SRO. However, it may also create new habitat which could result in beneficial effects during operation. Further WFD assessment is required as it may result in

some WFD effects on the Mendip groundwater due to potential interaction between the quarry and local groundwater (both levels and quality). In operation, Mendip reservoir may create new recreational opportunities if it is open to the public, therefore resulting in beneficial social effects.

Table B.7 (in Appendix B) shows a summary of conclusions of comparisons of the four outlet options for each of the environmental assessment types. Further assessment is required for each of the options during Gate 2 to develop a preferred solution.

Initial water quality assessment

A high-level water quality assessment has been completed to identify parameters of concern for Gate 1. A parameter of concern would be identified as approaching or exceeding the limits set out in the Water Safety Regulations 2016[7].

The analysis has indicated the following major water quality considerations:

- EA database information indicates no parameters of major concern at the River Avon abstraction location. Although there are no parameters of major concern, completion of a water quality monitoring programme is recommended to ensure all water quality parameters are investigated as the option is developed.
- INNS treatment is considered necessary before surface water is input into the quarry. This treatment process, assumed to include clarification and filtration, may also mitigate against water quality parameters of concern if found at the River Avon abstraction location.
- There is a risk of stratification of the water in the reservoir depending on the incoming water quality and the degree of turnover. This is likely to require a reservoir mixing system.
- The mixing of surface water from the River Avon and groundwater of unknown quality from the quarry may impact the downstream treatment requirements. As no specific data is currently available on the quarry groundwater quality, this must be further investigated.
    - EA database information on a groundwater spring adjacent to the quarry indicates the occasional presence of high nitrate levels. This should not present a water quality hazard when diluted with influent water from the River Avon abstraction and as such is not considered to require further specific treatment.
- For all downstream options, current and comprehensive data for all water quality parameters should be gathered to allow investigation into water quality issues and to determine the parameters that should be considered limiting hazards in Gate 2. An EA water quality database investigation has currently highlighted the following water quality considerations:
    - Kennet & Avon Canal – alkalinity, chloride, hardness/magnesium, nitrate and nitrite parameters have been highlighted for further investigation as influent levels exceed existing levels in the canal.
    - Service Reservoir near Warminster – the water quality implications of mixing treated surface water with Wessex groundwater in the reservoir must be considered. To ensure wholesomeness of water in the existing network, water conditioning may need to be considered before blending.
    - River Stour – alkalinity, chloride, hardness/magnesium, nitrate and nitrite parameters have been highlighted for further investigation as influent levels exceed existing levels in the River Stour.
    - Chewton Mendip – alkalinity, barium, chloride, fluoride, nitrate and nitrite parameters have been highlighted for further investigation as influent levels from upstream locations exceed existing levels in the Barrow Reservoir discharge location.
- Once possible discharge locations, flows and compositions are known, the environmental designations and discharge restrictions for these locations must be reviewed.

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Gate 2 water quality assessment procedure

The Gate 2 procedure should consider which parameters of concern are limiting hazards and their associated risk scores in the form of water quality risk assessments. A limiting hazard is defined as any parameter that is likely to drive the development of the SRO option. A WQRA for each option should be drafted in dedicated spreadsheet tools and reviewed in a collaborative WQRA workshop including all SRO stakeholders and the DWI. Throughout the WQRA process, the list of limiting hazards for each option should be reviewed and refined to give a representative view of the parameters which are likely to need treatment. The WQRA process will also identify data gaps and residual risk considerations to be addressed moving forward into subsequent Gates. This strategy is summarised in Figure 5.1 and explored in detail in the ACWG Risk Framework Report[8], which should be referred to for guidance during the Gate 2 process.

Figure 5.1: ACWG WQRA methodology

Source: ACWG WQ Risk Framework Report – Jacobs 2021

6. Initial outline of procurement and operation strategy

Procurement strategies considered

The RAPID process assumes all solutions will meet Ofwat's eligibility criteria for DPC and follow the DPC process route. Under a DPC route, the appointee would run a competitive procurement process and award a DBFMO type contract to the CAP for a predefined period.

Due to the current early stage of the scheme's development, a definitive recommendation for a single procurement option has not been made, however DPC is currently considered likely to be the preferred route of delivery for the Mendip Quarries SRO. Where the transfer element interacts with existing infrastructure it may be deemed that this element of the SRO is not delivered through DPC (e.g. transfer to Chewton Mendip utilising the existing Line of Works) but the reservoir and abstraction would be included. This will be considered further in Gate 2.

Alternative procurement strategies may be employed at a later stage if the scheme is deemed not suitable and an alternative offers more value for customers. For delivery under the DPC, the following procurement structures have been considered:

- Single Appointee – Receiving water company contracts with CAP.
- Joint Venture – Receiving water companies form a Joint Venture that contracts with CAP.
- Single appointee and a Bulk Supply Agreements – One receiving company contracts with CAP and holds a BSA with other receiving water companies.

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Following further evaluation in Gate 2, if the solution is deemed not suitable for DPC, there are various alternative procurement strategies such as in-house delivery, in-house delivery with a BSA, through a Regulated Third Party, or other models.

The eligibility assessment for DPC is made up of a three-stage test.

1. Is the project greater than £100m whole life Totex?

The cost estimates show that both the capex and whole life totex are greater than £100m. Therefore the project passes the size test.

2. Is the project sufficiently discrete?

The transfer into and the management of the reservoir is discrete, and falls within one water company boundary, with activities falling under the Environment Agency's remit. Hence, on this basis, this element of the project could be considered 'discrete'. However, using the source as a resilience scheme would indicate the project is 'somewhat less suitable' for DPC, based on Ofwat guidance. The reservoir could support multiple potential transfer options, and therefore poses interoperability considerations across multiple receiving water companies.

Table 6.1:Project discreteness test – transfer options

<table>
<tr><th></th><th>Kennet & Avon Canal Transfer</th><th>River Stour Augmentation</th><th>Chewton Mendip Transfer</th><th>Service Reservoir near Warminster</th></tr>
<tr><td>Stakeholder interactions and statutory obligations</td><td colspan="3">Limited impact on appointee's ability to meet its statutory obligations</td><td>Potable water transfer and WTW requires interaction with DWI</td></tr>
<tr><td>Interactions with network</td><td>Discrete network of assets. No interaction with Water Company network.</td><td>Discrete network of assets with manageable interactions with Bournemouth Water Company network.</td><td>Discrete network of assets with manageable interactions with Bristol Water network.</td><td>Relies on assets that are actively managed as part of overall system operation of the network.</td></tr>
<tr><td>Contributions to supply/ capacity and ability to specify outputs</td><td colspan="4">Current understanding is this would be a resilience option which is somewhat less suitable for DPC, based on Ofwat guidance.</td></tr>
<tr><td>Asset and operational failures</td><td>Asset failure is well understood however market is not well experienced in delivering canal transfers yet.</td><td colspan="3">Asset operational failure is well understood, and market experienced in this type of project delivery.</td></tr>
</table>

Overall, Mendip Quarries has characteristics making it 'Discrete' and somewhat suitable for DPC, particularly in relation to interoperability and clear isolation of assets. However, there are significant risks that could reduce the suitability of the project for DPC such as the change in demand for the water resource and contracting requirements may be difficult to specify.

Overall, based on the framework for identifying DPC projects and information available at this stage of development the initial conclusion is that the scheme is likely to be suitable for a DPC route.

3. Will the scheme deliver Value for Money (VfM) for customers if delivered via DPC?

At this stage of development, only the value and discreteness assessments have been considered. The VfM assessment will be completed as part of Gate 2.

DPC tender model

Under DPC, there is scope to tender at different stages of the project lifecycle which provides several tender model options ('very early', 'early', 'late' and 'split' models) available to split activities and responsibilities

between the appointee and the CAP. A late DPC tender model is the most often selected model used in the market, allowing the client to be actively involved in the design and planning in the early stages to closely manage the project risks. Further analysis in Gate 2 is required to investigate the most preferable tender model, alongside the output of the VfM assessment.

Anticipated operational utilisation

The option has potential to supply as many as nine different water companies. The regional planning process will identify those receiving companies and WRZs for which the scheme provides a best value solution for water resource needs.

The reservoir could either be operated as a resource for baseload supplies, or it could be operated as a resource to increase resilience to severe drought events. Based upon the regional need, and initial regional plans, it is unlikely the scheme will be needed to provide a baseload supply in a normal year. It will most likely be needed to meet peak demands during extreme droughts in the groundwater and chalk dominated parts of the region (Wessex Water and Bournemouth Water). West Country water companies are most affected in peak periods by the combined impact of Environmental Destination licence reductions and climate change.

Different utilisation options will be incorporated into the associated WRMPs and regional plan decision making to determine the best (conjunctive) scheme-use in the regions, when considered as part of the overall programme appraisal, and best value-planning outcomes.

7. Planning considerations

This section of the report sets out the planning consent routes available for the project and identifies the initial considerations for each route. No decision on the consenting route is being made at this stage of the project. A high-level review of the potential risks and mitigation is presented along with the proposed next steps required to confirm the consenting route and more detailed consideration of engagement and overall programme.

Existing planning permission and restoration plan

Since the granting of the original permission for the quarry there have been several applications and permissions granted on the site. The latest permission granted was to deepen the existing quarry, and for the extension of operations until 2040, subject to regular reviews of the ongoing management of the water environment.

The restoration scheme attached to the existing planning permission includes the creation of a large lake in the centre of the main quarry and a smaller lake within an identified extension area. The restoration strategy proposes landscaping and bio-diversity provision and outlines potential after uses including Public Water Supply, which would be potentially subject to further planning permission.

Planning consent routes and initial considerations

The review of the planning considerations for this project assessed the abstraction and transfer from the River Avon along with INNS treatment, the reservoir and four transfer options to receiving WRZs. There are a further two scenarios for abstraction from the River Avon resulting in different DO benefits. For the purposes of assessing consenting routes the project has been deemed to be a reservoir development and a transfer of water resources development of which there are four options, one of which is for potable water transfer.

Depending on the type and scale of development proposed for the project, and particularly the final DO of the scheme, the available planning consent routes are either: an application for Development Consent under the Planning Act 2008 (PA2008), as a Nationally Significant Infrastructure Project; or an application for Planning Permission under the Town and Country Planning Act 1990 (as amended).

The DCO process was introduced to streamline the process of gaining consent for major infrastructure projects and provides greater certainty over timescales through maximum timescales for each stage including

determination. Should the chosen option meet the definition as an NSIP then the DCO route must be followed and the project cannot be consented any other way.

A key difference between the DCO process and the submission of a planning application through the Town and Country Planning Act (TCPA) is that a DCO enables a number of separate consents to be secured in a single application, including compulsory acquisition powers (CPO), whereas the TCPA route has a more limited focus, leaving a number of separate consents to be required including any CPO. On the other hand DCO requires the design and related aspects such as construction methods and mitigation to be fixed prior to submission, which might be less desirable if it is proposed to build overall scheme in several phases.

It is therefore the case that due to the complexity and the multiple elements of the project, if applications were made under the TCPA there could be additional risks to the scheme in terms of gaining consent for each element and potential delays to operational delivery. Equally it should also be noted that under the TCPA, water undertakers have certain Permitted Development rights which may be applicable and remove the need for a planning application to be made for certain works. The indicative programme shown in Chapter 3 shows the DCO route for planning. It has been assumed that the TCPA route would fit within the timescales shown with the potential for this to be a shorter period depending on whether a public inquiry would be needed.

Reservoir development

The existing quarry permission includes a restoration plan which includes the creation of a large lake in the quarry. For the quarry to be developed into and used as a public water supply reservoir/water storage solution, a new/amended restoration plan would need to be submitted to the County Planning Authority. However, if the proposal is for the construction of a reservoir that meets the definition as an NSIP as defined in Section 27 Part 3 of the PA2008 then an application will need to be made to the Secretary of State for Environment, Food and Rural Affairs for a DCO.

A key test would be whether the works to the quarry meet the definition of ‘construction of a reservoir’ and then the thresholds related to capacity or deployable output would apply. What constitutes a reservoir is not set out in the PA2008. The Reservoir Act 1975, whose purpose is to ensure the safety of reservoirs, defines Large Raised Reservoirs as (a) a large, raised structure designed or used for collecting and storing water; and (b) a large, raised lake or other area capable of storing water which was created or enlarged by artificial means. The quarry reservoir would not fall within these definitions. As part of the work to confirm the consenting route it will be advisable to seek clarity on the status of the quarry project as a reservoir project from DEFRA, and legal advisors.

According to the PA2008 the construction of a reservoir is within the definition of an NSIP if it is considered that the volume of water to be stored in the reservoir will exceed 30MCM, or the deployable output of the dam or reservoir will exceed 80Ml/d[9]. In addition, section 27(1)(b) of PA2008 states that to meet the definition the construction will be carried out by one or more Water Undertakers – as per the Water Industry Act 1991.

Section 2 identifies the proposed total volume of the water to be stored in the Mendip Quarries reservoir is 52.8MCM. If it is confirmed that the proposal meets the definition of ‘construction of a reservoir’ it would therefore qualify as an NSIP as per the PA2008 and consent would be required through the granting of a DCO.

9 “deployable output” means, in relation to a given facility, the annual average volume of water that can be produced per day from that facility under drought conditions, “drought conditions” means conditions resulting from a shortage of precipitation that has a 0.5% chance of occurring within a 12-month period;” as per The Infrastructure Planning (Water Resources) (England) Order 2019

Should the proposal change such that the capacity of the reservoir proposal does not meet the threshold it is still possible to apply to the Secretary of State for a Direction under Section 35 for the project to be considered an NSIP and therefore seek consent through a DCO.

Transfer of water resources development

For a raw water transfer development between river basins or water undertakers' areas in England to be an NSIP, and require a DCO, the DO of the facility to be constructed as a result of the development will exceed 80Ml/d, or the additional DO of the facility to be altered as a result of the development will exceed 80Ml/d.

None of the proposed transfer of raw water resources developments meet the threshold to be considered NSIPs in their own right. The Service Reservoir near Warminster option does exceed the DO threshold, however the proposal relates to the transfer of drinking water and is therefore excluded according to the PA2008 (S28 (1)(d)).

Should the reservoir development be promoted as a NSIP requiring a DCO then the works related to the abstraction from the source and other related infrastructure could be consented as part of the DCO as "associated development" (as defined in the PA2008). The transfer of water resources development would also be deemed "associated development" as an integral part of the project.

If the proposed WTW or the other transfer related infrastructure is not included within a DCO then the planning route would likely involve a planning application under TCPA for the WTW and potentially other applications for the infrastructure works should the permitted development rights of the water undertakers in the respective areas of development not apply.

Risks and Mitigation

High level risks and potential mitigation related to planning for this Gate 1 submission include the following:

Figure 7.1: Planning risks and mitigation identified

Risk	Mitigation
Project definition and selected consenting route is challenged	Engagement with Environment Agency and seek legal advice to confirm route
Demonstrating the 'need' case for the project	Ensure compliance with draft/final National Policy Statement
Project does not meet threshold for NSIP	Application to Secretary of State for direction under Section 35 of PA2008 Application to Local Planning Authorities for planning permission.
DCO is challenged at acceptance / examination– adding time/cost	Seek EIA scoping opinion Ensure compliance with the PA2008
Land acquisition issues	Seek agreement over land required Prepare robust compulsory acquisition strategy Ensure land justified as being essential for the project
Requirements imposed in DCO	Embed flexibility in the DCO
Judicial review	Ensure robust process and evidenced

8. Stakeholder Engagement

This section of the report provides a summary of the regional stakeholder engagement to date, including customer preferences, to identify any issues that need further investigation. It also documents the engagement completed up to Gate 1 and the direction for Gate 2.

Stakeholder engagement completed ahead of Gate 1

Specific stakeholder engagement for the Mendip Quarries project has been delivered through project specific meetings with statutory consultees and regulators. A summary of engagement to date is presented below:

Table 8.1: Summary of Project Specific Stakeholder engagement

Stakeholder	Activity to date
Drinking Water Inspectorate	Project specific meeting in September'21 and subsequent correspondence
Environment Agency	Project specific meetings in May, September and November '21
Natural England	Project specific meetings in September and October'21
RAPID	Project specific meetings in September'21 and briefing at board meeting October'21 attended by Ofwat, EA and DWI
Regional Planning groups	Regular briefings on progress at WRSE and WCWRG steering group and Board meetings

Customer Preference

Customers from ten water utility companies (including South West Water) have been consulted on their attitudes towards the interregional water transfers and water resource schemes by participating in WRSE's research programme. The research aimed to frame customer views on improving resilience of water supply to drought and other disruptive events, in a non-project specific context, alongside associated outcomes such as delivering social outcomes, improving the environment, and reducing customer drought measures. The research was delivered through an evidence review and qualitative and quantitative analysis, whist ensuring feedback was cost efficient and consistent across regions.

The research considered evidence gathered from WRMPs, PR19 and ongoing research. The sponsor companies have previously carried out customer research projects for previous WRMPs, which were mainly aimed at gathering the customer attitudes towards schemes within the company boundary and the region.

The key findings of the research is summarised below and is publicly available at Customer Preferences Summary Report:

- Customers are fully supportive of the coordinated and collaborative approach to water resource planning in the South East.
- Customers are willing to support plans and investments which will safeguard service levels and the environment for future generations.
- Customers have established similar views that transfer options rank toward the lower end of preferred options. There is an expectation from customers that self-reliance should be targeted over a perceived riskier strategy of relying on long-term imports into the region.
- Customers are more willing to see transfers when there is a lower impact on themselves and are less willing to see water transferred out the region if the recipients (customers and companies) are more wasteful in their water use.
- Previous research by companies has found that transfers by river or canal are more appealing than by pipeline options due to perceptions by customers that this would have wider benefits and fewer negative impacts. Additionally, research has previously shown that customer's transfer scheme concerns include cost, disruption due to construction, leakage, impacts on the environment, energy required, lack of benefits to the local community, and the deteriorated service levels in the donor communities.
- A key learning outcome of the research is that customer engagement will be more meaningful when schemes are framed in the broader context of the current situation. They want to understand how the SROs fit into the wider plan, in terms of combinations of source(s) and transfers and how they substitute for each other and the consequences of a no build solution. When presented in isolation, a customer's

ability to provide an informed perspective will be limited, which may mean that water transfer schemes are seen less acceptable.

Research carried out by Wessex Water using their online customer panel 2020 for the West Country North SRO is also relevant to this scheme. Overall, customers were broadly supportive of the concept of sharing water and transferring surplus water to the neighbouring regions. The results of this research are included in the Gate 1 submission for West Country North.

The next stage of research will be broader qualitative and quantitative research and it will be linked in with customer research for the regional plan.

Preparing for community engagement

Prior to a DCO application for this scheme, a community consultation and engagement strategy will be developed, which will include engagement through existing quarry liaison groups.

9. Key risks and mitigation measures

An initial non-monetised risk register has been produced for Gate 1, and Table 9.1 summarises the key risks and mitigation measures identified. This register will be developed for Gate 2 to produce an accurate costed risk register once the solution has been better defined.

Table 9.1 Key programme risks

Description	Mitigation plan
Quarry Decommissioning There is uncertainty around the quarry owner's plans. Therefore the risk remains that quarrying does not cease by 2040, or that the owners are not willing to sell the site at an acceptable price when quarry operations cease.	Continued engagement with the quarry owner to discuss technical and commercial matters as well as timescales. Review of alternative quarries in the Mendip area due to be decommissioned circa 2040. Obtaining agreement with owners early in the programme would mitigate this high-impact risk.
Deployable output benefit An initial assessment of DO benefit has been conducted informed by historical drought events, but a full stochastic assessment has not been carried out, nor have opportunities for conjunctive use with existing resources in receiving WRZs been explored.	A full assessment of the 1-in-500 yield is proposed for Gate 2. This will include rainfall-runoff modelling and the use of stochastic datasets. Inclusion of the options in water company water resources system models so that potential conjunctive benefits for each WRZ can be estimated.
External challenge (planning) External challenge (such as a legal challenge, judicial review, or public enquiry) may affect delivery and programme.	Ensure robust process and programme, which is evidenced.
Stakeholders on the River Avon Enhanced abstraction at Newton Meadows may lead to unacceptable navigational and/or environmental impacts on the River Avon. Other river stakeholders may oppose enhanced abstraction.	Continued engagement and consultation with Bath & North East Somerset Council, Avon Navigation Trust, the Environment Agency, and other relevant stakeholders for the River Avon.
Water quality There is uncertainty in the River Avon water quality, and in the requirements at both the Mendip reservoir and in the receiving watercourse/waterbodies. Treatment requirements are therefore unconfirmed at this stage.	Sample and model water quality in the River Avon; understand mitigation measures required to manage water quality in the Mendip reservoir; investigate baseline conditions in receiving watercourses/waterbodies, including those linked to the reservoir through groundwater connectivity.
Transfer conveyance & existing infrastructure The capacity in the existing infrastructure downstream of the transfers is not understood at this stage, including the capacity of pipeline networks, abstraction points and treatment works. For each transfer option, the related uncertainties and risks differ; for example, the capacity of the Kennet & Avon Canal is to be assessed.	Further work to understand the capacity envelopes for each transfer corridor, supply network and water treatment capacities. Engagement with the relevant water companies, and the Canal and Rivers Trust.
Environmental – INNS The conveyance of raw water from Newton Meadows to the Mendip reservoir and the onward transfer(s) opens a new pathway for the potential spread of invasive species.	Undertake INNS transfer risk assessment, covering the raw water transfer to the reservoir, the proposed INNS treatment and transfers to receiving water courses. Identify further mitigation measures if required.

Description	Mitigation plan
Environmental There is a risk that ecological receptors will be affected, and habitats disrupted by changes in water chemistry, quality, levels and flows because of abstraction from the River Avon, changes in water levels in the reservoir, and transfers into receiving watercourse/waterbodies. There is a risk that abstraction and/or discharge may be unacceptable due to environmental restrictions.	Undertake baseline studies to assess the watercourses/ waterbodies impacted, and investigations into the potential changes from changes in groundwater levels and from the transfers. Build mitigation measures identified into the project programme and scheme design as more specific environmental risks are identified through further investigation and more detailed assessment.
Reservoir leakage Due to the advantageous geological properties at the reservoir leakage has been considered to be manageable under the current proposals. However, further quarrying could increase leakage of the reservoir and there is a risk that if lining is required the cost could be prohibitive.	Continue to develop understanding of hydrogeology (including using hydrogeological modelling) and keep under review through engagement with geologists at quarry.
Reservoir water quality There is a risk of stratification of the water in the reservoir depending on the incoming water quality and the degree of turnover. Algal growth could lead to die back and the formation of taste and odour pre-cursors.	Pre-treatment of incoming water to remove nutrients that might encourage algal growth. Inclusion of a reservoir mixing system.

10. Option cost/benefits comparison

Confirmation of scheme delivery

As discussed in Section 3, depending on the transfer option(s) selected and the decommissioning date of the quarry, the scheme can be commissioned between autumn 2042 and autumn 2046.

Confirmation of scheme cost consistency

Capital and operating cost estimates have been developed using a spreadsheet that uses Thames Water's Engineering Estimation System cost models where applicable (Thames Water sponsored some of the early work on this scheme which included initial costing). The capital cost estimates have been built up based on the concept design and are preliminary at this stage because further work is required to better define some scheme elements (e.g. to better define treatment process needs). The cost estimates exclude any works or payments to make the schemes carbon neutral.

To enable the comparison of different solutions, the costing has been split into elements: the inlet conveyance and reservoir as one grouped water resource element which applies to all options; and each of the outlet conveyances (and potable water treatment where applicable) costed separately. The capital costs of the abstraction infrastructure from the reservoir have been included in the water resource element, but the operating costs are included in the transfer element to reflect the different volumes and to allow for combinations of options to be selected.

We have included for an assessment of optimism bias using the approach set out in the ACWG Cost Consistency Methodology (Rev C). This follows the recommendations made in the Supplementary Green Book Guidance on Optimism Bias to help deliver consistency in the approach for all Strategic Resource Options. Elements have been categorised as standard or non-standard to determine the upper bound optimism bias figure of 44% or 66% respectively. These upper bounds have been used without scaling due to the relative immaturity of the option development and no quantitative cost risk assessment has been included for in Gate 1.

Table 10.1 summarises discounted costs (NPV) and average incremental costs (AIC) for the scheme elements. The estimates are shown for the resource and transfer elements separately and for a combined scenario where the AIC of the larger resource is added to the transfer AIC – for the smaller transfers this implicitly assumes that multiple transfers are developed so that the resource can be fully utilised.

Estimation of the discounted cost has followed guidance from the All Company Working Group to ensure consistency in the calculation across SROs. The ACWG cost consistency report reviewed approaches to

calculation of financing costs and recommended a consistent approach. The AIC provides an estimate of the unit cost for delivering the DO of the scheme – as the costs will depend upon the level of utilisation a maximum and minimum utilisation AIC have been calculated. In both cases the denominator, discounted DO over the life of the scheme, is the same – i.e. the AIC is a unit cost for making available capacity, not a unit cost of water actually delivered.

Table 10.1 Cost estimates (at 2017/18 prices)

Element and Sub Option	Water resources benefit (Ml/d)	Total NPV (£m)	Average Incremental Cost (AIC) (p/m3)		Whole Life carbon (tCO2e)
			Min Utilisation	Max Utilisation	
Resource elements					
Mendip reservoir (including inlet conveyance and INNS treatment)	29	311	106	127	72,000
Mendip reservoir (including inlet conveyance and INNS treatment)	87	623	69	84	105,000
Transfer elements					
Outlet transfer to Chewton Mendip	16	32	14	23	7,000
Outlet Transfer to SR near Warminster & WTW 30Ml/d	30	275	77	105	116,000
Outlet Transfer to SR near Warminster & WTW 90Ml/d	90	605	49	77	141,000
Outlet transfer to R. Stour	30	63	16	21	11,000
Outlet transfer to K&A canal 30 Ml/d	30	184	49	76	25,000
Outlet transfer to K&A canal 50Ml/d	50	248	34	61	29,000
Combined resource and transfer assuming 87 Ml/d resource and equivalent volume of transfers are developed					
Outlet transfer to Chewton Mendip	16		84	107	
Outlet Transfer to SR near Warminster & WTW 30Ml/d	30		147	189	
Outlet Transfer to SR near Warminster & WTW 90Ml/d	90		119	161	
Outlet transfer to R. Stour	30		85	105	
Outlet transfer to K&A canal 30 Ml/d	30		118	160	
Outlet transfer to K&A canal 50 Ml/d	50		103	145	
Outlet transfer to Testwood WTW 30 Ml/d*	30		232	290	

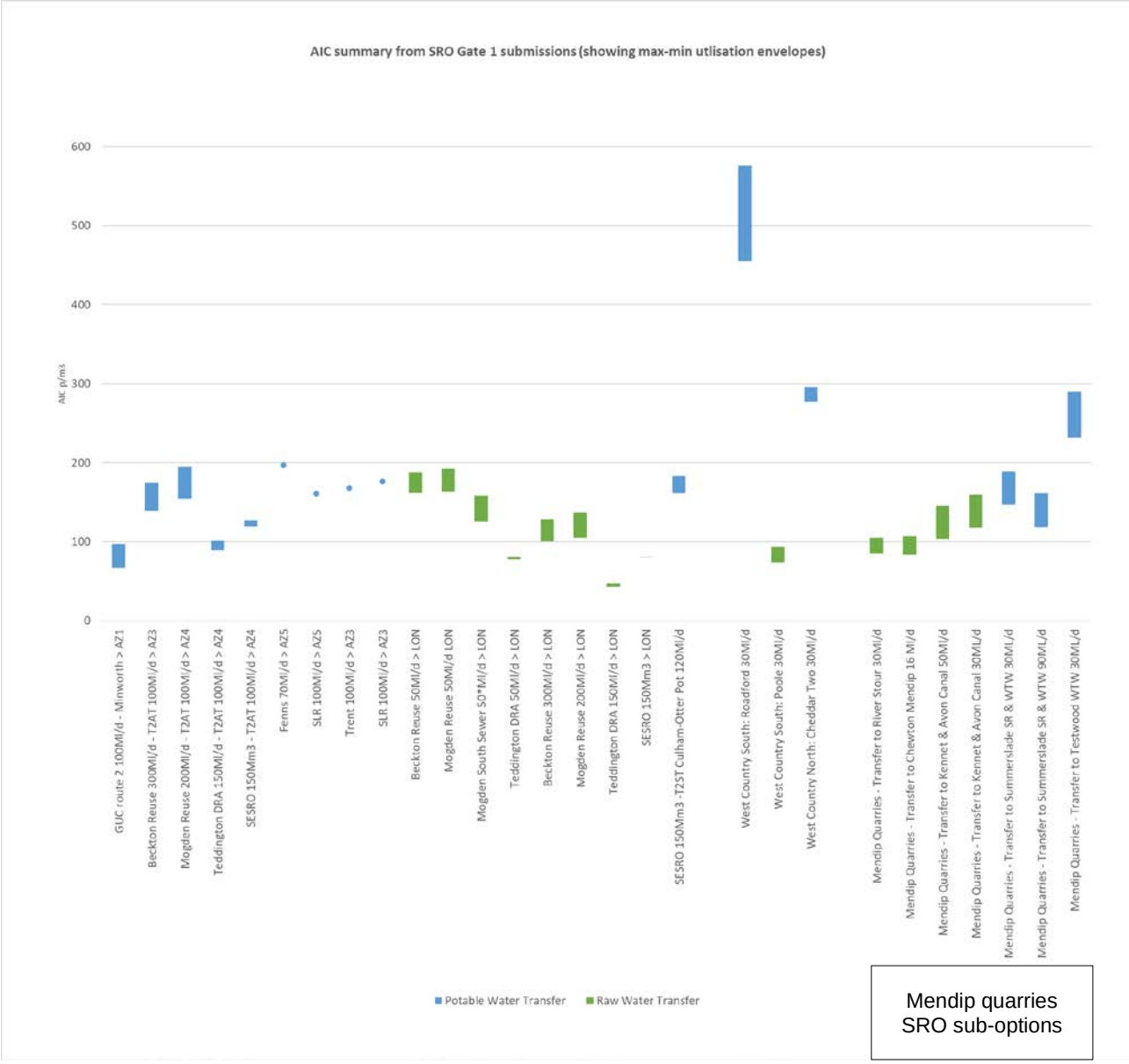
Note: *Transfer to Testwood WTW is calculated by adding the AIC to SR near Warminster plus the potable water transfer from WSX centre to Testwood as shown in Table 12 of the Gate 1 report for West Country South SRO.
Total NPV and whole life carbon have been assessed assuming full utilisation
Maximum utilisation is assumed for these calculations: 1 in 500 year deployable output for 365 days/year, to enable comparison between options. Required utilisation to be confirmed by the regional groups and water companies.

A high level comparison is presented in Figure 10.1 of the combined element AICs from Table 10.1 with a selection of AICs for other SROs from published Gate 1 reports. From the chart the following initial observations can be made:

- For supplying Wessex Water and Bournemouth Water, the AIC for the Mendip Quarries transfer to the River Stour is comparable with that for the West Country South Poole effluent reuse SRO.
- For supplying Thames Water in London the AIC for the Mendip Quarries transfer to the Kennet & Avon canal is higher than for the South East Strategic Reservoir Option (SESRO) for the larger reservoir size, but is comparable with the Beckton and Mogden reuse AICs.
- For supplying Affinity Water the AIC for the Mendip Quarries transfer to the Kennet & Avon canal is higher than for the Grand Union Canal transfer option, but is potentially comparable with other alternatives (e.g. SESRO, Thames to Affinity and Anglian to Affinity).
- For supplying Southern Water the AIC for the Mendip Quarries transfer to Testwood WTW is higher than for the Thames to Southern Transfer, although further work would be needed to estimate the AIC for a larger pipeline from the SR near Warminster to Testwood WTW.

At this stage of development, it is not possible to state which option or combination of transfer options provides best value for customers. Whether the transfer to the Kennet & Avon is optimal for the south-east region will be determined by the WRSE Best Value Planning framework. Equally changes to abstraction make it likely that the Mendip Quarries resources will be needed in the West Country Water Resources region. If the option is selected in both regions then the regional reconciliation will need to ascertain the best value use of the option.

Figure 10.1: AIC-comparison



Carbon assessment

Table 10.1 provides the whole life carbon for each of the elements and sub-options. Due to the current level of design development for Gate 1, there is still significant uncertainty in these values which will be addressed as the scheme develops. An assessment of the carbon reduction opportunities are presented in Section 5.

The reservoir has the largest footprint, however this value is much smaller than traditional reservoir construction given the reduced material imports and movements with much of the site already profiled for the reservoir. Transfer to Chewton Mendip has the smallest whole life carbon due to short length and smaller volume. On the other hand, the potable transfer to a SR near Warminster has the highest whole life carbon due to the length and requirement for a new WTW.

Operational carbon has been estimated for each option. Emissions from normal grid energy have been estimated based on future projections from the Treasury Green book table 1 (Grid Average EF for the Commercial/Public sector 2021).

11. Impacts on current plan

This section describes the impact of the proposed Mendip Quarries solution on current delivery plans for the scheme partners and explains how the solution fits in with the developing regional plan and the upcoming water resource management plans.

Wessex Water

Wessex Water published their current WRMP in August 2019 (wessex-water-final-wrmp). At the time the WRMP forecast that, given the investments made over the previous 10 years, Wessex Water had access to enough water to meet the needs of its customers for at least the next 25 years without the need to develop new sources of water. The plan included proposals to reduce the amount of water taken from the environment, through water efficiency initiatives, metering and reducing leakage by 15%.

South West Water

South West Water also published their current WRMP in August 2019 (sww-bw-wrmp19---finalplan_aug2019). The plan covers both the South West Water area and Bournemouth Water. The WRMP demonstrated that the balance between supply and demand could be maintained over the plan period to 2045 through reducing leakage, optimising water resources to ensure they are resilient to future droughts, and developing planning tools and understanding of future options. In the Bournemouth area the plan included a 20 Ml/d transfer to Southern Water, which subsequent studies have shown is not feasible due to the potential impact on river flows at Knapp Mill on the River Avon within the Hampshire Avon SSSI.

West Country Water Resources Group

The West Country Water Resources Group published the initial draft of the first ever regional water resources plan for the South West of England in September 2021 (initial-draft-regional-plan-for-reconciliation-final). Following a reconciliation process with other regions this plan will be subject of informal consultation and further development in 2022 and 2023. It will be used to support individual water company water resource management plans due to be finalised in September 2023.

Although the WRMPs published in 2019 showed that all the companies in the West Country would be able to maintain a balance between demand and supply for the next 25 years without developing new water resources, the future looks different due to a range of factors:

- New planning requirements to enhance resilience to drought events with a probability of 1 in 500 years;
- The Government's pledge in its 25-year Environment Plan that we would be the first generation to leave the environment in a better condition than we found it;
- Climate change and its impact on water availability due to hotter, drier summers;
- An expectation in the National Framework for water resources that there should be long term reductions in water use by reducing consumption and leakage alongside the development of new sustainable sources of water;
- The need to plan for all water users not just public water supplies provided by water companies;
- A desire to fully explore all opportunities for water transfers, within and between regions, of different scales and lengths;
- A requirement to be adaptative to uncertainty;
- A continued requirement to ensure that our plans are affordable to customers.

The regional plan considers a range of possible future water needs by 2050, which all show that the region is likely to face a deficit in water availability without intervention. To address the challenges the plan proposes a strategy with four distinct themes:

- Reduce the uncertainty associated with environmental needs and demand reduction;
- Improve the use of existing water sources;
- Ensure future strategic options can be implemented;
- Improve understanding of non-public water supply needs and improve connectivity and storage to support them.

Mendip Quarries is identified as one of the strategic resource options that could assist in meeting the future needs. As there are uncertainties about the feasibility and deliverability of the strategic resources options and the lead times are long, the plan proposes that they continue to be developed so that they can be deployed when required.

Thus the Mendip Quarries solution fits with the long term ambitions and strategies for both companies and for the region. The solution would provide supply resilience as abstraction reductions and climate change begin to impact on existing sources yields.

12. Board statement and assurance

The decision to promote the Mendip Quarries solution as part of the RAPID gated process has been made through the normal internal governance processes within Wessex Water and South West Water.

The Boards of Wessex Water and South West Water fully support the submission and have each approved Board statements as follows.

> The Board are satisfied that the application for Mendip Quarries to become a RAPID Strategic Resource Option meets the requirements outlined in RAPID's Strategic regional water resource solutions guidance for 2021.
>
> The Board also confirm that they:
>
> - Support the recommendation for the solution to become a RAPID Strategic Resource Option
> - Understand their role in the submission as a receiver, supplier, or as an internal transfer of water

A full assurance process, including third party external assurance, will be applied ahead of the Gate 2 submission in accordance with RAPID's guidelines.

13. Solution or partner changes

The core partners are Wessex Water and South West Water.

For Gate 1 the funding share percentages are SWB 50%: WSX 50%.

The partnership arrangements will be reviewed during the Gate 2 period and confirmed in the Gate 2 submission.

Other stakeholders who will be key to the successful delivery of the scheme include:

- the owners of the selected quarry
- Canal and River Trust for the potential transfer to Thames Water.

14. Efficient spend of gate allowance

This section provides evidence of appropriately allocated efficient expenditure presented in 2017-18 price base.

Gate 1 Expenditure

Table 14.1 Gate 1 costs

Description	Cost £m @ 2017/18 prices	Comments
Technical studies including pre-feasibility study and Gate 1 submission	0.13	Awarded through framework agreements that have been competitively tendered, and cross checked against similar commissions. All packages have defined deliverables and key dates.
Partner cost including programme management	0.03	
Regulator costs: EA National appraisal unit & area costs	0	Assumed not applicable.
Natural England Discretionary advice service	0	Assumed not applicable.
Total	**0.16**	

The only allowances in the PR19 final determinations for supply side resource development were the ring fenced allowances for the three West Country SROs. Therefore we request that additional funding of £0.16m is allocated for Gate 1 for the Mendip Quarries new solution.

This is considerably lower than the costs involved with progressing the other West Country SROs because:

- Technical work has not been to the same level of detail, although we consider it is adequate to demonstrate the potential of the solution. More detailed technical studies have been deferred to Gate 2 (refer to sections 14 and 15).
- We have been able to benefit from learning and experience on the other SROs.
- The breakdown does not include any EA costs for the National Appraisal Unit, EA area costs or Natural England costs, which we assume are not applicable.
- We have not carried out any external assurance of our Gate 1 submission.
- As there are fewer work packages, the associated programme management costs have been lower.

Gate 2 expenditure

A preliminary forecast of the expenditure for Gate 2 is given in Table 14.2 below. As mentioned above the governance and funding arrangements between the solution partners will be reviewed before the Gate 2 submission.

In the Gate 2 submission we will provide appropriate evidence that the expenditure has been efficient in accordance with the guidelines. We will also develop proposals for funding of future gates to inform discussions with RAPID and to be presented in the Gate 2 submission.

Table 14.2 Preliminary Gate 2 budget

Ref.	Description	Cost £m @ 2017/18 prices
1	Technical and engineering:	
1.1	Project technical lead & coordination	0.10
1.2	Hydrology and hydrogeology	0.38
1.3	Site selection and surveys	0.05
1.4	Concept design	0.38

Ref.	Description	Cost £m @ 2017/18 prices
1.5	Environmental assessments	0.37
1.6	Drinking water quality considerations/DWSP	0.11
2	Programme and planning (incl DPC assessment)	0.12
3	Cost estimating	0.11
4	Contribution to regional planning (SRO specific regional modelling)	0.14
5	External assurance	0.05
6	Stakeholder engagement	0.05
7	Specialist consultants (land and legal)	0.29
8	Third party costs (EA NAU, NE, CRT)	0.17
9	Partner costs including programme management	0.17
10	Contingency	0.24
	Total	2.72

15. Proposed Gate 2 activities and outcomes

This section of the report provides our proposals for Gate 2 activities, outcomes, penalty assessment criteria and incentives; and includes an explicit consideration of the impacts of solution delays.

The proposed Gate 2 activities have been identified to meet the requirements of the RAPID gated process, recognising they will be done in parallel with regional and water company water resource management plans. Key activities to be undertaken are provided in Table 15.1 to identify the preferred concept to be developed in detail for Gate 2.

A suitable quarry has been identified for this project, however a site selection study prior to Gate 2 will confirm whether there are other quarries in the area that are preferable. Groundwater modelling of the reservoir site will assess the reservoir under drought conditions and assess the impact during a drawdown on the local waterbodies and groundwater abstraction sites.

A detailed planning and consents strategy will be prepared to include: programming for the DCO and/or planning applications and integration with the WRMP24 and DPC, identification of the deliverables necessary and a review of the planning risks and mitigation. Further stakeholder engagement particularly with relevant Local Planning Authorities, the Environmental Agency and other statutory environmental bodies as well as other consultees to include land interests will be conducted. A legal review and assurance of work will be undertaken prior to Gate 2 submission in particular the project definition in relation to the Planning Act 2008.

To inform the Gate 2 concept design, a programme of ecology and water quality monitoring will be conducted to confirm the hydrology and environmental flows, verify the proposed water source and serve as a basis of the INNS risk assessment and water quality risk assessments. Water quality modelling will investigate the reservoir mixed water quality condition to inform the design of the INNS treatment works and the drinking water quality risk assessment.

Alongside further environmental studies including the WFD level 2 and INNS risk assessment that were not conducted in Gate 1, environmental assessments that were conducted in Gate 1 (HRA, SEA, BNG, NC) will be updated as the design develops, as will the carbon assessment. Baseline studies will be conducted for

environmental and social topics (to include biodiversity, soil quality, water resources, air quality, noise and vibration, climate and carbon resilience, landscape and visual, historic environment, population and health and material assets). The current restoration plan will be reviewed, and the objectives of the restoration scheme integrated with the concept design to identify opportunities to deliver wider benefits. The interaction of Mendip Quarries SRO with regional plans will be reviewed, including in-combination effects with plans or projects identified. EIA scoping will define the environmental surveys required in Gate 3.

The transfer options will be developed further, to optimise the route, further consider environmental and social impacts, and the interactions with existing assets. The regional and water company plans will inform which transfer routes are preferred to support the West Country and South East regions. This may adjust the capacities of the transfer infrastructure to match the deployable output required.

A site selection study and concept design will be developed for the associated infrastructure, including INNS and water treatment works, abstraction and outfall facilities, and pumping stations. Infrastructure assessments to identify any network reinforcement requirements downstream of the point of receipt of a bulk supply are excluded and will be the responsibility of the receiving water company.

Table 15.1 Gate 2 Key Activities

Workstream	Activities	
Planning	• Identifying deliverables for DCO /planning applications. • Legal advice on DCO process. • Land referencing of scheme sites. • Consents and licensing strategy.	• Public consultation (non-statutory) input to options definition and preferred option selection. • Engagement with Local Planning Authorities, the EA and other environmental bodies.
Procurement	• Procurement strategy development	• Value for money assessment
Technical and engineering	• Consider regional plans to inform DO and transfer options. • Groundwater modelling including groundwater/surface water interactions. • Rainfall run-off modelling using stochastic data series and climate change projections to estimate 1:500 yield. • Engagement with water companies to incorporate option into system models to assess DO benefit for each receiving WRZ. • Site selection. • Optioneering of transfer routes. • Downstream infrastructure assessment. • Desk-based ground investigation. • Monitoring programme (flow, water quality). • Water Quality Risk Assessment. • Concept design for INNS and Water Treatment facilities.	• Water mixing and blending assessment. • Develop operational philosophy. • Develop a strategy for water quality monitoring and improvement (e.g. bubbler system for destratification). • Develop reservoir concept design including construction access to adit portals, adit screens, adit design and outline pump type/size/arrangement. • Develop concept of surface power and flow control facilities. • Power study and renewable energy concept design. • Update costing, risk and mitigation. • Updated delivery programme. • Proposals for Gate 3 activities and outcomes.
Environmental assessments	• Ecology monitoring programme. • Abstraction licence considerations (at reservoir and Newton Meadows). • Wider benefits assessment – social outcomes, resilience. • Baseline studies for environmental and social topics.	• Review in-combination effects with plans or projects. identified in the regional plans • Environmental, social and economic evaluations. • INNS risk assessment. • WFD, SEA, BNG, HRA.

Workstream	Activities	
Engagement	• Customer engagement. • Stakeholder engagement.	• Regional consultation to WCWRG and WRSE. • Landowner engagement.

The list of activities is extensive so it will be necessary to prioritise the activities that are critical to determining the feasibility and deliverability of the scheme and securing it as a viable option in the regional plan and company WRMPs. We plan to adopt a phased approach to Gate 2 such that interim conclusions are available in summer 2022 for discussion with RAPID and stakeholders.

Gate 2 penalty assessment criteria

The Delivery Incentives Framework detailed in the Final Determination of PR19 states that a penalty of up to 30% of each company's total efficient spend will be applied for inadequate deliverables or late submissions. It is proposed that this framework would be applied for Gate 2 submissions.

Assessment of solution delay impacts

Mendip Quarries is a new solution submitted to the RAPID gated process and as such had a delayed Gate 1 submission date. Although the project plan is based on the standard Gate 2 submission date we would welcome the opportunity to discuss with RAPID whether there is any flexibility in the Gate 2 submission timeline. As discussed in Section 3, as the current selected site is not available until around 2040 a short delay at Gate 2 (to say March 2023) would not impact on solution delivery as construction is not presently proposed to start until 2030, allowing for a longer time period for project development and obtaining consents in Gate 3 and 4.

16. RAPID's criteria for a new solution

Section 6 of RAPID's guidance for SROs for 2021 (RAPID: Strategic regional water resource solutions guidance for 2021 - Ofwat) sets out the process for entering a new solution into the gated process.

We consider that the Mendip Quarries SRO meets all five of the criteria, as explained below. We have also engaged with RAPID, the Environment Agency, the Drinking Water Inspectorate and Natural England in the run up to entering the solution and during the preparation of the Gate 1 report.

Is there value in accelerating the solution's development to be 'construction ready' for the 2025-2030 period?

Yes. As explained in section 11 even with ambitious demand reduction measures the WCRWG regional plan identifies the need for supply side schemes to meet the predicted long term deficit in the West Country. There are also continuing requirements for additional supplies in WRSE. Mendip Quarries is one of the strategic options recommended for progression in the regional plan.

The quarry is currently in operation extracting aggregate. Based on current production rates it will be worked out around 2040, but this date is based on an assessment of the market demand for aggregate so it could be sooner or later depending on market conditions and the geological challenges as the quarry goes deeper.

The studies to date have identified that:

- Construction work within the quarry footprint needs to be undertaken from the existing haul roads before quarrying ceases and the dewatering is switched off.
- The inflow conveyance, water treatment works and outflow conveyance could all the constructed in parallel before 2040. There is also an option to phase parts of the outlet conveyance to suit the need for the water as it is largely independent of the other work.
- The longest duration activity is likely to be first filling of the reservoir.
- The outline project plan presented in section 3 shows that the solution would be operational around 2042, which is later than the predicted window for all the other SROs of 2035 to 2040, but potentially it is less vulnerable to programme delays.

Although the construction would not commence in the period 2025-2030, it would be possible to complete the construction much more quickly and with more certainty than other options because the “reservoir” will have already been constructed by 2040. At this stage the key issue is to secure the option, such that it can be reliably used as the basis for planning of future water resources strategies.

Does the solution need additional enhancement funding for investigations and development?

Yes. Dedicated enhancement funding is required to progress investigations and development of the design in order that the option can be secured as a viable scheme in the regional plan and WRMPs.

The proposed scope of Gate 2 work is set out in section 15 and the outline budget in section 14.

During Gate 2 we will undertake further work to establish the optimum programme of work and timescales and the potential funding requirements.

Does the solution need the additional regulatory support and oversight provided by the Ofwat gated process and RAPID?

Yes. The solution has the potential to be a true regional resource. There are options to convey the water to Bristol Water, Wessex Water, Thames Water, Bournemouth Water (South West Water) and Southern Water.

The EA are actively involved in monitoring the dewatering of the quarry, but they have not previously suggested it as a potential water resource.

The project has the potential to make a link between the water sector and the minerals sector, which currently does not exist:

- Minerals planning policy is defined in section 17 of the National Planning Policy Framework (Ministry of Housing, Communities & Local Government NPPF_Feb_2019_revised). The policy requires high quality restoration of quarries but it does not mention the possibility of restoration as water storage.
- Mineral planning permission is the responsibility Mineral Planning Authorities, which in England are county councils. Guidance on planning applications (https://www.gov.uk/guidance/minerals) lists six possible types of after-use following mineral extraction but water storage in the form of a reservoir is not listed.

Does the solution provide a similar or better cost / water resource benefit ratio compared to current solutions?

Yes. Initial cost estimates indicate that the NPV and AIC is less than current solutions under consideration, as explained in section 10.

On the face of it as the reservoir will have already been created and the water treatment and conveyance work is similar to other schemes, the cost/benefit ratio ought to be much better than other solutions.

Does the solution have the potential to provide similar or better value (environmental, social and economic value – aligned with the Water Resources Planning Guideline) compared to current solutions?

Yes. The environmental impact of the reservoir will be very low, as it will already exist.

The quarry received planning permission in 2010, based on an environmental statement and restoration plan included in the planning application. The conveyance options will include the normal environmental impacts and mitigations.

Therefore the scheme should have much better environmental and social value than a new surface water storage reservoir of the same capacity, due to its lower impact.

17. Conclusions and recommendations

Conclusions

Based on the Gate 1 studies our conclusions are that:

- The proposal to re-purpose an existing quarry in the Mendips for use as a reservoir is technically feasible, subject to more detailed studies at Gate 2.
- Although the quarry is in carboniferous limestone, potential leakage rates are not significant enough to preclude development of the quarry as a reservoir.
- A major deliverability advantage is that the void / storage space will already have been created with minimal impact on the environment or public, which is significant in comparison with schemes seeking to construct new impounding reservoirs or fully bunded reservoirs of an equivalent capacity.
- The reservoir would have a gross volume of approximately 52.8MCM, providing a potential yield of up to 89Ml/d (assuming winter refill from the Bristol Avon). Depending on regional needs, the scheme could be used as a drought resilience option or contribute to normal year-round supplies in the West Country or South East.
- It could act as a true regional water resource providing additional water supply in the West Country and South East regions.
- There are four transfer options that could provide benefits to customers from Bristol Water, Wessex Water, Bournemouth Water; and water companies in the South East region either via a raw water transfer to the River Thames or a treated water transfer to Southern Water in Hampshire.
- No significant unacceptable environmental impacts have been identified that cannot be adequately mitigated in the design.
- The outline project plan indicates that resource availability would be in the early 2040s, subject to the precise decommissioning date for the quarry. There is significant flexibility regarding the timing of the transfer options to suit the needs and investment expenditure profiles.

We consider that the Mendip Quarries SRO meets all five of RAPID's criteria for new solution.

Our boards have reviewed the proposal and support the recommendation that the solution is entered into the RAPID gated process.

Recommendations

It is recommended that the solution is accepted into the RAPID gated process.

Appendix A – List of abbreviations

Abbreviations	
AA	Appropriate Assessment
ACWG	All Company Working Group
BNG	Biodiversity Net Gain
BSA	Bulk Supply Agreement
CAP	Competitively Appointed Provider
CPO	Compulsory Purchase Order
CRT	Canal & River Trust
DBFOM	Design, Build, Finance, Operate and Maintain
DCO	Development Consent Order
DO	Deployable Output
DPC	Direct Procurement for Customers
DWI	Drinking Water Inspectorate
EA	Environment Agency
EIA	Environmental Impact Assessment
HRA	Habitats Regulations Assessment
HOF	Hands Off Flow
INNS	Invasive Non-Native Species
K&A	Kennet & Avon
MCM	Million Cubic Metres
Ml/d	Megalitres per Day
NC	Natural Capital
NE	Natural England
NAU	Environment Agency, National Appraisal Unit
NSIP	Nationally Significant Infrastructure Project
NPV	Net Present Value
Ofwat	Water Services Regulation Authority
RAPID	Regulator's Alliance for Progressing Infrastructure Development
SAC	Special Protection Area
SEA	Strategic Environmental Assessment
SPA	Special Area of Conservation
SR	Service Reservoir
SRO	Strategic Resource Option
SWB	South West Water
TCPA	Town and Country Planning Act
VfM	Value for Money
WCWRG	West Country Water Resource Group
WFD	Water Framework Directive
WRMP	Water Resource Management Plan
WRSE	Water Resources South East
WRZ	Water Resource Zone
WSX	Wessex Water
WTW	Water Treatment Works
WQRA	Water Quality Risk Assessment

Appendix B – Tables supporting Chapter 5

Table B.1: Residual effects (post mitigation) from the options level SEA

		Newton Meadows		Mendip reservoir		Option 1: Kennet and Avon Canal		Option 2: Service Reservoir near Warminster		Option 3: River Stour		Option 4: Chewton Mendip	
SEA Topic	SEA Objective	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Biodiversity, flora and fauna	Protect and enhance biodiversity, priority species, vulnerable habitats and habitat connectivity	---	---	---	+++/---	---	---	---	0	---	---	---	0
Soil	Protect and enhance the functionality, quantity and quality of soils	-	0	-	0	-	0	-	0	0	0	-	0
Water	Increase resilience and reduce flood risk	-	0	-	0	-	0	-	0	-	0	-	0
	Protect and enhance the quality of the water environment and water resources	0	--	--	--	0	0	0	0	0	--	0	0
	Deliver reliable and resilient water supplies	0	+++	0	+++	0	++	0	+++	0	++	0	+
Air	Reduce and minimise air emissions	-	0	-	0	-	0	-	0	-	0	-	0
Climatic Factors	Reduce embodied and operational carbon emissions	-	-	--	-	-	-	-	-	-	-	-	-
	Reduce vulnerability to climate change risks and hazards	0	-	0	0	0	+	0	0	0	+	0	0
Landscape	Conserve, protect and enhance landscape, townscape and seascape character and visual amenity	-	-	-	++	-	0	-	-	-	0	-	0
Historic Environment	Conserve, protect and enhance the historic environment, including archaeology	-	0	-	0	-	0	-	0	-	0	-	0
Population and Human Health	Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	-	0	-	++	-	0	-	0	-	0	-	0
	Maintain and enhance tourism and recreation	-	0	-	+++	-	0	-	0	-	0	-	0
Material Assets	Minimise resource use and waste production	-	0	-	0	-	0	-	0	-	0	-	0
	Avoid negative effects on built assets and infrastructure	-	0	-/+	0	-	0	-	0	-	0	-	0

Legend for Table B.1.

+++	Major Positive
++	Moderate Positive
+	Minor Positive
0	Neutral
-	Minor Negative
--	Moderate Negative
---	Major Negative
	Positive and negative

Mitigation measures included in the SEA outputs for Residual effects (post mitigation) are listed below.

- Biodiversity, flora and fauna:
  - Re-route the pipeline to avoid areas of ancient woodland;
  - Undertake detailed ecological surveys and assessment;
  - Introduce habitat compensation, creation and/or species relocation schemes where required; and
  - Undertake an INNS assessment.
- Soil:
  - Reinstate ground upon completion of construction works;
  - Best practice methods for working within close proximity to geological SSSI sites to be implemented; and
  - Best practice methods for working within, or within close proximity, to landfill sites to be implemented during the construction phase.
- Water:
  - Introduce measures to reduce the impact on flooding during the construction phase;
  - Undertake further WFD assessment; and
  - Undertake monitoring of river levels and flows.
- Air:
  - Implement best practice mitigation measures during construction phase.
- Climatic factors:
  - Investigate the use of renewables during construction and operation for energy supply and use of materials with lower embodied carbon;
  - Consider undertaking a carbon footprint study to help identify areas for carbon savings or alternative materials; and
  - Use greener energy as and when it becomes available.
- Landscape:
  - Reinstate the ground following pipeline construction;
  - Include best practice measures to reduce visual impact during construction; and
  - Screen above ground structures to minimise visual effects.
- Historic environment:
  - Re-route pipeline around heritage assets such as scheduled monuments;
  - Implement best practice measures during construction and site pumping stations and other permanent above ground infrastructure away from historic assets; and
  - Archaeological Watching Brief may be required during the construction phase.
- Population and Human Health:
  - Implement best practice construction methods to reduce amenity effects for the community; and
  - Open the reservoir to the public.

- Material assets
  - Implement sustainable design measures,
  - Reuse excavated material on site;
  - Implement best practice mitigation measures to minimise effects during construction;
  - Reinstate roads and cycle routes above the pipeline; and
  - Use directional drilling where possible to minimise disruption on road and rail infrastructure.

Table B.2: Summary of WRSE HRA output – Likely significant effects and uncertain effects

Option	Potential for likely significant effects	No likely significant effects
Newton Meadows River intake and Raw water transfer	Mendip Woodland SAC (UK0030048) (approx. 0.5km)	Bath and Bradford on Avon Bats SAC (UK0012584) (Multiple sites; closest approx. >4.13km)
	Severn Estuary Ramsar (UK11081) (approx. 40km)	Mells Valley SAC (comprises four separate units) (UK0012658) (approx. 3km-5km)
	Severn Estuary SPA (UK9015022) (approx. 40km)	-
	Severn Estuary SAC (UK0013030) (approx. 40km)	-
Mendip reservoir	Mendip Woodland SAC (UK0030048) (approx. 0km)	Mells Valley SAC (comprises four separate sites) (UK0012658) (approx. 3km-5km)
Option 1: Kennet and Avon Canal	River Avon SAC* (UK0013016) (approx. 8km) (*Salisbury Avon)	Pewsey Downs SAC (approx. 4km)
	Mells Valley SAC (comprises four separate sites) (UK0012658) (approx. 0.04km-3.25km)	Salisbury Plain SAC (approx. 3 km)
	Mendip Woodland SAC (UK0030048) (approx. 0.5km)	Salisbury Plain SPA (UK9011102) (approx. 3km)
	Kennet and Lambourn Floodplain SAC (UK0030044) (approx. 25km)	Bath and Bradford on Avon Bats SAC (Multiple sites approx. >9km)
	-	Avon Valley Ramsar (UK0013016) (approx. 45km)
	-	Avon Valley SPA (UK9011091) (approx. 45km)
Option 2: Service Reservoir near Warminster	Mendip Woodland SAC (UK0030048) (approx. 0.04km)	Mells Valley SAC (comprises four separate sites) (UK0012658) (approx. 5km)
	River Avon SAC* (UK0013016) (approx. 2km) (*Salisbury Avon)	Salisbury Plain SAC (approx. 7 km)
	-	Salisbury Plain SPA (UK9011102) (approx. 7km)
	-	Chilmark Quarries SPA (UK0016373) (approx. 8km)
Option 3: River Stour	Mendip Woodland SAC (UK0030048) (approx. 0.04km)	Mells Valley SAC (comprises four separate sites) (UK0012658) (approx. 4km-7km)
	Solent and Dorset Coast SPA (N/A) (approx. 45km)	Fontmell and Melbury Downs SAC (UK0012550) (approx. 7km)
	-	Rooksmoor SAC (UK0012681) (approx. 5km)
Option 4: Chewton Mendip	Mendip Woodland SAC (UK0030048) (approx. 0.5km)	Mells Valley SAC (comprises four separate sites) (UK0012658) (approx. 4km-7km)
	-	North Somerset and Mendip Bats SAC (UK0030052) (approx. 7km)
	-	Chew Valley Lake SPA (UK9010041) (approx. 5km)

Table B.3: Output of the WFD assessment

	Number of waterbodies assessed	Number of waterbodies passing WFD assessment	Number of waterbodies requiring further WFD assessment	Waterbodies requiring further WFD assessment
Newton Meadows river intake and raw water transfer	10	9	1	GB109053027371:Bristol Avon (By Bk to Netham Weir)
Mendip reservoir	2	1	1	GB40901G804600:Mendip (GW)
Option 1: Kennet and Avon Canal	18	18	0	N/A
Option 2: Service Reservoir near Warminster	10	10	0	N/A
Option 3: River Stour	11	10	1	GB108043016051:Stour (Middle u/s Pimperne Brook)
Option 4: Chewton Mendip	8	8	0	N/A

Table B.4: Output of the NC assessment. Change in area (ha) of the stock post construction*

Option	Baseline Natural Capital Stock					
	Orchards and Top Fruit	Ancient Woodland	Active Flood Plain	Lakes and Standing Waters	Modified Waters (Reservoirs)	Ponds & linear features
Newton Meadows River intake and raw water transfer	-	-	0.00	-	-	0.00
Mendip reservoir*	-	-15.03	-14.17	6.42	80.00	-3.50
Opt 1: Kennet and Avon Canal	-0.07	-1.35	0.00	0.00	-	0.00
Opt 2: Service Reservoir near Warminster	-	-0.18	0.00	-	-	0.00
Opt 3: River Stour	-	-0.05	0.00	-	-	0.00
Opt 4: Chewton Mendip	-	-0.03	0.00	-	-	0.00

Note that only stocks which result in a change in area post construction are included in this table. Where no result is entered, none of this habitat type was found in the element boundary. * These figures relate to land requirements beyond the existing quarry site

Table B.5: Summary of the outputs of the BNG metric calculation

Elements	On-Site Baseline (Habitat units)	On-Site Post Intervention (Habitat units)	Total Net Unit Change (Habitat units)	Total Percentage Change (%)	Key habitat types contributing to score
Newton Meadows River intake and raw water transfer	160.03	121.39	-38.64	-24.15	Cropland - cereal crops; Grassland - modified grassland
Mendip reservoir	560.37	687.21	126.84	+22.64	Lakes - Reservoirs; Woodland and forest - other woodland, broadleaved
Option 1: Kennet and Avon Canal	277.54	215.91	-61.63	-22.20	Cropland - cereal crops; Grassland - modified grassland
Option 2: Service Reservoir near Warminster	136.29	97.2	-39.09	-28.68	Cropland - cereal crops; Grassland - modified grassland
Option 3: River Stour	225.53	148.96	-76.57	-33.95	Cropland - cereal crops; Grassland - modified grassland
Option 4: Chewton Mendip	100.18	74.79	-25.39	-25.35	Cropland - cereal crops; Grassland - modified grassland

Table B.6: Outputs of the ecosystem services screening: Quantitative Assessment

Option	Ecosystem Service (change in value £/year)			Estimated total change in value (£ per year)3
	Carbon Storage[1]	Natural Hazard Management	Air pollutant removal[2]	
Newton Meadows	-£30.65	-£14.75	Scoped out	-£45.40
Mendip reservoir	-£2,654.28	-£1,708.83	Scoped out	-£4,363.12
Opt 1: Kennet and Avon Canal	-£204.98	-£131.97	Scoped out	-£336.95
Opt 2: Service Reservoir near Warminster	-£39.31	-£24.96	Scoped out	-£64.27
Opt 3: River Stour	-£19.03	-£12.12	-£33.50	-£64.65
Opt 4: Chewton Mendip	-£19.95	-£9.57	Scoped out	-£29.52

Notes: 1. Baseline value provided by each stock calculated using the high short-term traded sector carbon value for policy appraisal for 2020, provided by the standard methods and the Department for Business, Energy and Industrial Strategy (BEIS) Interim Non-Traded Carbon Values. 2. Scoped out when the option does not cause the loss of associated stocks. 3. GDP discounting has not been applied as part of the monetisation of values.

Table B.7: Comparison of the four water transfer options against environmental assessments

Option	Strategic Environmental Assessment	Habitats Regulations Assessment	Water Framework Directive	Natural Capital and Biodiversity Net Gain
Option 1: Kennet and Avon Canal	Likely to provide the most beneficial balance of positive and negative effects.	Potential for likely significant effects on 4 designated sites.	No waterbodies requiring further WFD assessment.	Results in the greatest loss of NC baseline stock - ancient woodland, and orchards and top fruit. Results in the least % loss of BNG habitat units. Results in the greatest loss in value of ecosystem services per year.
Option 2: WSX Service Reservoir, Warminster	-	Potential for likely significant effects on 2 designated sites.	No waterbodies requiring further WFD assessment.	-
Option 3: River Stour	Likely to provide the most adverse balance of positive and negative effects.	Potential for likely significant effects on 2 designated sites.	One waterbody requiring further WFD assessment.	Results in the greatest % loss of BNG habitat units.
Option 4: Chewton Mendip	-	Potential for likely significant effects on 1 designated site.	No waterbodies requiring further WFD assessment.	Results in the least loss of NC baseline stock - ancient woodland. Results in the least loss in value of ecosystem services per year.